

Running Head: WEB 2.0 SUPPORTING DIALOGIC AND HERMENEUTIC ACTIVITIES

Web 2.0 Supporting Dialogic and Hermeneutic Activities in Science Curriculum

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Abstract

Taking a humanistic stance on science and technology education, this research seeks to disrupt the traditional mode of curriculum transmission and to encourage a dialogic and hermeneutic (meaning-making) approach toward curriculum use. Drawing upon the work of Martin Buber (1965, 1996) to inform the notion of dialogue and Wolfgang Klafki (2000) to inform the notions of hermeneutics and reflection, we designed an activity structure for use within a web-based urban ecology curriculum to support the relationships between curriculum developers, teachers and students. We conducted research drawing upon interviews, classroom observations, and student artifacts to examine the participants' beliefs and the relationships between each other and the curriculum. We found that the activity structure supported students in a unique meaning-making process that was hermeneutic in nature in that they were able to synthesize and reflect on their experience with the curriculum and provided teachers with the opportunity to observe what meaning students took away from the curriculum. While the research highlighted the important hermeneutic aspects, the interactions were not found to be particularly dialogic. The students seemed to have little understanding that people, potential dialogic partners, write the curriculum and many of the expressions of teachers and curriculum developers highlighted a sense of individualism rather than a communal focus on curriculum use.

Introduction

In the era of “new capitalism,” the curriculum becomes increasingly commodified and static buffeted by a culture of frequent measurement and assessment. This can reinforce the isolation and deskilling of both teachers and students (Gee, 2000a, 2000b, p. 93; Luke, 2004), as well as leading to forms of “educational reductionism” (Shirley, In Press). This study will examine ways to support dialogue and reflection on the curriculum within the science classroom and investigate how students, teachers, and curriculum developers converse, relate, and make meaning of an urban ecology curriculum. Under the relentless pressures of accountability, such activities and the skills they require are often undervalued or ignored (McHenry, 1998; L. Rose, 2007).

This research is situated within a humanistic perspective on science and technology education and research, through a pupil-centered approach asking questions around the educationally sound propositions of curriculum, teaching and learning, as well as around the political realities in which science and technology education is embedded (Aikenhead, 2007). This research furthermore seeks to disrupt the traditional transmission-based view of curriculum development, enactment, and research, and to illuminate the idea for all participants involved—including teachers and students—that the curriculum itself has a perspective. In orienting this research, the following questions will be explored:

1. What are the relationships that curriculum developers, teachers, and students have with the curriculum?
2. How do the beliefs of each of these individuals about the other participants influence their relationship with the curriculum and with each other?

3. What are the influences of mediating factors, such as framing questions and technology, on these relationships?

Philosophical Underpinnings: Dialogue, Hermeneutics, and Reflection

This research is influenced by the notion of a humanistic perspective on the science curriculum which "...gives priority to a student-centered point of view and to citizens as consumers of science and technology in their everyday lives, as opposed to a scientist-centered view aimed at scientific or science-related careers" (Aikenhead, 2007, p. 881). With environmental degradation and social injustice as a regular occurrence in the lives of urban students, providing pupils with a critical, dialogic, and empowering education in the ecological sciences and the relationships between the natural and human worlds is of paramount importance.

As noted above, the purpose of this research is to illuminate the tacit goals and perspectives which underpin the curriculum itself and disrupt the default curricular structure of transmission, as illustrated in *Figure 1*. The traditional curriculum transmission model includes curriculum developers originally developing ideas that are placed in the curriculum, the curriculum then conveying those ideas to the teacher and finally the teacher transmitting the ideas to the students. This model includes a one-way transmission of knowledge from the curriculum developer to the students with little or no reflection or interaction and with the science concepts passed between the parties as static sets of facts.

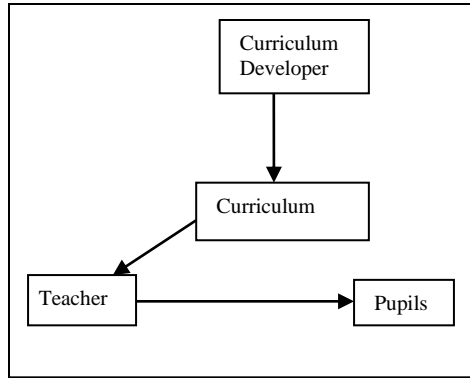


Figure 1: Standard conception of interaction around the curriculum.

Instead, this research seeks to encourage a model in which the pupils, teachers, and curriculum developers establish a dialogic and reflective relationship around the curriculum materials, specifically with reference to the *whys* and *whats* to be taught and learned. As a necessary component to this process, each participant group is able to participate with a unique, self-directed, and respected voice in the process, and each group is able to get a sense of the others. As such, the process begins to look more similar to the structure illustrated in *Figure 2*. *Figure 2* illustrates the multiple relationships and interactions that occur at all stages of the use of the curriculum. No longer is the curriculum simply disseminated from the curriculum developer, but rather both the student and teacher have a more active voice in the use of the curriculum and the construction of science knowledge. Dashed lines are included in the diagram in order to indicate that these relationships occur around, and to an extent *with*, the curriculum. In keeping with the humanistic perspective, there is a particular focus on facilitating the expression of the pupil voice. Since this model of curriculum use differs from the traditional convention (as illustrated in *Figure 1*), explicit activity structures and strategies may be important to help shift the relationship between the different individuals involved in the process.

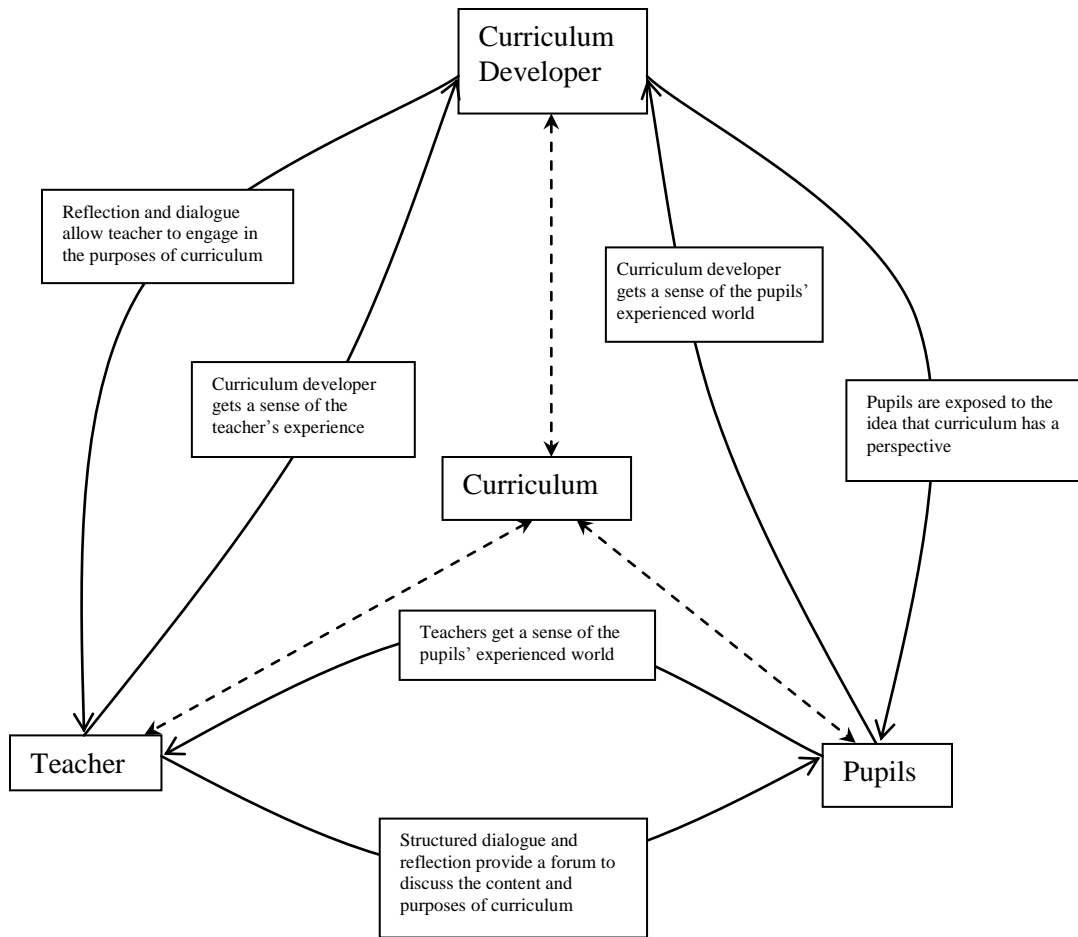


Figure 2: Interaction around the curriculum based on dialogue, reflection, and hermeneutics.

Towards these aims, the writings of existentialist thinker Martin Buber (Buber, 1965, 1996) inform the concept of dialogue in this research, while the critical constructivist Didaktik tradition of Klafki (Hudson, 2003; Klafki, 2000) inform the structure of reflection on the curriculum by teachers, students, and curriculum developers. This combination of related schools of thought in education encourages the engagement with the teachings and with each other in the curriculum that provide guidance and direction in meeting the students' own lived situations. The concept of dialogue will be discussed in further detail, followed by a discussion of the concepts of hermeneutics and reflection. These concepts will be discussed in terms of the historical and philosophical underpinnings from which they emerge.

The Dialogic Philosophy of Martin Buber and Interhuman Relationships

Dialogue is an essential component of the teaching and learning process (e.g., Arnett, 1992; Buber, 1965, 1996, 2002; Freed, 2003; Kristiansen, 1996; McHenry, 1997, 1998). The view of dialogue in this research follows the work of Buber (1996), in that dialogue is ontological in nature, and at its core relational and reciprocal. Dialogue in this sense becomes a form of relationship building. Buber notes that most dialogue exists in the form of I-It, in which an individual engages in dialogue with an other as if they were an object to be used or experienced, and often narrowly goal-directed. One must be ready, however, to enter into dialogue in the form of I-You. Buber places a great deal of emphasis on ensuring in this general sense of the I-You dialogue that each individual is respectfully maintained as a distinct entity.

Buber further distinguishes between the general I-You relationship, which occurs by grace, and the educational form of the I-You relation. This understanding is referred to by Buber as an “inclusive” I-You relationship, which has both purpose and function. When a teacher and pupil enter into an inclusive I-You relationship, they must have an event in common—such as the curriculum—and the educator is expected to experience the teachings from two sides, his or her own and that of the pupil (Buber, 1965).

Buber addresses the idea of curriculum in his dialogic philosophy, and draws upon the Germanic, rather than American, tradition of conceptualizing curriculum. The curriculum, in Buber’s ideal sense, would represent “...a selection of the world which is concentrated and manifested in the educator... lifted out of the purposelessly streaming education by all things, and is marked off as purpose” (Buber, 1965, p. 89). As an authentic “selection of the world,” the curriculum would help to provide pupils with the situations which they face. Such a position requires a fairly faithful representation of the “teachings” as well as a “...critical-reflective

encounter with history, a meaning-making engagement with all those traditions constituting the spiritual-cultural heritage” (Murphy, 1988, p. 112). This places responsibility on the educator to select and provide this representation of the teachings to the pupil, but then also provide some amount of autonomy to the learner to make meaning of them.

While he clearly puts import on passing on the traditions and history of the past, Buber also recognizes the limitations of such an approach. He notes that there is an inherent danger in which the “will to educate” degenerates into arbitrariness, so “...that the educator may carry out his selection and his influence from himself and his idea of the pupil, not from the pupil’s own reality” (Buber, 1965, p. 100). As such, the process of selection—the curriculum—is strongly influenced by Buber’s dialogic philosophy, and the educator must be able to understand his or her pupils and what they experience in *their* world.

In contemporary times and structures in the educational enterprise, much of the authority for addressing the larger questions of what and how to teach has been displaced from the teacher in the classroom to the curriculum developers, educational publishers, and educational policy makers (Atkin, 2002). Despite the move away from a “teacher-proof curriculum” (Shkedi, 1998), there are many choices still held by curriculum developers not always made explicit to the teacher. The concept of the educative curriculum, for example, seeks in part to make the judgments and decision making processes of the curriculum developers explicit to teachers in order to make more informed decisions themselves (Ball & Cohen, 1996; Davis & Krajcik, 2005). Whether such educative features are explicitly built into the curricular materials or not, the process of hermeneutics (meaning-making) and reflection by teachers and pupils is an important step to engage with these often tacit and behind-the-scenes processes of selecting, sequencing, and prioritizing curricular and educational materials.

Hermeneutics and Reflection

While dialogue is relationship-building through interhuman encounter, hermeneutics is the act of building relationships with texts, curricula, and materials through the act of interpretation. Such interpretation can be seen as a dialogue between teachers and learners and the curriculum itself (Gallagher, 1992; McHenry, 1998). Through this interpretation, meaning is made and understanding is gleaned. These interpretive acts are essential actions for teachers in the lesson planning process as it is difficult for students to comprehend and make meaning of curricular materials when presented verbatim, although much interpretation by teachers is often done in a tacit manner without fully considering the implications of this process (Ben-Peretz, 1990).

Through the dialogic and hermeneutic processes, students, teachers, and curriculum developers will be encouraged to reflect upon the curriculum and what can be learned from it. Klafki's five questions found within the German Didaktik educational tradition (Hudson, 2003; Klafki, 2000) can provide some structure for such inquiry. The Didaktik educational tradition is a perspective on learning and teaching originating largely in northern Europe which emphasizes that individuals are embedded within a cultural environment and encourages a critical analysis of curricular materials in order to allow students to enter into and make decisions within society as a unique and important individual but understanding that each individual has a responsibility to others (Hudson, 2003).

Klafki's questions for Didaktik analysis (Klafki, 2000) form the basis for this critical process, and emphasize a hermeneutic and interpretative stance (Hudson, 2003). These questions were originally written for teachers as they consider their material options and translated from the German by Hudson (2003). We further modified Klafki's questions in order

to operationalize them within a learning context between teachers and students. Every effort was made to retain their educational and reflective essence and value, although framed in such a way to better connect with the contemporary American educator and pupil. The “big idea” concept was borrowed from the Understanding By Design framework (Wiggins & McTighe, 1998), as it is also a general enough phrase that educators and pupils can determine its meaning even without exposure to Understanding By Design. Klafki’s original questions for Didaktik analysis are presented side-by-side with the operationalized form of the questions in *Table 1*.

It should be noted that the operationalized form of Question IV is not an entirely appropriate translation when the original intent is considered; we were unclear as to what the intent of the question was until more research and discussion was undertaken. The original intent was to allow teachers to uncover the necessary precursors of understandings for teaching new content and material (Klafki, 2000). We realized this oversight as the research was underway, and decided to keep our original yet inaccurate translation. In hindsight, we would have preferred to express our translation as “How does the structure of the content, in terms of the readings, activities, etc., convey this **BIG IDEA** to your students? What ‘building blocks’ do your students need to make sense of this module or lesson?”

	<i>Original Questions (Klafki, 2000)</i>	<i>Operationalized Questions</i>
I	What wider or general sense or reality does this content exemplify and open up to the learner? What basic phenomenon or fundamental principle, what law, criterion, problem, method, technique, or attitude can be grasped by dealing with this content as an “example”?	What was the BIG IDEA that you learned while studying this module?
II	What significance does the content in question, or the experience, knowledge, ability, or skill to be acquired through this topic already possess in the minds of the children in my class? What significance should it have from a pedagogical point of view?	How did this BIG IDEA relate to something you already knew? Would you have presented it differently to connect with something you were already familiar with?
III	What constitutes the topic’s significance for the children’s future?	How might you use this BIG IDEA in the future?

<i>Original Questions (Klafki, 2000)</i>	<i>Operationalized Questions</i>
IV How is the content structured (which has been placed in a specifically pedagogical perspective by Questions I, II, and III)?	Did you get a sense of what kind of message the materials were conveying, and for what purpose? How does the structure of the curriculum—the pieces—convey this message to you?
V What are the special cases, phenomena, situations, experiments, persons, elements of aesthetic experience, and so forth, in terms of which the structure of the content in question can become interesting, stimulating, approachable, conceivable, or vivid for children of the stage of development of this class?	How does the structure of this curriculum—the pieces—make this module interesting and fun? Was there anything that you learned that was surprising?

Table 1: Klafki's original questions for a Didaktik analysis and our operationalized form.

This reflective inquiry is considered "...‘dialogical,’ because to reflect is to enter into a dialogue with [Klafki’s] framework for Didaktik analysis..." (Gudmundsdottir, Reinertsen, & Nordtømme, 2000, p. 329). Such dialogue from a teacher’s perspective entails a relationship with the framework itself, the curricular materials and their purposes (and indirectly, the curriculum developers), as well as with the students. For the purposes of this research project, the intended use of Klafki’s framework was extended to provide a form of scaffolding to support and facilitate dialogue between students, teachers, curriculum developers, and the curriculum itself. By allowing students to respond to Klafki’s questions, pupils are provided with a voice to respond directly to the curriculum and to the educator’s teachings in a structured manner. While this does not meet Buber’s “criteria” for a standard I-You dialogue (which occurs by grace; c.f., Buber, 1996), it does fit into what Buber would categorize as an educative inclusive I-You dialogue, which occurs by function (Buber, 1965). This distinction implies that Buber assumed that some sort of moderate structure is an important and necessary piece for an educational I-You dialogue, whether between people or between people and the curriculum.

This research seeks to gain a better understanding of the beliefs, dynamics, and experiences borne out by an approach supported by dialogue, hermeneutics, and reflection as described in this section. Computer- and network-based curricula hold potential in facilitating

and fostering dialogue and hermeneutics. Stahl (2006) notes that interpretation and meaning-making (hermeneutics) within a social and historical context is necessarily central to collaborative learning mediated by technology. As this moves the focus from the individual to the small group, he further asserts that the processes which occur at the level of the group can be found to be reflected at the level of the individual and vice versa (G. Stahl, 2006).

Social annotation technologies—such as the web-based tool Diigo (<http://www.diigo.com/>)—where pupils virtually and collaboratively mark up online texts are one facet of the technology-based environment envisioned by Stahl in which this group cognition process occurs. There is a burgeoning base of empirical research to support this claim, although perhaps not in the exact model as proposed by Stahl. In a study of college students, for example, Wolfe (2008) found that a network-based annotation system encouraged students to consider new perspectives on the texts and that students made use of more sophisticated and reflective reading strategies when presented with annotated texts. Such research points to the promise of social annotation technologies as a way for students in classrooms to collaboratively interrogate and make meaning of web-based curriculum materials—especially when provided with a framework and hermeneutic scaffolding, such as Klafki's Questions.

Teachers also have the ability to pose clarifying questions and other forms of scaffolding in these web-based materials through these technologies, providing for a class-localized system of supports and scaffolding in line with the ideas advanced Universal Design for Learning (UDL) in order to address the needs and preferences of all learners (Pisha & Stahl, 2006; D. H. Rose & Dalton, 2006; D. H. Rose & Meyer, 2002; S. Stahl, 2006). For much of its history and application as a framework, UDL has been concerned with providing such scaffolding and supports at the level of the curriculum developer and educational publisher (CAST, 2008; Pisha

& Stahl, 2006). The use of tools such as Diigo provides teachers with the power to supplement the more general scaffolding provided by the curriculum developer and provide more focused scaffolding tailored to the needs and preferences of the particular students in their classes (Coyne et al., 2006), and is consistent with the teacher-empowered form of education as envisioned by Buber (1965).

We are particularly interested in determining and describing the dialogic relationships between curriculum developers, teachers, and students around the curriculum, as well as the effects of beliefs and mediating factors, such as Klafki's questions and technology, on these dialogic relationships.

Methods

Context: The Urban Ecology Curriculum

This study took place in the context of a high school urban ecology curriculum designed to support students in learning essential ecological and environmental content learning goals as well as scientific inquiry practices. Not only is the curriculum written with particular scientific-oriented goals in mind, decisions are made in terms of what and how information is conveyed through the curricular materials. By allowing students to reflect on what has been learned—and why—pupils gain the opportunity to evaluate the teachings of the curriculum in light of their own situations.

While the curriculum has been developed as a “paper-based” product, an educational research and development group has developed a parallel web-based version for three of the eight modules in the curriculum (Urban Land Use, Climate Change, and Urban Biodiversity), which each last between three and four weeks. The development of the web-based version has been further guided by the principles of Universal Design for Learning (e.g., Coyne et al., 2006;

D. H. Rose & Meyer, 2002; D. H. Rose, Meyer, & Hitchcock, 2005), and as such contains many features aimed at the inclusion of all learners in the learning process not available in the paper-based version such as the availability of the materials in multiple forms of media and the presence of on-demand scaffolding (such as hints and models). For the purposes of this study, the focus was on the Urban Land Use and Climate Change modules.

In addition, the web-based version also provided access to the features of the commercial web-based service Diigo (<http://www.diigo.com/>). Diigo allows students, teachers, and curriculum developers to collaboratively highlight text and images, place persistent virtual sticky notes, and hold asynchronous online dialogue within the context of the web-based materials themselves. See *Figure 3* below for an illustration of the dialogic features of Diigo in use within the web-based curriculum materials.

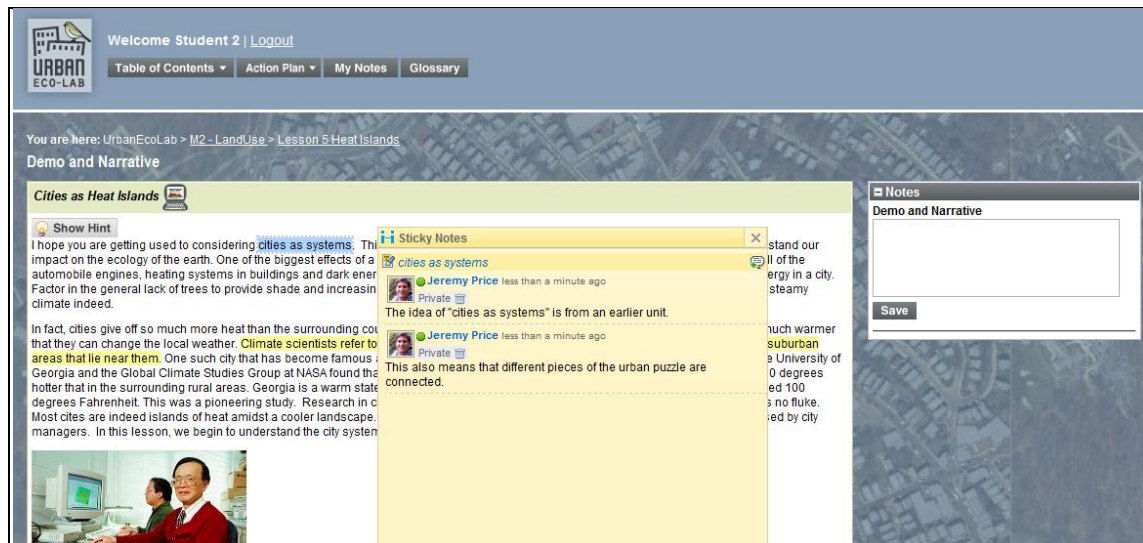


Figure 3: The web-based tool Diigo in use within the context of the online curriculum.

As a part of this study, we provided every student in one of the teacher's classes with a laptop computer in order to access the web-based curriculum materials in class. The goal was for the instruction to take on a blended learning approach (Hartley, 2007; Ziegler, Paulus, &

Woodside, 2006), where face-to-face instruction and interactions ideally exist in synergy with web-based materials and online dialogue.

We embedded the operationalized form of Klafki's questions (see *Table 1*) within the web-based curriculum as a form of scaffolding in order to encourage and support dialogue and meaning-making in the science classroom. Conversations were invited to take place in the context of the virtual sticky notes provided by Diigo. Every page of the curriculum contained a virtual sticky note with these scaffolding questions, and teachers and students were invited to respond.

Participants and Settings

Two teachers who expressed interest in the goals and methods of this research were selected from a cohort of teachers involved in the pilot phase of the development of the urban ecology curriculum. One teacher (Mr. Kent¹) taught urban ecology, grades 11-12, in a high school in a large New England city of approximately 1200 students, of whom 51% are black, 23% are Hispanic, 18% are Asian, and 8% are white. While a majority of pupils in this class speak English as a first language, a small number of students speak Arabic, Spanish, Haitian Creole, and Somali as a first language. The second teacher (Ms. Casanova) taught urban ecology to English Language Learners, grades 9-12, in a high school of about 2100 students, of whom 9% are black, 17% are Hispanic, 6% are Asian, and 68% are white in a large suburb of the New England city. None of this teacher's students speak English as a first language; instead, they speak languages such as Spanish, Brazilian Portuguese, Somali, Haitian Creole, Japanese, and Chinese as first languages. One class for each teacher was chosen for participation in this research. In addition, two members of the curriculum development team were selected: one of

¹ All proper names are pseudonyms to protect the privacy of the participants.

the primary investigator of the grant-funded curriculum development project (Dr. Levi), a biology professor at a liberal arts university, and a doctoral student in education (Ms. da Gama) who serves as a graduate research assistant for the project. It should be noted that the two authors of this study are also members of the curriculum development team as well.

Data Collection Methods

We collected three different data sources: ethnographic interviews and student poster sessions and classroom observations. Multiple data sources were utilized and analyzed in order to provide a framework for trustworthiness and validity to our study (Freeman, deMarrais, Preissle, Roulston, & St Pierre, 2007).

Ethnographic Interviews. Ethnographic interviews (Spradley, 1979) were conducted with the two teachers and the two members of the curriculum development team. Interviews with the teachers were carried out over two sessions, while interviews with the curriculum developers were carried out over one session. The purpose of these interviews was to uncover the participants' expectations and experiences with the web-based urban ecology curriculum.

Student Posters. Two poster session activities were conducted as capstone activities at the end of two different modules. The students were provided with the modified form of Klafki's questions for a Didaktik analysis and asked to respond to these questions based on the module of the curriculum they just completed. The purpose of this activity was to provide pupils and teachers with a structured opportunity for interpreting and reflecting on the curriculum and to provide a forum for dialogue around these experiences with the curriculum. The posters were created in groups of 3-4 students each. One of the researchers (Jeremy Price) acted as facilitator of the activity, introducing the goals of the activity, responding to questions while students were making the posters, and facilitating a brief discussion with students afterwards. The first poster

session in the first class was conducted with the teacher participating in the activity. In subsequent sessions, the teacher acted in an assistant-facilitator role, so that the teacher circulated throughout the class, provide guidance and support to the students. The posters from all student groups were collected and analyzed.

Classroom Observations. We videotaped one class of each teacher for the duration of one multi-day lesson in order to gain further insight into the interpretation by, practices of, and relationships with students by the teacher. In addition, the poster session activity in the classroom was also videotaped. During the poster-making portion of the activity the camera was focused on one particular group, chosen by the teacher to provide a representation of the class as a whole, while at all other times was focused on the classroom as a whole.

Data Analysis

The data collected was analyzed utilizing a variety of qualitative methods which sought to highlight the relational, dialogic, and hermeneutic qualities of classroom interactions. The modes of analysis were matched to the modes of data collection as outlined below.

Student Posters. The posters were collected and analyzed for emergent themes across the two classes. These thematic codes were applied to the poster contents in a recursive and comparative manner until a final set of codes and sub-codes were determined (Glaser & Strauss, 1967). We found that students expressed their meaning-making through in three main ways:

- **Experience:** This category encompasses responses in which the individual and social activities and experiences themselves that students encounter inside and outside the classroom are highlighted. Such experiences include mentions of fieldwork, in-class activities such as role plays or experiments, and use of the digital version of the curriculum on computers.

- **Demonstration of Science Knowledge:** This category denotes those responses in which students demonstrated an understanding of science content, concepts, or simply science-related (and appropriate) vocabulary knowledge. Responses in this category also included more conceptually complex responses, such as recognizing ambivalence in the curriculum and the complexity of making environmental policy decisions.
- **Action:** This category is comprised of responses which point to a sense of activism and agency on the part of the students within an environmental context. Such responses by students indicated a range of activism and agency, from an abstract “something needs to be done” to a sense of personal stake and agency and community involvement.

These categories are described in more detail in the *Findings* section of this paper.

Ethnographic Interviews. The interviews were analyzed according to the thematic codes uncovered through the analysis of the student posters. The analysis was carried out across all interview-based data sources, providing a way to uncover and illuminate the nested and iterative relationships between the intents or belief systems of the participants and the expression of actions (Gershon, 2008). The process of creating and sharing the reflective posters are considered the pupils’ and teachers’ expression of action.

Classroom Observations. The observations of both a standard lesson as well as of the poster session activity itself were analyzed utilizing a form of critical discourse analysis (Rogers, 2004), paying attention to the qualities of the interactions between the students, the teachers, and the web-based curriculum materials, as specifically uncovered by the analysis of the student posters. Similar to the interview data, the observational data is used to uncover and illuminate

the nested and iterative relationships between the intents and expressions of the various participants.

Findings

Drawing upon the various data sources, we find that various overarching themes emerged. In discussing these findings, we will describe first the role of technology in the interpretation and enactment of the curriculum; while the teachers and students did use the online version of the curriculum, they did not make use of the extended dialogic and hermeneutic features of in-text discussions, virtual sticky notes, and highlighting. Next, we will describe the perceptions of the students and teachers on the dialogic and hermeneutic activity which was successful, the interactive poster session based on Klafki's Questions for a Didaktik Analysis. Lastly, we will discuss the results of the poster sessions, and how the themes which emerged from the analysis of the students' expressions through the posters can be traced back to the intents of the curriculum as articulated by the curriculum developers and teachers.

The Role of Technology

The teachers and students made use of the more traditional and UDL-based features of the online curriculum, such as accessing readings, completing exercise questions in class and at home, and making use of reading supports and scaffolding, such as highlighting main ideas and listening to reading passages read aloud. However, the teachers did not utilize the Klafki questions in the Diigo sticky note features. Technology was used to engage students in the science, but not to support reflective dialogic interactions with the curriculum.

Ms. Casanova noted that working with the curriculum materials online seemed to motivate students: "There were more students... doing their homework, even those who normally don't." She also noted that many of the online features made the work more enjoyable

for students, especially the recorded readings of the texts, and fed into students' natural affinity towards technology, saying, "Kids love gadgets."

Mr. Kent noted that in addition he interacted with his students differently when working with the curriculum online. "I did a lot of one-on-one instruction... a lot more coaching than I usually do. There was little room to take on a passive role while I was teaching."

Teachers and students did not, as mentioned above, make use of any of the annotation features made available through Diigo, nor did they respond to any of the embedded reflection questions. Both teachers noted that since there were only two of the eight modules available online, they were unwilling to make the investment to learn to use Diigo and incorporate another added layer of complexity into their daily teaching routines. "If it was available for the long term, I would have done it since September," noted Mr. Kent. "I definitely see the potential though, because we teach our students to use Post-It notes and highlighters to mark up text. This fits perfectly with that." Ms. Casanova described a similar reasoning: "I still don't know how to implement it. I need the time to sit down and play with it, see what others have done with it." While these teachers and their students did not make use of the online opportunities for dialogue, hermeneutics, and reflection, the in-class poster activities provided students and teachers with these opportunities.

Classroom Perspectives on Dialogue and Hermeneutics through Interactive Poster Sessions

While the technology-based component of the dialogue and reflection did not occur as planned, the poster session activities conducted during class time were successful in providing a forum for dialogue and reflection around the curriculum. Incorporating explicit activity structures can support students and teachers in engaging in reflective discourse around science curriculum though it is unclear whether it altered their relationship with the curriculum.

In reflecting upon the experience during the post-session discussion, two ELL students in Ms. Casanova's class independently expressed a similar theme, namely that they were unaware of how much of the content and concepts of the curriculum upon which they were able to draw. "I learned that I knew more about ecology than I thought I did," stated one of these students.

Other students described how the activity forced them to consider what they had learned in class in a different way. One student in Mr. Kent's class stated:

The questions were hard, but it was a good thing. We put in some effort, and we came up with some good answers. All the stuff we discussed was kind of like a review, and makes you think back about what you learned.

Another student in Mr. Kent's class appreciated the group-oriented aspect of the activity, stating, "It [the activity] was a little difficult, but working together helped bring out some ideas. I could've worked independently, but working together can bring out new ideas." As can be seen from the responses of the students to this activity, these students were challenged cognitively to make sense and meaning of the curriculum in the context of Klafki's Questions. They did not, however, explicitly state that they became more aware of or empowered in their role in the dialogic and hermeneutic curriculum process.

Mr. Kent believed that both he and his students benefited from the poster session activity, and noted that he would like to do this activity at the end of each module in the curriculum. He brought up three reasons as to why he found the activity and process to be beneficial, time for reflection, iteratively addressing misconceptions, and then getting a sense of the range of meanings students make of the lessons and his teachings. For the first reason, taking the time to reflect on and process the content covered in the module, Mr. Kent referred to research on teaching which encourages teachers to pause to allow students to make sense of things:

You know, I really think it's powerful. Pausing, you know there's a whole lot of research that says you shouldn't talk more than seven minutes without giving, or 12 minutes, without giving people the chance to register what you have said, absorb it. Certainly after spending three-and-a-half weeks on a complicated topic with like, touching on some really big areas, it's just nice to stop and pull out some major concepts.

For the second reason, Mr. Kent discussed the ideas of both pulling out misconceptions of science students may harbor, as well as having the opportunity to reinforce the teaching of science:

... I'm always curious about prior knowledge and especially when it has to do with misconceptions which are so hard to unravel.... So, getting at those misconceptions, and then using new information to completely replace it. But I know the research is that, you know, even then they tend to go back to the misconceptions unless you, you just can't sort of leave it at that. You need to continually reinforce.... I really like the idea of going back to the prior understandings and seeing how the lessons interplayed with them, if at all.

Lastly, Mr. Kent appreciated that he was able to gain insight into the range of meanings that students made of the content and concepts he interpreted and presented from the curricular materials. "It's very interesting to see what one person thought was a big idea and what another person thought," he said. "And they reflected that too, I mean, they each took different things away from it." While Mr. Kent placed more emphasis on the general idea of reflection, he also hinted at the idea of dialogue between him, his students, and the curriculum in this last statement.

Ms. Casanova had a slightly different perspective on the activity. She noted that the kids enjoyed completing the activity, but also attributed some of their enjoyment to the presence of

the researcher—a visitor. “The kids loved it,” she stated. “The kids loved too having a visitor, and feeling like they were shining in front of somebody.” She did, however, indicate that the activity did serve a purpose, that of providing for a synthesis of content and concepts in the module. While acknowledging the beneficial aspects of the activity, Ms. Casanova also indicated that she has already been encouraged to do synthesizing activities similar to this one, and that it is a good way to maintain a core message in her teaching and to stay on task in her class:

I think it’s a good way to pull it together. I think that not using this type of activity, which, we, in our collaborations, have been encouraged to use this type of thing a lot. And actually, it’s one of the ways that we learn to teach ELL, and I think it’s a better way of teaching all the way around. Otherwise, you get lost on the message you are trying to get through to them, and you can get off task yourself. And the kids do too.

She further elaborated on these ideas, tying this activity to other similar activities, concepts, and terminology prevalent in contemporary teacher training:

I’d done stuff like that actually, because I, in, before lessons in the past I’d, you know, ask them about what do you know about this, or I’d give them a word splash, and ask them what do you know about this, and then at the end of the lesson, what did we really learn, what was, you know, things like that. It was, you know, same type of thing, but using different words. And I think you actually learn to teach toward that main idea.

Ms. Casanova, unlike Mr. Kent, emphasized this activity—or rather, the thinking behind it—as a way to keep her teaching and her students on task. She did, however, recognize the importance of reinforcing learning and saw this as one way among many to accomplish this task of reinforcement.

The students and the two teachers brought different perspectives to bear on the experience of completing the poster session using Klafki's Questions. The students, on the one hand, felt they had been allowed to uncover and express their own reflections on what they had learned; the teachers appreciated the opportunity to allow their students the time to reflect, as well as to maintain a sense of continuity between the teaching goals and the student tasks.

The Facilitation of Dialogue and Hermeneutics through Interactive Poster Sessions

As indicated earlier, the students' responses to the modified form of Klafki's questions for a Didaktik analysis through the in-class poster activity fell into three general categories:

Experience, Demonstration of Science Knowledge, and Action. These categories can then be traced back from the student responses in the posters into the data collected through interviews with the teachers and curriculum developers. Not surprisingly, these adults exhibited a more complex and nuanced perspective. In addition, the adult participants highlighted relationships between these themes which were rarely evident in the expression of the students through their posters. As a result, in presenting the interview data, there may be some passages which speak to more than one category. Each of these categories will now be examined in turn with examples which illustrate the responses by students.

Experience. The Experience category encompasses responses on the posters in which the individual and social activities and experiences themselves that students encountered inside and outside the classroom are highlighted. Such experiences include mentions of fieldwork, in-class activities such as role plays or experiments, and use of the digital version of the curriculum on computers. The students responded with expressions relating to their experiences across the activity, and in response to all of Klafki's Questions. These experiences were detailed as

specific and often isolated incidents without tying them to their experiences outside the classroom in their own lives.

Several of the responses addressed the experiences of students outside in the field, where they collected and analyzed environmental data from their school yard or other field site. In response to Question 5, Group 2 in Mr. Kent's class wrote during Session 1: "It was fun/Interesting → ...Going outside = observations." Another group, in response to the same question, wrote: "going outside learning about trees – leaf id," referring to the tree identification field activity in the Energy and Climate Change module of the curriculum. Group 1 in Mr. Kent's class referred to their fieldwork in response to Question 4 during Session 1, in order to support their understanding of the message they interpreted in the curriculum: "The basic message is that what causes heat islands are things that can be change like pollution or population. *We went outside and saw the situation first hand*" (emphasis added). Group 3 in Ms. Casanova's class even requested that more field experiences—and hands-on experiences in general—be built into the curriculum in response to Question 2: "Go more outside, MORE EXPERIMENTS!" These students clearly indicated that they preferred to encounter science as a hands-on experience, either outside the boundaries of the classroom and in the field, or even within the classroom through hands-on experiments. These experiences were always described as individual and cognitive in nature, and not as a shared or dialogic experience with others.

Other students did express the importance of other types of activities in the classroom, especially around working together and on real-life scenarios. Group 3 in Session 1 of Mr. Kent's class, in response to Question 4, expressed appreciation for one particular activity in the Energy and Climate Change module in which students participated in a role play of an environmental justice case study around the use of an urban brownfield, land polluted by a gas

station which once occupied the space: “They gave us information, it made us feel like we were in that situation (gas station).” In response to Question 5 in Session 2, Group 3 of Mr. Kent’s class wrote about the range of activities in which they engaged: “It was fun learning the different Lesson, because it got us involved in games and questionnaires that made the activity interesting.” Group 1 in Ms. Casanova’s class, in response to Question 4, described how working in groups was not only beneficial, but one of the perceived aims of the curriculum: “...the purpose is that we got to work in groups with partners. It help us to understand better and help us for the future.” Group 2 in Ms. Casanova’s class similarly indicated the benefits of working as a group in response to Question 5: “working in groups, going outside, we can help each other, because is more interesting...” This illustrates the range of responses by students to the activities offered in the curriculum, and while these students did mention the ideas of working collaboratively and engaging with real-life scenarios, these experiences were limited to the classroom and did not extend to their own lived experiences.

The teachers and curriculum developers spoke of experiences largely in more abstract and generalizable terms. For example, Dr. Levi, in describing what he hopes students will gain through the curriculum, framed experiences in terms of a set of cognitive tools and a scientific worldview:

The students get a set of tools that they can use in their quote scientific and general lives that involve a belief in logic, um, a way to organize information, the ability to quantify ideas, and the ability to make and test predictions about the world, and to, and to put faith in *data*, not just in stories.

Dr. Levi is describing a particular belief system about the way that people ought to interact with the natural world, based on data, quantifiable information and ideas, and making and testing

predictions. Dr. Levi further makes the distinction between science and other disciplinary subjects taught in school

... because of the way that science is done, the reductionist approach that we take to science, means that, under most circumstances, the context, the narrative, the place in which the phenomenon takes place is independent of the phenomenon itself. In other words, a chemical experiment can be created anywhere in the universe, and the outcome should be the same, if the boundary conditions are the same.

This “reductionist approach” allows for natural phenomenon—or man-made experiments—to be essentialized and decontextualized, which is, according to Dr. Levi, “...very different than the way in which humans view the world, and we learn about the world. We learn about the world because of its context.... So, good science teaching involves creating narrative and place around the science.” It is important to understand that the essential reductionist approach persists at the core—as close to a scientific “truth” as can be derived, a belief in the scientific method—even when context is woven around it. This can be seen reflected in the students’ responses around their experiences with the urban ecology curriculum, as they similarly compartmentalized science experiences in the classroom from their experiences outside the classroom. While this is an unintended consequence (as it violates the relationships between experience and science knowledge as described below), this tension between the contextualized lives of students and the decontextualized ideal of science is one to be aware of while setting the goals for and writing science curricula.

Ms. da Gama similarly describes science, hoping that through the curriculum, “...students are engaged in science, and they see a place for themselves in science, see it to be relevant, see it to be exciting, and have a strong understanding of the fundamental concepts

associated with urban ecology.” Similar to Dr. Levi, she mentioned a tension between experience and science. She goes on to describe interpretation as, in a sense, in terms of disagreements between common sense and scientific laws:

Within science you can come up with your own interpretation about why something is stopping, for example, you can say, that, the tendency of an object is to stop, that’s what normally happens, but that interpretation would go along, against the first law of motion, which suggests that everything *should* keep going, unless a force stops it. So, in that case, that interpretation is not founded in the basic law. Although it’s within what you see and what you experience, it’s limited in how much knowledge it has.... In science, once you’ve gone beyond that, and see it a different way, your understanding of that should change. Even though you can still see the reality, you see the reality in a different way.

Ms. da Gama reinforces Dr. Levi’s comments concerning the potential disconnect between what one experiences and the laws determined by scientists. She notes that science can provide a different understanding of reality and experience than an uninformed view.

Mr. Kent has a slightly different view on the ideas of truth and interpretation in science. It first should be noted that Mr. Kent majored in both environmental science and history as an undergraduate in college, and has stated that ideally he would teach one environmental science class and one history class, or a class on the history of environmental movements in the United States. In discussing the nature of science, Mr. Kent highlights the changing and immediate nature of the discipline, rather than enduring qualities and a system of truths:

...[S]cience being, uh, especially environmental science, being like what’s going on in the news, what am I seeing outside, what am I experiencing, in terms of weather changes,

et cetera. And then, um, digging into that, and then it's really fun to notice the, um, how much we don't know, or how, you know, explanations change as new things come to light, the ever-changing nature of it.

In many ways, Mr. Kent's comment stands in stark contrast to the more abstract deliberations of Dr. Levi and Ms. da Gama. While the curriculum developers bring a much larger and broader sense of goals, as a classroom teacher, Mr. Kent is also required to consider the actual lives of students in his teaching. While curriculum developers should not lose sight of these larger and more abstract goals, it is also important to enter into a dialogue with teachers (and students) to get a sense of their lived experiences.

While the students tended to focus on experience within the classroom, and those isolated experiences were a part of learning science, the adults tended to focus on drawing connections between experience and science. Experience was either seen as a resource upon which to draw in learning new concepts in science, as Mr. Kent did, or science was seen as a way to interact with or interpret experience, as Dr. Levi and Ms. da Gama did. In either case, such perspectives rest upon a knowledge and understanding of science.

Demonstration of Science Knowledge. In addition to describing their experiences, students also expressed understandings of science content and concepts in their posters to varying degrees. Students' responses tended to focus on expression of conceptual knowledge and rarely included more complex scientific reasoning or discussion of the complexity in science—knowledge, in a sense, became an end goal in itself. This differed from the focuses of the teachers and the curriculum developers as the adults maintained a relationship between understanding of science and doing something with this knowledge, even if this expression by the adults was at the abstract level.

The first and most prominent type of science knowledge demonstration was the expression of conceptual knowledge. For these responses, students appropriately used vocabulary or made reference to a scientific concept from the curriculum. For example, in Session 1, Group 3 of Mr. Kent's class wrote in response to Question 1: "heat islands gain and produce more heat than they lose." Group 5 of Ms. Casanova's class responded to Question 2 with: "We've learned about Albedo, land use and others because those problems are part of our life and our future. That's what's affecting the Earth." In response to Question 5, Group 3 noted in Session 2: "We learned that alternative solutions to save energy. Like timers, solar panels, windmills."

A much less prominent demonstration of science knowledge was the use of scientific reasoning in students' responses to Klafki's questions. Only three of the responses exhibited the use of reason—rather than just the expression of facts or concepts, and all three can be found in the second poster activity session of Mr. Kent's class. Each of these responses by three different groups exhibited a form of cause-and-effect relationship which was supported by a conceptual understanding of the scientific concepts, an appropriate use of vocabulary and terminology. For example, in response to Question 1, Group 4 noted, "Global warming has a big impact on Climate Change. The temperature increases by the increase of Carbon Dioxide in the air. An example would be that global warming increases the temperature, therefore hurricanes occur stronger & aggressive. It causes damage." A Group 5, also in response to Question 1, wrote:

- Learning the different types of electricities or sources of energy that we get for example:
 - coal
 - Solar Power
 - Nuclear waste
 - Wind Power (wind mills)
 - Hydro power

- From Climate Change we learned that Since 1979 the Size of the Summer polar ice cap has Shrunk more than 20%. This effected us because ice caps are earth's air condition...it Reflects the Suns energy back into space

Lastly, Group 3 used reasoning in order to support a form of environmental action in response to Question 3: “We would put them in very Big places like factories and school and big buildings. Places that use the most energy because it causes less polution to the environment.”

The last way that science knowledge was demonstrated was through the expression of complexity or ambivalence in science and in the curriculum. Only three of the responses expressed this type of knowledge. Group 5 of Ms. Casanova’s class, in response to Question 5, wrote about the complexities of leadership and planning based on science while using an online city-building simulation: “We played the game and used the website making decisions for the citie's future, putting more green areas and have Less dark surfaces in the city. The surprising part was that we thought that it was easy to choose/lead a city, but it's much complex and affects everyone.” The second group, Group 2 of Mr. Kent’s class in Session 1, highlighted ambivalence in the curriculum. In response to Question 3, they wrote: “There are good and bad messages. The bad message was that the environment is very polluted. The good message is now that we know about Heat Islands we can do something about it.” Mr. Kent’s Group 2 further supported this point in their response to Question 4: “Through slide shows, current events, presentations (Bad). Good because we[’]re aware.”

The highlighting of complexity and ambivalence—a demonstration of understanding that more than one perspective can be expressed at one time—leads into the final category of responses in reflection: the expression of environmental agency and action. Such a perspective, however, can be seen in the statements of the adult participants in this study. For example, Dr. Levi described the goal of the curriculum and the role of science as the following:

I think that the most critical role that science education plays is creating what I call scientific and environmental literacy, in that students will one, recognize their stakeholder status on environmental issues. Two, recognize that they don't have to be scientists to make positive social change. And, three, not only is that opportunity available to everyone, it is a responsibility that everyone should engage.

He highlighted several points, especially the concepts of "scientific and environmental literacy," where knowledge is positioned as a driver for social change, allowing students to recognize their own place in scientific and environmental issues, how they can impact change, and that engaging in science is an opportunity for everyone, not just the few. This differed from the expressions of the students, who largely represented science knowledge as an end in itself.

Mr. Kent also describes the way that science plays into the lives of students, discussing the ways that science can be used to make sense of information:

You know, in science it's, it's nice to be able to look at a statement or a study that someone is putting out and just be able to make an opinion on whether or not it's a credible statement or a believable statement or if it's supported by evidence, um, because that's going to affect, you know, them the rest of their lives.

As much of the information one receives is structured through a scientific lens, Mr. Kent builds upon Dr. Levi's notion of "literacy" for his student. In this sense, science is ideally used by students to evaluate a claim for its credibility based on evidence.

Ms. da Gama does not make mention of the concept of literacy, but she did discuss the notion of truth in science, describing the limits of interpretation in science:

I think it [science] is a different way of thinking in many ways, uh, conceptually, uh, tends to be more explanatory, exploratory, but within certain limitations. So science has

its foundation of knowledge, or its base, so you're working within that base. And, in that case, although you're exploring, you're still within a realm of, OK, some things are going to be right, some things are going to be wrong, and not up for interpretation.

The positions presented by these adult participants, however, have been largely uncritical. There is a deep belief in inculcating students into the scientific worldview, which can be, as described in the Experience category, at odds with the students' lived experiences. The students who highlighted complexity and ambivalence were drawing attention to this tension. In most cases, understanding these tensions can only be arrived at by uncovering and deeply engaging with them and through active and reciprocal dialogue. The largely shallow and one-dimensional nature of the students' responses which demonstrated an expression of science knowledge can be seen as an attempt to make sense of this tension. Some synthesis of this tension, however, is illustrated through the expressions by students in the next category, Action.

Action. Students also expressed forms of environmental agency and activism in their posters. Expressions of action fell into four subcategories: Abstract, Method, Personal, and Community. For the most part, students approached environmental activism—and their agency within the process—as fairly abstract, that some sort of action needs to happen, but what or how by whom is rarely discussed. In addition, the students rarely tie a sense of action and agency to an understanding of science or to particular experiences they have had, either inside or outside the classroom. Students also rarely referred to environmental action as a task undertaken with others as a community, but was instead seen as a task to be undertaken as an individual with a personalized sense of responsibility. The curriculum developers and teachers, while demonstrating a more sophisticated sense of connectedness between action, knowledge, and experience, reinforced the ideal of the individual, often by default. This default worldview

concerning environmental action—focusing on the actions of the individual rather than collective action as a community—is reflected in the participants’ view of themselves in acting around the ideas of schooling, curriculum, learning, and teaching. They see themselves as individuals in the school system, rather than as a community in dialogue with others, reinforcing the traditional transmission-based notions of curriculum and instruction.

A response by students on a poster included in the Abstract subcategory indicated a generalized expression that action needs to happen, with no reference to specifics in terms of who, what, or how, or they expressed a grand idea with no clear expression of the steps or contingencies that would have to be accomplished to attain a successful outcome. For example, Group 1 of Mr. Kent’s class during Session 1, in response to Question 5, wrote: “We learned about heat island and its consequences. It’s easy to reduce heat island effect.” Group 4 of Ms. Casanova’s class expressed agency in this form in response to Question 1: “We can change the land.”

For inclusion in the Method subcategory, students expressed in their response a specific method for accomplishing an action, with little reference as to who would or what exactly success would look like. Group 3 of Ms. Casanova’s class expressed this dire message in response to Question 4: “Understood the message - if we don't take care we can all die→extinction, to learn about the way we live, learning about all the cities in the world, need clean air to live, now that we know what is going on we can fix it, important to know but we need to inform the gov't.” Group 4 of Mr. Kent’s Session 2, in response to Question 3, wrote: “We can decrease the use of human activities, that cause global warming, use hybrid cars, transportation, green roofs, etc.”

Inclusion in the Personal subcategory, meanwhile, indicated an expression of a personal responsibility for action, indicating that they themselves specifically would undertake an action. They indicated such a position as “I” or “We” undertaking the action, indicating a personal responsibility to do something. Group 4 in Ms. Casanova’s class, in response to Question 4, wrote: “We can change the land by putting more trees, and green areas. Because we have more good air, and better life and without pollution.” Ms. Casanova’s Group 4 indicated personal responsibility in a fairly abstract sense, but Group 2 in Mr. Kent’s class during Session 2 in response to Question 3 indicated a slightly more concrete and actionable position. This group wrote: “We are going to use these ideas in the future by being more environmentally friendly a) use CFL light bulbs = to save money & to use less energy b) extreme weather = put things in your house & do things that would cause less pollution.”

Lastly, for inclusion in the Community, students expressed action in a relational manner, indicating that action occurs in conjunction with others. The responses of only two student groups indicated this relational aspect of environmental action and activism. In response to Question 3, Group 4 of Ms. Casanova’s class indicated that it was necessary to recruit the help of others: “We can get help from other people to plant trees, and build important things for our area.” Similarly, Group 5 in Session 2 of Mr. Kent’s class responded to Question 4 by drawing attention to the relationships between themselves, their community, and the environment: “The message that we got out the assignments is that how we as students or teenagers can make a difference in our lives and the community & people around us treat the environment better.” The importance of the statements of these two student groups—in contrast to the norm—indicated that environmental activism is not something accomplished alone, but a task undertaken with the help of and in conjunction with others.

It was noted above that Dr. Levi perceived scientific and environmental literacy as a way to interact with the world for positive social change. He further supports this by describing the idea of using sciences in decision-making, hoping that

...students will recognize that science is important in their lives, and that especially environment and the life sciences have direct implications about the choices they'll make in their lives. And they are stakeholders in the outcomes of those decisions, not only personally, with respect to their own, their own lives, but the lives of their children, and grandchildren, and their extended family of humanity.

While Dr. Levi highlights an important connection between science knowledge, choices, and ultimate outcomes, by default he reinforces the individualized—anti-dialogical—notion of personal responsibility, as it is personal choices which have an effect on a larger web of community outcomes. The same case, however, can be made of communal and dialogical choices having a broad impact on the environment and the community.

Ms. da Gama also spoke of using science and knowledge of concepts in urban ecology to bring about positive change, as well as highlighting the impact that students themselves can have in the public sphere in terms of the choices they make. Again, similar to Dr. Levi, by default she refers to the notion of individual roles and choices:

So they're working within what's known about urban ecology to enhance it, to enhance the environment, to make it a better place. And, to understand what their role is in that, so they play a role in that. Even if they don't go out to their whole community and start this massive program, like, they see their part in making the environment a better place. Like their choices, how their choices can improve or, actually, be detrimental to the environment.

Mr. Kent also sounded similar themes, hoping to not only introduce his students to the concepts of science, but also the notion of caring:

...In science, it's nice to be able to look at a statement or a study that someone's putting out and be able to make an opinion on whether or not it's a credible statement or a believable statement, or if it's supported by evidence, because that's going to affect them the rest of their lives. And also, a lot of these kids are not choosing environmental science, they're being placed in environmental science, so I'm hoping they'll come away with an appreciation for the environment and for the challenges that we face. More than just the challenges, so many potential solutions that are out there these days, especially with alternative energy and green design. There are lots of examples of cities who are doing things differently, who have found innovative solutions. So, just knowing the options, and just caring a little bit more.

Mr. Kent used more concrete and specific language to discuss the possibilities for action than Dr. Levi and Ms. da Gama, speaking of jobs and career opportunities, specifically alternative energy and green design. He also noted that not all of his students were in his class by choice, so that he is hoping in some cases to instill a sense of caring about environmental issues in his students. Like Dr. Levi and Ms. da Gama, he emphasizes his students acting as individuals, rather than acting together or in conjunction with others.

The adult participants have set the stage for the importance of science in the lives of students, as well as the genuinely useful skills and opportunities which come from learning science in the modern world. Such skills are neither learned merely for the sake of learning science nor for purposes of job training, but are seen as coming from a desire for making positive change. The idea of individual—rather than communal or dialogic—agency was reflected in

both the expressions by students as well as in the intents as described by the teachers and curriculum developers. Such intentional themes can be traced forwards and backwards from the student expressions through the poster session activities and through the discussions with the teachers and curriculum developers.

Conclusions

Scaffolding Dialogue, Hermeneutics, and Reflection

This research highlights one relatively successful way to provide opportunities for students and teachers to reflect on curriculum materials in a critical and constructive manner. Klafki's Questions for a Didaktik Analysis provided a challenge for students, cognitively, linguistically, and conceptually. Yet the students were willing to engage with the questions and come up with relatively cogent and thoughtful responses through the activity. Students were able to synthesize and make meaning from the content that was covered in the curriculum modules. The students felt gratified and rewarded by uncovering the extent of what they had learned in a social, public, and collaborative setting. Teachers were given the opportunity to see what students took away from their teaching, and what meaning students made from the materials.

Some of Ms. Casanova's comments highlighted the idea of perceived sameness of the activity undergirded by Klafki's Questions to a broad range of activities already within her repertoire of teaching strategies. This provides a necessary reminder of some of the challenges to this hermeneutic and dialogic approach to disrupting the traditional curriculum transmission model, that of *adaptive presentism* in the field of education. Building upon the work of Lortie (1975), Hargreaves and Shirley (In Press) describe a burgeoning attitude among teachers overwhelmed by the volume of change and reforms imposed on their work in their classrooms, in

which they tend to “...become cynical and concentrate on immediate issues in their own classrooms even more than they did before the reforms were implemented” (p. 11). Hargreaves and Shirley further compare adaptive presentism to the idea of “repetitive change syndrome” as proposed by Abrahamson (2004, in Hargreaves & Shirley, In Press), leading to a sense of “...‘innovation overload’ and change-related chaos...” (Hargreaves & Shirley, In Press, p. 12). While this is a fairly common phenomenon among schools doing their best to keep up with the requirements of accountability, Ms. Casanova’s comments serve as a reminder of the complex and institutional challenges to even small-scale classroom-level innovations as this one, which seeks to foster a dialogic and hermeneutic approach around curriculum.

This process of dialogue and hermeneutics with Klafki’s Questions as a form of scaffolding can potentially be valuable for curriculum developers as well, in terms of curriculum development and research. The scaffolding provides a structured and fairly standard form that curriculum developers and researchers can use to gather data on the meanings constructed around and the sense made of the curriculum across a number of classes, teachers, and schools. When coupled with teacher interviews and self-reflection, the process of tracing intents through expressions (Gershon, 2008) allows the meaning expressed through student work to be traced back and forth between the different levels of participants—curriculum developers, teachers, and students.

This process also allows curriculum developers and researchers to see the unexpected meanings constructed from and unintended consequences of the curricular materials, content, and activities. From a humanistic perspective on science and technology, allowing for these unexpected meanings and unintended consequences to emerge is an important part of the

educational process (Aikenhead, 2007). As Buber writes (framing these meanings and consequences in the language of renewal):

A child does not represent the sum total of his parents; the child is something that has never been before, something quite unpredictable. Similarly, a generation can only receive the teachings in the sense that it renews them. We do not take unless we also give. (Buber, 2002, p. 235)

In this passage, Buber contends that students can take the teachings of the past and of adults, either from the content and structure of the curriculum or through the instructional practices of the teacher, and transform—or renew—them to meet their own situations. Learning, from this perspective, cannot occur through the strict transmission model.

However, the findings pointed to a process which was *hermeneutic* in nature—in that it was primarily seen as a reflection and meaning-making activity—but it was not found to be particularly *dialogic*. The students engaged in dialogue with each other in the small group settings, and the teachers indicated they were able to get a better sense of their students' experience with the curriculum, one of the criteria of the inclusive educative I-You relationship described by Buber (Buber, 1965). There is little evidence, however, of students gaining an understanding of the fact that people, potential dialogical partners, write the curriculum. This may in part be due to the way that the presentation of the poster session activity was made to the various participants, which did not particularly emphasize this aspect of the research study. The lack of dialogic interactions may, however, reflect the larger American ideology of individualism as it is found in the teaching profession (Lortie, 1975) and in the process of teaching and learning though the related concept of meritocracy (Jefferies, 2009; McQuillan, 1998). The default sense of individualism as highlighted through perceptions of environmental action uncovered in this

research further reified this ideology, and called attention to a tacit worldview which makes genuine dialogue a more complex and difficult endeavor.

Time may be one way to allow for participants to uncover and expose this underlying worldview. The responses to Klafki's questions in the posters presented by students were more sophisticated during the second session, as students more clearly articulated a perspective on the curriculum itself and the meaning they made of it. In addition, two examples of scientific reasoning emerged through the responses. It may be that more time for regular reflection is needed to allow for these dialogic relationships to occur, to allow students enter into a relationship with the texts, which carries behind it human agency on the part of the author. Buber calls this approach to interpreting texts—and, we argue, curriculum—as a “You-saying:”

Let them try, as best they can, to receive this saying with their ears—as if the speaker had said it in their addressing them. To this end they must turn with their whole being toward the speaker, who is not at hand, of the saying that is at hand. (Buber, 1996, p. 174)

Learning to “turn with their whole being,” as a community rather than an individual, to the curriculum and hear the speaker behind the texts requires time and room for potential to make mistakes (in order to learn from mistakes), both of which are in short supply as adaptive presentism takes hold in the face of high-stakes testing and a culture of accountability (Hargreaves & Shirley, In Press). More research needs to be conducted in order to determine the challenges and approaches to further foster a dialogic and You-saying approach to curriculum, learning, and teaching.

Technology provides another potential solution to address this problem around the lack of dialogic interactions, particularly in terms of the role of the curriculum developer. The online Diigo-based component of the design plan was not utilized in this round of the research, due in a

large part to the extended effort needed to learn how to use Diigo when only two of the curricular modules were available online. Neither teacher felt that it was worth the time and effort to learn the system, noting that in a cognitive cost and benefit analysis (which was likely done tacitly, and was made explicit only retrospectively through the interview process) the effort to learn how to use the system did not make up for the cognitive expenditures necessary to make use of the added layer of technology.

The teachers indicate that the availability of the entire curriculum online would facilitate their adoption of the added annotation layer; this, however, may not be enough, as there is media competition (G. Stahl, 2006) occurring between the various technological layers. For example:

- Separate usernames and passwords are required for logging into the curricular materials themselves and for logging into Diigo; this point is especially salient as in the classrooms, there was no guarantee that students will have the same laptops from day-to-day.
- The Diigo interface is physically separated on the screen from the curriculum materials, and is part of the web browser chrome and interface (as an add-on extension to the browser software or as a bookmarklet, or functional application triggered by clicking a bookmark) rather than integrated into the materials themselves.
- The Diigo interface is flexible, customizable, and complete, but also requires some degree of technical knowledge and experience to master.

Providing for a common log-in, closer integration between the interface of the online curriculum and the features provided by Diigo, and displaying only those features necessary for annotation

(rather than storage, organization, and retrieval) purposes more prominently may have lessened the cognitive requirements and teachers may have been more willing to try this system.

These empirically discovered weaknesses, however, point to a potential short-coming in the theoretical and philosophical grounding of this research. In terms of the learning in groups, Stahl assumes that “[t]he knowing that groups build up in manifold forms is what becomes internalized by their members as individual learning and externalized in their communities as certifiable knowledge.” Such an assumption, however, requires a fairly high degree of meaningful and focused dialogue mediated by the technology. As noted above, this level of dialogue was not found in this research. A technologically-deterministic (Pederson, 2001) or technological utopian (Gur-Ze'ev, 2000) perspective would place the onus of responsibility for this failure on the teachers and students for not following through on the potential of the technology. As this research follows a humanistic perspective (Aikenhead, 2007), however, no such responsibility is placed on the teachers and students; the use of the poster activity at the end of the units served as a workable alternative.

Such caution, however, should not prevent such research from moving forward. While it is possible for technology-mediated interactions to annihilate the possibility for the I-You relationship, the encounter mediated by technology may provide further opportunity to engage in an unmediated I-You way. But such an approach requires that the focus remain on the human relations, and not on the potentialities of the technology per se. Even the Hasidim² recognized this subtlety, as related by Buber in this Hasidic tale:

‘What can we learn from a train?’ one hasid asked dubiously.

‘That because of one second one can miss everything.’

² The Hasidim, or “pious ones,” are observant Jews originally from Eastern Europe brought to the public eye through Buber’s *Tales of the Hasidim*.

‘And from the telegraph?’

‘That every word is counted and charged.’

‘And the telephone?’

‘That what we say here is heard there.’ (Buber, 1991, p. 2:70)

If it is possible to be reminded of our humanity by a train, telegraph, and telephone, it is possible also to find the potential for genuine I-You dialogue in education in the Internet Age. One-to-one laptop programs, where laptops are provided to every student in a class or school, are under study as a sustainable model for providing students with the opportunities afforded by Internet and Communications Technologies. The Amazon Kindle line of electronic book readers which incorporate some of the features which could be utilized for a dialogic and hermeneutic approach to learning is being viewed as a future textbook delivery device (Biggs, 2008; Siegler, 2009). The combination of the opportunities provided by the technology as well as the increased availability of sophisticated and relatively inexpensive Internet appliances may encourage the delivery of curriculum and texts over the Internet rather than in printed form (i.e., printed textbooks).

This combination of dialogue and reflection around the curriculum by students, teachers, and curriculum developers in a technology-rich environment has the potential to lead to a reconsideration of curriculum as a fixed source, but instead as involved in the dialogue itself. Precedence for this idea can be found in the open source curriculum movement. This movement builds upon the open source software initiatives and applies the ideals of openness and distribution to the development of educational materials, frequently distributed over the Internet. According to *Wikipedia*, itself an open source initiative, “[the open source curriculum] process invites feedback and participation from developers, educators, government officials, students and

parents and empowers them to exchange ideas, improve best practices and create world-class curricula” (“Open source curriculum,” March 1, 2008). Jimmy Wales, the founder of *Wikipedia*, asserted that the curriculum will be one of “ten things that will be free” (2005). Supporters hope to motivate established publishers to release curricula in a free open source format as a way to ensure the broad distribution of “knowledge” (Lessig, 2005). The use of this web-based system could provide the curriculum developers with valuable information as well as support the teachers and students in viewing the curriculum developers as potential dialogic partners through curriculum enactment.

Two considerations must be made, however, when moving towards an open source curriculum model. The first consideration is a part of a larger critique of neoliberal influences on curriculum development (c.f., Apple, 2001; Carter, 2005; Petrina, 2000; Robertson, 2003) while the second involves a consideration of the quality of the dialogue around the curriculum. Firstly, it must be remembered that in such a model where commercial curriculum developers and publishers are involved, it is the publishers and their agents who benefit economically from the work of students and teachers, even if the students and teachers benefit educationally, cognitively, and socially from the dialogic and hermeneutic process. Considering ways to expunge this inequality is a necessary step in the movement toward an open source curriculum. Secondly, not all dialogue is of a meaningful nature—in fact, most of it is not. Furthermore, according to a Bakhtinian perspective on dialogue, there is the possibility that dialogue in the ideal sense would devolve into a confused and chaotic Menippean dialogue (Cheyne & Tarulli, 1999). In this carnival-like atmosphere where everyone has a voice, there is a potential for creating more noise than genuine dialogue, and instead, a more balanced approach must be found (Vaagan, 2007).

Opening Up the Dialogue Around Assessment

As noted above, utilizing activities which encourage students to respond to Klafki's Questions can be used by teachers to understand what meaning is made by students from classroom instruction and the curricular materials. In other words, such activities provide teachers with a mode of assessment for evaluating students' understandings as well as evaluating their teaching and materials. The activity presented in this research study is especially powerful when used as a model of formative assessment. Formative assessment provides data to bring about a change in teaching to better serve students (Boston, 2002). More specifically, the activity presented in this research can be seen as a form of planned formative assessment, in which teachers "...undertake a specific activity (for example, a survey or brainstorming) to obtain assessment information on which some action would be taken" (Bell, 2007, p. 974). Such an approach by teachers to formative assessment could be especially useful and powerful if teachers *also* utilize Klafki's Questions for their original purposes, for prospective curricular planning (Klafki, 2000). This bookended approach would provide direct and interpretable information for classroom teachers.

Another interesting point to be made about utilizing an activity such as the one presented in this research can be found in the research by Cowie (2000 in Bell, 2007), which found that students' sense of their identities as learners were often embedded in their experiences with formative assessment. In addition, Cowie further found that students viewed assessment as an embedded and interactive process between teachers, other students, and parents. As a hermeneutic and dialogic activity, formative assessment activities which center on Klafki's Questions provide students with the agency to interact with one another and with the materials to make communal meaning of a shared classroom experience. This meaning is shared with peers

and teachers in a structured, safe, and supportive environment in which the information gathered from the activity is not used to judge individual students, but to allow teachers—and ideally curriculum developers—to make adjustments in instruction and the design and use of materials to better meet the needs of students while maintaining a sense of conceptual faithfulness to the curriculum.

Educators and researchers have advocated for the movement away from strict accountability measures, and to include classroom-based formative modes of assessment (e.g., Atkin, Black, & Coffey, 2001). We hope that this research can help to open the discussion around assessment, and to encourage a dialogic, respectful, reflective, and student-centered discourse around the purposes and practices of curriculum use.

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