

Queering Science for All

Probing Queer Theory in Science Education

KRISTIN L. GUNCKEL
University of Arizona

Looking for an Opening

I am looking for an opening. I am sitting on the edge of my chair, my mouth dry. It is late afternoon and the conversation has been going on for over an hour. I am one of twenty-six graduate students and post-docs sitting tightly in a room, the same room we have been in all day, talking to each other about science curriculum materials. This conversation, the one we are having now, is on the agenda as “Tea Time Chat: Rethinking Diversity.” Someone passes around a platter of tea cookies. At the front of the room, four of the principal investigators on the project are visible on a television screen, participating via Internet Polycom technology from several remote locations. We have been exploring how curriculum materials can address issues of diversity. So far, the conversation has been mostly about reaching inner-city African American students and sometimes about urban schools that have students from multiple ethnic backgrounds. The two people leading the conversation, both post-docs, are African American. They are the only people of color in the room or on the TV. Everyone defers to them as the experts on diversity. I am looking for an opening to suggest that in addition to race, class, and gender, maybe there are other ways to think about diversity. I am looking for an opening to try to get people to really “rethink” diversity.

My pulse begins to race to about 110 beats per minute. I feel the sweat begin to bead on my forehead, and I feel short of breath. I don't hear what anyone else is saying right now; I am only trying to figure out how I am going to say it. I want everyone to realize that there are other people who get left out of science education, who are invisible in the discourse, and who are marginalized in schools. Can anyone tell how anxious I am? I silently curse that it always works this way, that whenever I want to bring up this topic, it always feels like I am coming out again (and again) for the first time, even though most of the people in this room and on the TV know I am a lesbian (I think they do, anyway). But every time it feels this same way. The anxiety is there about how the topic will be received and whether or not people will see it as relevant. I am going to take the risk, once again, because it is relevant, it is important, and it has bearing on all students' learning and all teachers' teaching.

“What other diversities should we look at? How about special education?” There, someone said it. I have to speak now! This is the perfect opening. Go!

Suddenly, a voice in the corner of the room, my voice, I think, says, “Well, I think we need to think about sexual orientation and about how school science helps or hinders gay, lesbian, bisexual, and transgender students learning science and teachers teaching science.”

There, I said it! Now, what will they say? How will they react? I look around the room and at the TV, anticipating someone will say something, anything. I wait. Silence.

What is Queer Theory?

Defining queer theory is a slippery task, because queer theory resists definition. At its core, queer theory is about making the normal queer. It questions the normative processes that structure lives, actions, language, power, and knowledge. These processes define and categorize people, ideas, identities, and institutions. Because queer theory is about disrupting normative processes, it is also about disrupting definitions and categories. Therefore, to define queer theory too closely is to contradict the intent of queer theory. As described by Sullivan (2003), “queer theory is a discipline that refuses to be disciplined....It does not want to straighten up and fly right” (p. v). It is easier to describe what queer theory does than to try to define what queer theory is (Britzman, 1995; Sullivan, 2003).

Queer theory disrupts the normative processes. It challenges categorical thinking and specifically aims to disrupt the hetero/homo binary. Queer theory examines how the social construction of sexuality is normalized so that heterosexuality is portrayed as the only normal and natural form of being human. Queer theory reveals how truths and selves are socially constructed, questions how and by whom identities are created, and opens spaces for the reconstruction of the self. As such, queer theory asks what can be, rather than what is (Snyder & Broadway, 2004).

Snyder and Broadway (2004) identify three areas of focus for queer theory: deconstructing the social construction of identity, disrupting binaries, and interrupting heteronormativity. Drawing from poststructuralism and the works of Derrida and Foucault, queer theory takes the position that identity is socially constructed (Morris, 2000; Sullivan, 2003). How one identifies oneself depends greatly on how the self is created by others (Letts, 1999; Luhmann, 1998; Sears, 1999). Language and discourse play an important role in defining these identities. Within the discourse, human sexual identities are reduced to binaries (male/female, heterosexual/ homosexual, straight/gay, etc.). Each term in the binary is constructed in a unified, monolithic essence (Gamson, 2000; Sullivan, 2003). Furthermore, moral value is attached to the terms, with the first term seen as more desirable, more normal than the second term (Snyder & Broadway, 2004). As a result, heterosexuality becomes defined as the natural order and is normalized as the standard against which all behaviors, identities, relations, and social constructions are measured as either normal or deviant (Sullivan, 2003). Queer theory allows for the reconstruction of possible identities outside the monolithic normal/abnormal or natural/deviant binaries (Gamson, 2000; Morris, 2000; Snyder & Broadway, 2004). Following Derrida, queer theory aims to deconstruct these binaries by showing that the binary terms are not unified essences but exist only in relation to the existence of the opposite (Butler, 1999; Morris, 2000; Pinar, 1998). Queer theory aims to interrupt heteronormative thinking and thus open areas for broader perspectives of, more complex thinking about, and more imaginative possibilities for conceptualizing the human experience (Sumara & Davis, 1999).

An important distinction exists between queer theory and theories of assimilation of gay and lesbian people. Both approaches strive for social justice and at their center aim to eliminate homophobia, discrimination, and harassment of gay, lesbian, and all queer people (Tierney & Dilley, 1998). However, assimilation theory strives to gain acceptance for gay and lesbian identities from the heterosexual majority. In contrast, queer theory questions the construction that privileges heterosexuality as normal and marginalizes homosexuality as deviant (Luhmann, 1998; Malewski, 2001; Tierney & Dilley, 1998). Rather than normalize homosexuality, queer theory rejects the hetero/homo binary altogether and in the process, brings the entire heterosexist structure of society to collapse (Luhmann, 1998). According to Tierney and Dilley (1998), queer theory is not only about the rights of individuals, but is also “about how identity and power intersect,” how institutions are controlled, and how discourses are legitimized (p. 62).

Stay in the Closet: Too Queer for School

I am sitting in a chair across the desk from the principal, feeling very uncomfortable and vulnerable. This is the second time in less than two years, in two different schools, that I am having this same conversation with a school principal.

“No, you can be assured that I do not discuss my sexuality in the classroom,” I say quietly.

“I didn’t think so. I just wanted to make sure. If I get parents calling about this, I want to be prepared. You should know that I support you and will go to the school board to defend you, if it comes to that,” the principal says nervously.

My mind is screaming at him. “What do you mean you will defend me? I have done nothing wrong. It was my car that was vandalized with hateful words. It is your school that condones this sort of violence by forcing all queer people to stay in the closet. I am not the only queer teacher here in this school! There are queer kids and kids who come from queer families who are your students. What sort of message are you sending them?”

Instead, I politely say, “Thank you.”

My mind is still screaming as I walk out the door, weak-kneed and feeling nauseated. “Don’t you realize the damage that your actions are causing? Don’t you see that this school is forcing some students to be invisible? Don’t you understand that you are denying all of your students, not just the ones who might be gay, lesbian, bisexual, transgender, but all of your students possibilities to understand the world from a different perspective? Don’t you see that you are forcing all students to learn your knowledge of the world and denying them opportunities to construct a new, maybe better world?”

I slowly walk back to my classroom. The police officer comes by later in the day, during sixth period science, to take a statement. One student is suspended from school. The whole school knows what happened. But I can’t talk about it, at least not to students.

I wonder to myself, “How could this be different? What would be so terrible for these students to know? How am I supposed to be their teacher when I have to stay hidden? How can I be real? They know. Students know when teachers are holding back. They have questions. The unanswered questions become fears; they become reasons for violence and for intolerance of difference. How can we expect to raise children who can make the world a better place if we instill in them the seeds of distrust, dislike, and yes, hate, for the Other?”

No one sees the damage done by shoving this day back in the closet.

What is Queer Theory in Education?

Queer theory in education critiques schools and education as institutions and processes that limit possible identities, promote binary constructions, and naturalize heteronormativity. Queer theory provides a framework for examining schools, curriculum, and pedagogy to find those identities, bodies, and experiences that have been silenced, ignored, and rendered invisible. It provides another lens through which to understand how schools and education function to structure and reproduce the norms of the culture.

Many people question what sexuality has to do with education and whether it is appropriate to connect sexuality with education. Applying queer theory to education has two important purposes. First, from a social justice perspective, the application of queer theory to education strives to make schools and the processes of education more egalitarian and democratic (Letts, 2001; Malewski, 2001). By questioning how schools promote heteronormativity and examining how schools limit possible identities, queer theorists seek to limit the damage done to gay, lesbian, bisexual, transgender, and all other queer people in schools. Schools are highly homophobic and heterosexist institutions (Pinar, 1998). Only by disrupting heteronormativity and creating spaces for new or Other identities can schools achieve democratic equality (Letts, 2001). However, applying queer theory to education is about more than giving voice to marginalized identities (Britzman, 1995). It is also about questioning the purpose of school, what counts as knowledge, what knowledge is taught, how students learn, and what students learn. This section will review some of the work that relates to both purposes for applying queer theory to education and will conclude with an exploration of possible implications for not just marginalized queer people but for society as a whole.

Discussion of sexuality in schools is a taboo. It is generally viewed as relevant only to health education and then, as only relative to sexually transmitted diseases, AIDS, abstinence, and heterosexual marriage (Britzman, 2000). The possibility that sexuality is relevant to elementary education is even more controversial. There is the assumption that children are innocent and need protection and sheltering from sexuality. This assumption reflects the conception that schools are intended to transmit knowledge to students, who are empty vessels waiting to be filled (Malewski, 2001). However, elementary school children know a great deal about sexuality and gender relations from the media, peer groups, their encounters with the world, and from school (Brickmore, 1999; Wallis & VanEvery, 2000). To think that sexuality is not present in schools is indicative of how heterosexism constructs normality in such a way as to render sexuality invisible.

Sexuality is always present in schools, not just in sex education classes (if they exist). For example, Brickmore (1999), Sears (1999), and Wallis and VanEvery (2000) show how schools promote the image of the family as always consisting of one father and one mother plus the kids as the only natural family configuration. Sexuality is present in this image, but because it is an image of a heterosexual family, the sexuality component is unseen. Explorations into how schools unquestioningly promote heterosexism reveal that sexuality is present and ubiquitous in the schools already. What is taboo is not the sexuality itself but any image, form, or discussion of sexuality that reveals the ways that sexuality constructs the normative world.

Schools are places where children construct their identities (Letts, 1999; Schneider & Owens, 2000). However, the heterosexism present in schools prevents students from recognizing all possible identities. The value-laden binaries (male/female, straight/gay, heterosexual/ homosex-

ual) normalize and validate only certain identities and limit how children learn to grapple with the complexities of identity (Britzman, 1995; Letts, 1999; Morris, 2000). Such limits on possible identities and the values associated with particular identities do damage and violence to those constructed by others as outside the normal and the natural (Butler, 1999; Letts, 1999; Morris, 2000; Schneider & Owens, 2000). Queer theory exposes the damage these binaries do to not only marginalized identities but to society in general (Sedgwick, 1999). People with non-heteronormative identities have always been present in schools, as children, parents, and teachers. The literature is full of examples of how students whose sexual or family identities are marginalized must negotiate significant obstacles in achieving academic or social success in schools and who often choose to drop-out of school rather than face continual harassment and persecution (Blackburn, 2004; Luhmann, 1998; Schneider & Owens, 2000). From an ethical and social justice perspective, illuminating the heterosexism of schools is a step towards equalizing the educational opportunities for all students. Furthermore, opening the closet door of schools so that all children, families, and teachers can find their identities within the school community makes it possible for all people to benefit from the often hidden contributions of non-heterosexual people (Schneider & Owens, 2000).

Schools are also places that deal with knowledge. In the Western way of thinking, where mind, body, and spirit are separated, knowledge is connected to the mind only (Malewski, 2001). There is no acknowledgement of the role that bodies and spirits play in knowledge creation. There is no recognition of the role that Eros, desire, satisfaction, and pleasure play in learning (Britzman, 1995, 2000; Malewski, 2001; Sumara & Davis, 1999). Queer theory exposes how sexuality underpins notions of what counts as knowledge, how knowledge is constructed, how students learn, and what students learn. Queer theory offers new ways to rethink the grounds of knowledge, what counts as knowledge, and how knowledge is organized (Britzman, 1995, 2000; Malewski, 2001; Sumara & Davis, 1999; Tierney & Dilly, 1998). Queer theory reconnects knowledge and learning to sexuality and shows that, in fact, sexuality as linked to knowledge is ever-present in schools.

However, as with identities discussed above, schools present knowledge along heteronormative lines and thus, render the sexual component invisible. If only one definition of sexuality is allowed, it limits what counts as knowledge (Sumara & Davis, 1999). Britzman (1995) and Luhmann (1998) use queer theory to interrogate these limits and ask what is beyond the limits, what is it we cannot bear to know? Queer theory helps broaden knowledge by extricating and interpreting the ways that knowledge is heterosexualized and therefore, limited. Interrupting the heteronormative structures of knowledge is necessary “to broaden perception, to complexify cognition, and to amplify the imagination of learners” (Sumara & Davis, 1999, p. 202).

Queer theory questions not only what counts as knowledge but also how knowledge is constructed and who constructs it. Queer theory asks not what we know but how we know (Luhmann, 1998). Britzman (2000) suggests that sexuality is necessary for curiosity and making new ideas. She applies queer theory to question how the structures of education limit curiosity and thus, limit the possible cultural constructions of knowledge. Britzman (1995) suggests that queer theory can transcend the limits of thinkability and offer new possibilities for knowledge not previously thought. Tierney and Dilly (1998) show that in addition to asking how knowledge is constructed, queer theory asks who constructs the knowledge. To Tierney and Dilly it is as important to understand and interpret the identity of the author of knowledge as it is to understand or create the knowledge. Similarly, Luhmann (1998) uses queer theory to disrupt the view of teaching as knowledge transmission and suggests that teaching is knowledge creation. Queer

theory questions how students come to understand. It requires that educators think about how desire and sexuality bring students to engage in learning (Malewski, 2001). Queer theory also requires that teachers ask about how students resist learning and how certain identifications prevent learning. In all of these questions, identity and sexuality are central. They play a role in what knowledge is constructed, how it is constructed, who constructs it, who learns it, who teaches it, and how. Queer theory posits knowledge not as answers but as interminable questions (Luhmann, 1998).

Applying queer theory to education has significant benefits. First, for people whose non-normative identities prevent their visibility in schools and interfere with their learning and teaching opportunities, applying queer theory to education opens an avenue for achieving democratic equality (Letts, 1999; Malewski, 2001). However, interrupting heteronormativity also opens possibilities closed off previously to all people. Queer theory opens education to become, in the language of Sedgwick (1999), a universalizing discourse. As a universalizing discourse, queer theory allows educators to move beyond inclusionary curricular efforts (Malewski, 2001). Rather, queer theory in education opens new identities, new knowledge, new ways of constructing understanding, and new ways of teaching and learning to everyone. Thus, queer theory in education is more than claiming equal rights for all; it is also about claiming the previously unseen and previously unknowable for everybody.

Volcanoes, Earthquakes, and a Passion for Learning

“You live in one of the most exciting places on Earth! There is only one other place like it and that place is in Africa. Imagine the place that you live is as exciting as Africa. Beneath your feet, this very minute, the Earth’s crust is being pulled apart. What happens in places where the Earth’s crust is pulled apart?” I look around at 30 bored faces staring back at me. “Look out that window. What do you see? Out there, on the horizon, what is that?”

The faces continue to stare at me. A few students in the back of the room are whispering to each other. A few students turn to look out the window.

“It’s a volcano! A volcano almost in your backyard! Isn’t that the coolest thing? I mean, how many people even know that those black hills are volcanoes? Did you know that in New Mexico we have almost every type of volcano there is? We have more types of volcanoes than Hawaii or Oregon! Look, you can see one right now. What else happens when the Earth’s crust is being pulled apart?”

A hand rises in the back. I think, “Finally, a response.”

“Can I go to the bathroom?”

“Earthquakes,” I practically yell, ignoring the question. “Yes, we have Earthquakes here. Not as big as the ones in California, but they happen here almost everyday. We can’t feel most of them, but they record them at the Seismic Laboratory. Did you know that only a few years ago they recorded a whole bunch of Earthquakes just south of here and that geologists think that it may have been related to fresh magma rising to the surface? They think that the magma actually almost erupted— it was that close! We could have taken a field trip to see a live volcanic eruption!”

A few students look up, suddenly looking a little interested. I am practically hoarse. I find Earth science fascinating, and I want my students to be fascinated too. I spent more than eight years studying geology, and I want to share with my students the incredibly amazing stories that

the Earth has to tell. Where is their passion? Where is their curiosity? Don't they see how wonderful this is? How do I make this relevant to their lives? "Come on," I am thinking, "Learning about the stories of the places we live is great. Don't you want to go on an adventure, find out what we can, learn more, discover exciting new things?"

The students seem so cut-off. There is no passion, and there is little curiosity. And if there is no pleasure, passion, curiosity, or desire, then there is no learning.

What is Queer Theory in Science Education?

Science education serves as an example site for applying queer theory and asking the sorts of questions about schools, identities, knowledge, teaching, and learning that are presented in the previous section. This section will review some of the recent work that applies a queer theory lens to science education.

How is Science Education Heteronormative?

Queer theory exposes the many ways that the science curriculum is heteronormative, promotes binaries, and bolsters the construction of limited identities. Snyder and Broadway (2004) show that secondary-level biology textbooks construct sexuality in strictly heteronormative terms. Of the eight textbooks they examined, none discussed sexuality outside of the heterosexual norm. None of the textbooks included a discussion of a possible genetic origin for sexual orientation or discussed homosexuality in any reference other than AIDS. Furthermore, none of the textbooks discussed human sexuality as having any purpose or motivation beyond reproduction.

Similarly, Letts (2001) reveals that the wording of the National Science Education Standards emphasizes reproduction as an essential attribute of all living things. School science normalizes heterosexual sex for procreation as the only natural form of sex for any organism and as a central, "defining characteristic of being alive, of being normal" (Letts, 2001, p. 269). Letts (1999) also illustrates how primary-level science trade books and textbooks superimpose binary cultural gender categories onto binary "biological" sex categories in such a way as to reinforce the male/female and masculine/feminine dichotomies. Letts refers to this superimposition as the construction of heterogender, a concept that simplifies the complexity of gender to make it seem that gender is naturally occurring and that there are only two, polar opposite ways of being that are normal.

I argue further that the emphasis in science education on some science process skills, such as classification, promotes the view that all things and all beings can be categorized, labeled, and organized into neat packages based on identifiable characteristics and relationships. Most sciences, including chemistry, physics, biology, and Earth science, rely on classification systems. Neils Bohr once stated that "the task of science is both to extend our experience and reduce it to order" (quoted in Hawkins, 1990, p. 100). Much of school science is about learning these classification schemes and learning the processes of classification. Students as young as third grade learn how to use dichotomous keys, based on binary descriptions, to classify objects and organisms (American Association for the Advancement of Science, 1989; National Research Council, 1996). I argue that the processes of classification naturalize "order" so that anything that does not fit into the reduced order is viewed as not normal. School science emphasizes the

importance of students learning to classify using binary descriptions to understand the order and as a result, promotes the conception that all objects and organisms fit into predetermined, ordered, and natural categories and identities.

Pedagogy also contributes to the heterosexism of school science. Letts (2001) explores the ways that school science is seductive and shapes students' knowledge. Sometimes, this seduction leads to delights and pleasures, and sometimes it leads to errors, wrongs, and betrayals. For example, Letts (1999, 2001) describes several instances of typical ways that teachers can perpetuate the heterosexual stereotypes in science classes. In one case, when studying insects, a sixth-grade teacher taunts a boy for refusing to hold a cockroach, an activity that the girls in the class were willing to do. In another incident, a fourth-grade teacher makes pedagogical decisions about how to conduct an activity based on a heteronormative framework that assumes allowing a boy and a girl to touch each other has sexual overtones, while allowing two girls or two boys to touch each other is an asexual activity. Reading school texts is another pedagogical practice that perpetuates heteronormativity. School science stresses reading for information contained in the text rather than reading texts to inquire about what is missing. Snyder and Broadway (2004) make the point that textbooks that are silent on issues of non-heteronormative sexuality force teachers and students to "read straight" (Britzman, 1995). Such texts thus deprive some marginalized students of the opportunity to see themselves in the text and deprive all teachers and students of the opportunity to read critically and explore knowledge beyond the heterosexual limits (Britzman, 1995; Morris, 1998).

Finally, Letts (1999, 2001) shows that the major policy documents that guide science education are heteronormative. Teaching "Science for All" is the current mantra of science education. The National Research Council's National Science Education Standards (1996) emphasize that

Science in our schools must be for all students: All students, regardless of age, sex, cultural or ethnic background, disabilities, aspirations, or interest and motivation in science, should have the opportunity to attain high levels of scientific literacy. (p. 20)

As Letts notes, this statement does not include mention of gender, masculinity, femininity, sexuality, or minoritized sexual identities in the list of identities included in Science for All. This "'discourse of invisibility' (Rodriguez, 1997)" promotes a biased, uncritical, and partial view of science education and science education reform" (Letts, 2001, p. 268).

Queering Science Education

Queering science education means exploding binary gender and sexuality constructions, collapsing heteronormativity, and opening spaces within science education for the marginalized identities. It requires that teachers and students complexify science education by "exposing the social codes, forces, and institutional powers that interact to shape the ideas of what is normative and deviant at any particular moment" (Snyder & Broadway, 2004, p. 631). Queering science education requires teachers and students to take a queer, critical stance towards science knowledge. It requires that teachers and students question how science knowledge is created and by whom.

Queering science education means providing teachers and students with a more complete presentation of sexuality than currently exists in most curriculum materials. Curriculum materials need to show images of people with various sexual orientations and family compositions. Within

biology, for example, queering pedagogy means addressing the misconceptions that homosexuality does not occur in nature and that the only purpose for sex is reproduction. It means exploring the controversies surrounding the evidence of a genetic basis for sexual orientation, the study and treatment of HIV and AIDS, and the sanitization of sex and sexuality in the curriculum. In elementary school, it means not hiding sexuality from children. At all levels, it means providing space within the curriculum for students to see themselves and their families. Queering science education means making the invisible visible.

Somewhat ironically, queering science education may actually be congruent with many of the aims and efforts of current science education reform. Current reform efforts emphasize Science for All. Science educators and science education researchers are grappling with what teaching Science for All really means. To many science educators, teaching Science for All may mean one science for all students. However, many other science educators are examining the possible ways that school science acts to either help or hinder students from diverse and often marginalized backgrounds learn science (Aikenhead, 1996; Brickhouse, 1994; Calabrese Barton & Yang, 2000; Jegede & Aikenhead, 1999; Keller, 1999; Lee & Fradd, 1996; Letts, 2001; Lynch, Kuipers, & Pyke, 2003; Moje, Collazo, Carillo, & Marx, 2001). In some ways, these projects are steps towards queering science education because they question how science and school science are hegemonized. However, these projects fall short in that they do not consider the role that sexuality plays in constructing science knowledge or learning science. Much work has explored how science and science education are gendered (Haraway, 1999; Harding, 1992; Hildebrand, 1998; Keller, 1999; Traweek, 1999). However, little work beyond Snyder and Broadway (2004) and Letts (1999, 2001) has considered how science and science education are sexualized. Queering science education requires that science educators and researchers, teachers, and students examine how science is (hetero)sexualized, and how this helps or hinders students whose identities are constructed outside the normalized territory.

In addition, current science education reform efforts emphasize the importance of engaging students in inquiry practices. The National Science Education Standards state that school science should reflect “the intellectual and cultural traditions that characterize the practice of contemporary science” (National Research Council, 1996, p. 21). An important aspect of inquiry, according to the NRC, is that “inquiry requires identification of assumptions, use of critical and logical thinking, and consideration of alternative explanations” (National Research Council, 1996, p. 23). Snyder and Broadway (2004) refer to inquiry as a queer pedagogy. However, rather than inquiring into nature, queering science education requires teachers and students to inquire into science. It requires teachers and students to identify assumptions about what is considered normal, and by whom. It requires teachers and students to use critical and (un)logical thinking and always to consider alternative explanations for what is considered normative and natural. Inquiry as a queer pedagogy engages students in science-in-the-making, rather than learning ready-made-science (Latour, 1987; Snyder & Broadway, 2004). It also helps students see science and science knowledge in relation to the world and to their lives, preparing students to take a critical stance towards the role of science in society (Brickhouse, 1994). Inquiry as queer pedagogy thus benefits all students not just those with queer identities. Viewing inquiry science as queer pedagogy fulfills the queer theory aim of making the queer normal and the normal (in this case, inquiry) queer.

Queering science education also means changing the power and authority relationships among teachers, students, and knowledge. All too often, school science rests on an authoritative view that science is about facts, that the role of the teacher is to transmit the answers, and the

students are to memorize and regurgitate science answers on tests (De'Sautels & Larochelle, 1997; Sharma & Anderson, 2003). Teachers then wonder why students become disengaged from learning and from school (Malewski, 2001; Morris, 1998). If queering science education means inquiring into the nature of science and science knowledge, disrupting the heteronormative structures, and opening spaces for exploring new identities and knowledge possibilities, it requires that teachers become more than knowledge transmitters in the classroom. Teachers must recognize the role that sexuality and desire play in engaging with ideas, inquiring into knowledge, and motivating students to learn. Furthermore, teachers and students must view the science curriculum as more than factual information; they must make learning relevant to more than tests and closing achievement gaps. Queering science education means turning the science classroom into a space that fosters curiosity, challenges the status quo, explores the unseen, and recognizes the ways that knowledge, sexuality, and identity are related (Morris, 1998).

For example, imagine the elementary classroom studying life cycles using an open jar of flightless fruit flies rather than pictures of the stages for the fruit fly life cycle. The teacher and students become co-learners (Malewski, 2001) as wonderings are offered and plans made to explore what happens as the fruit flies mate, lay eggs, die, and new fruit flies hatch. Questions are asked about the sex of the fruit flies and mating behaviors. The teacher treats these questions openly, not rushing to hide or make judgments about what should be seen. Curiosity and passion are awakened, possibilities are explored. Students inquire not just into life cycles but also into the ways that science comes to understand the world. Together, students and teachers have the opportunity to explore and question the hows and whys of that understanding as they explore their fruit flies.

Why Queering Science Education Is Important

Current science education documents, including *Science for All Americans*, *Benchmarks for Science Literacy*, and the *National Science Education Standards*, emphasize the importance of Science for All, defined as science literacy for all citizens. They stress the economic, technological, and political necessity for all people to know and understand science. A major effort in science education is defining what science literacy looks like and how to achieve it.

According to the sociocultural perspective of learning, all learning takes place within a social context (Aikenhead, 1996; Jegede & Aikenhead, 1999; Lemke, 2001). This social context includes the shared ways of knowing, valuing, and interacting with others within a community (Aikenhead, 1996; Jegede & Aikenhead, 1999). It also includes all of the community's shared tools for making sense of the world: languages, representations, belief systems, value systems, and special practices (Lemke, 2001). These shared ways of knowing, interacting, and sense making constitute a common culture among the members of the community. Defined in this manner, knowledge construction cannot be separated from culture. The learning of knowledge must include the learning of the culture in which that knowledge resides. Therefore, science literacy means becoming literate in the culture of science and the culture of school science (Aikenhead, 1996; Jegede & Aikenhead, 1999). As explored in the previous sections, these cultures are often constructed along heteronormative lines.

The culture of science, like all cultures, has a border that helps to define it (Aikenhead, 1996). For students for whom the culture of science is familiar, for whom their dominant culture is congruent with the culture of science, crossing the border to learn science is relatively smooth. For students for whom the culture of science is unfamiliar, the border crossing to science literacy

may be difficult or impossible (Jegade & Aikenhead, 1999). For queer students, the border crossing into the culture of science may be not only difficult but also dangerous. It requires students to mask their identity and deny their sexuality in order to gain entry into the heteronormative culture of science.

For science education to achieve its goals of science literacy, opening the borders to the culture of science to students who have been traditionally excluded from learning the culture of science is imperative. Giroux (1991) explores the characteristics of a border pedagogy that challenges the traditional borders around dominant cultures. Giroux constructed border pedagogy to challenge racist borders in education. Queer pedagogy could be considered a border pedagogy to challenge heteronormative borders. For example, Giroux's border pedagogy offers students multiple referents to explore the cultural codes of a culture. Similarly, queer theory also provides referents to explore the heteronormative codes of cultures, including the cultures of science and school science. Giroux's border pedagogy gives voice to students from the position of their own identities. Queer pedagogy demands a presence for queer identities in science education. Giroux's border pedagogy deconstructs the role that feelings, pleasure, and desire play in the master narratives of education. Queer pedagogy deconstructs the role that pleasure and desire play in the construction of heteronormative knowledge and identity. Giroux re-draws the cultural borders to include those who have been marginalized and excluded. Queer pedagogy constructs spaces for queer identities within science education. Thus, opening the borders to science education requires a postmodernist approach that critiques the culture and allows those outside to cross the borders easily and safely. To ignore border pedagogy in general, and queer pedagogy in particular, is to fail in achieving the goals of Science for All.

Yet, it is important for science educators to recognize that opening the borders of science education is not a minoritizing act. It is not just those whose identities are constructed by others as marginalized who will gain from obtaining access to the culture of school science. It also means that the culture of school science will change as well. Redrawing the borders of the culture of school science decenters the culture and shifts the location of power (Giroux, 1991). As a social construct, created through interactions among people, school science reflects the values, attitudes, knowledge, and identities of those who participate in the culture. The culture of school science will change when those traditionally left out gain access to the culture (Brickhouse, 1994). Thus, opening the borders of school science becomes a transformative act.

I believe that many in the science education community deny the inevitability of the transformation of science education, and eventually the culture of science, that Science for All is creating. Science educators cannot continue to operate believing that Science for All will have no impact on the culture of school science itself. Transforming school science benefits all members of society by providing space within school science for the open and free exchange of ideas necessary for a healthy democracy. If science education is going to play a role in preparing citizens "to engage intelligently in public discourse and debate about matters of scientific and technological concern" (National Research Council, 1996, p. 13), the culture of school science must embrace the liberal democratic ideal that values space for all ideas. Queering science education makes space for the new identities, new knowledge, and new ideas necessary for citizens to engage intelligently in matters of scientific concern in a postmodern world. Queering science education opens possibilities for understanding the complexities, multiplicities, and power dynamics that operate within science education and within the public scientific discourse. Thus, queering science education is a universalizing act. Science education for a liberal democracy requires queer Science for All.

Queering the Normal—New Possibilities

I am sitting in a chair across the desk from the principal, feeling very uncomfortable and vulnerable. This is the second time in less than two years, in two different schools, that I am having this same conversation with a school principal.

“No, you can be assured that I do not discuss my sexuality in the classroom,” I say quietly.

“I didn’t think so. Maybe you should.”

Did I just hear him right? Did he just say I should come out in the classroom?

“I think it would be good for the kids,” he says. “They need to see more gay people in real life. They need to understand that the vandalism that happened today was wrong. They need to feel your pain, in order to understand why it was wrong.”

I am shocked; I don’t know what to say. My mind is thinking, “This is so queer.”

He continues, “The closet doesn’t help anyone, not you, not me, not the students.”

Finally, I ask, “But what about the parents? What about the school board?”

He laughs. I think, “This is definitely queer.”

He says, “They need to understand that this school is about opening possibilities, not closing them down. We all learn from each other, and the only way we can do that is if we can be ourselves. All of our students are constructing identities. They need to see many identities, not just straight man and woman identities.”

“Um,” I say, not sure what to say next.

“You should know that I support you. I think that we need to make this school a place where you can come out to your students. Then, your students will see you as a more real person. They will probably connect more with your science teaching and maybe even learn more science. They may find the passion for learning.”

I politely say, “Thank you.” I walk out of the office weak-kneed. I think to myself, “What a queer world! There are lots of possibilities.”

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