The Effects of Culture on Student Questioning in the Science Classroom

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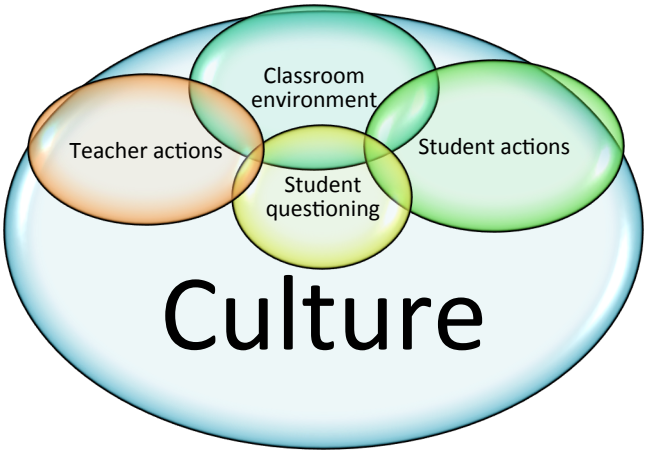
Abstract

This paper explores the effects of culture on student questioning in the high school science classroom. An essential part of learning in the high school science classroom is student questioning, yet cultural background may inhibit some students' willingness and comfort with asking questions. Because inquiry is so crucial to student learning in the science classroom, teachers benefit from learning the cultural tendencies of their students and how that may affect student questioning. The effects of culture on student questioning in the high school classroom may be examined using a cultural psychological lens, specifically through the framework of one of Hofstede's (1980) cultural dimensions, power distance. Through this exploration, we also offer suggestions for creating a comfortable science classroom environment for students of all cultures to ask questions.

Asking questions is an important task in the quest for knowledge, particularly in the field of science. Both novice and expert scientists ask questions as they construct their own meaning of scientific information and evidence. The National Science Education Standards (NRC, 1996) call for an emphasis on scientific inquiry in the classroom. As a result, science teachers must find effective means to teach their students the art of scientific questioning. Yet, often students' cultures dictate behavior that interferes with the important skill of student questioning. Current research does little to shed light on the intersection of culture and scientific questioning. This gap in our understanding may be filled by applying theories of cultural psychology to education, and specifically,



scientific questioning.

The emerging field of cultural psychology has moved from simply observing cultural differences to researching the "centrality of culture in understanding the psychology of human beings" (Adamopoulos & Lonner, 2001, p. 19). Researchers use cultural psychology to advance the understanding of a person in a sociocultural context (Adamopoulos & Lonner, 2001). Cultural psychology tells us that human behavior is dictated by culture, which is often "invisible and unnoticed" (Matsumoto, 2001, p.3). Culture is intertwined with identity (Hall, 1976). Therefore, the lens of cultural psychology can be useful in helping teachers and students understand cultural influences on discursive interaction.

One theory in cultural psychology applicable to understanding students' behavior is Hofstede's (1980) cultural dimensions. Although Hofstede's (1980) cultural dimensions were originally applied to the work force, their application to student-teacher interaction is easily transferrable. Examining Hofstede's cultural dimensions theory proves useful in exploring reasons behind cultural barriers to questioning. This paper will explore the effects of culture on student questioning in the high school science classroom using a cultural psychological approach, specifically through the lens of Hofstede's cultural dimension of power distance.

Questioning and Inquiry

National Science Education Standards emphasize authentic student-generated questions as a central strategy for teaching science (National Research Council, 1996, p. 31). Current science reform efforts worldwide focus on the nature of science. Nature of science refers to a constructive epistemology in which one makes his or her own meaning in science which is a unique way of thinking (Lederman & Zeidler, 1987). Some of the qualities that make scientific thinking unique are the tentative nature of science, the important role of observations of the nature world, the subjectivity due to reliance on theory, and the role of imagination and creativity (Lederman, 1998). The National Research Council (NRC, 1996) advances scientific inquiry as an approach for teaching the nature of science. The key aspects of the inquiry approach are questioning, using evidence to develop and evaluate explanations, and communication of findings (NRC, 2000).

Researchers have developed a variety of typologies for questions. Some have focused on a cognitive level, such as Bloom's taxonomy (Bloom, Engelhart, Furst, Hill, *&* Krathwohl, 1956; Krathwohl, Bloom, & Masia, 1964). Good, Slavins, Hobson, Harel, and Emerson (1987) categorize questions by purpose such as explanatory, procedural, clarifying, information seeking, diversionary, etc. Asking questions demonstrates a student's engagement in his or her own learning and is therefore crucial to learning science (Chin & Osborne, 2008; van Zee, Iwasyk, Kurose, Simpson, & Wild, 2001). Inquiry based science, therefore, requires the student to take on a primary role in guiding the learning.

The majority of questioning research focuses on teacher questioning, but a body of research on student questions exists. Research on student questions in science falls into four major categories according to Chin and Osborne's (2008) literature review. Those categories are: the role of the questions, the nature and type of the questions, the effects of teaching students questioning skills, and the relationship of student questions with other variables such as learning styles. Students ask questions for many purposes, some positive, some negative. Our paper focuses on content- and knowledge-oriented questions rather than procedural-or attention-seeking types of questions.

> For students learning science, their questions have the potential to (a) direct their learning and drive knowledge construction; (b) foster discussion and debate, thereby enhancing the quality of discourse and classroom talk; (c) help them to self-evaluate and monitor their understanding; and increase their motivation and interest in a topic by arousing their epistemic curiosity (Chin & Osborne, 2008, p. 3).

According to Chin & Osborne (2010), students ask questions because of a gap in knowledge, although not all students who have a gap in knowledge ask questions. Asking questions is a form of metacognition, in which a student identifies what he or she knows or does not know and also makes connections with other ideas. Questioning also leads to discourse and many have emphasized the importance of discursive interaction to the making of meaning in science (Chin & Osborne, 2010; Roth & Bowen, 1995; van Zee et al., 2001). Questions form the basis of dialogue by which students construct meaning through evidence based arguments, another important aspect of inquiry based learning (Chin & Osborne, 2010).

Despite numerous studies that demonstrate how instructional techniques can enhance student questioning, this method of student learning is not commonly used (Chin & Osborne, 2010; Dillon, 1988). Dillon's (1988) observations of science classrooms noted how little student questioning was actually occurring. As a result, much subsequent research has addressed teacher behavior and instructional strategies to encourage student questions, however, instructional strategies alone will not be successful if social or cultural barriers to questions are not addressed.

Very little research has been done to determine potential barriers that individual students might have toward asking questions. Chin and Osborne (2008) mention cultural barriers to student questioning, but do not specify what those barriers might be or suggest ways to overcome them. However, two notable exceptions are Good et al. (1987) and Carlsen (1991). Good et al. (1987) conducted a study to see if students of varying ability levels ask questions differently and whether gender and grade level modified effects. They examined all types of questions, not just knowledge seeking, and determined that as age increased, students of lower ability asked fewer questions. Although the study by Good et al. (1987) identified age as a barrier to questioning, cultural dimensions were not included in this research. Similarly, Carlsen (1991) was one of the first to look at the context for student questioning rather than the content and process of questioning. Carlsen applies a sociolinguistic paradigm that looks beyond the content and subject matter in questions and examines the relationships between the speakers and how what is said fits together into a discourse. He includes the speakers' roles, including their authority and power. Carlsen (1991) notes that "from a sociolinguistic perspective, teacher questions can be viewed as mutually generated by teachers and students (rather than exclusively teacher-generated) and may reflect and reinforce authority relationships in the classroom" (p. 159). Carlsen's work is one of the first to acknowledge how culture might impact a student's comfort level and experience with asking questions in a classroom setting. He describes participation structures which are arrangements of speakers, listeners, and the rules of discourse. Miscommunication results if these rules and structures are not understood by all participants (Hofstede, Hofstede, & Minrov, 2010).

Culture and the Classroom

Culture can be defined as learned beliefs and values shared by members of a society (Barrett, 1984). An entity in society can take many forms: individuals, families, work, and schools (Hofstede et al., 2010). Scherr (2010) notes that schools automatically infuse culture and nationalism in students; schools "bring forth collective identities" (p. 229). Culture is embedded in schools and therefore in students; culture influences all aspects of education, from instructional philosophy, to classroom environments, to discursive interaction.

In the American classroom today, teachers can expect students from a variety of backgrounds. International students, English language learners, and English-speaking ethnic minorities may have different expectations for themselves and their teachers. Schutz (2008) noted that because the American educational system espouses a middle class discursive style, even students native to the United States, but of the working class, may have varying approaches to questioning. Needless to say, international students and English language learners may also fail to engage in middle class discursive style common to the American educational system.

Hofstede's Power Distance

Hofstede's (1980) study on cultural dimensions provides an applicable theory to student questioning in the high school science class. Hofstede notes that although people have individual personalities, they often follow a pattern of habits and behaviors that can be called a "national culture" (1980, p 39). As a cultural psychologist, Hofstede was interested in why an international company, IBM, solved identical problems in such different ways. Hofstede's (1980) work found four major components of a culture he called "dimensions of culture" (p. 34), that can be measured relative to other cultures: power distance, collectivism versus individualism, femininity versus masculinity, and uncertainty avoidance. The dimension that relates mostly to students' approach to questioning is power distance. Power distance reflects the emotional distance that separates subordinates from their bosses (Hofstede et al., 2010). The power distance dimension shows how subordinates expect and accept that power is distributed unequally (Hofstede et al., 2010). The relationships represented in the power distance dimension translate for educators into students (subordinates) and teachers (bosses).

National cultures land along a continuum which ranges from large-power-distance to small-power-distance (Hofstede et al., 2010). In the large-power-distance situation, there is great distance between children and parents. Respect towards elders is overt and usually formal, and lasts through adulthood. Individualism is discouraged and dependence on seniors is a pattern. Generally speaking, inequalities between people are expected and desired (Hofstede et al., 2010). In educational systems of large-power-distance cultures, teachers are treated with respect or even fear. Teaching is teacher-centered, with the teacher initiating all communication. Examples of large-power-distance cultures are Japan, China, South Korea, and Mexico, which American teachers often encounter in their high school science classrooms.

In contrast, in the small-power-distance situation, there is little emotional distance between children and parents. Children are treated as equals as soon as possible. Independence is admired and encouraged at an early age. In educational systems of small-power-distance cultures, teachers and students are more equal. Students ask questions if they do not understand something; discussion, disagreement, and even argument are common forms of discursive interaction (Hofstede et al., 2010). Examples of small-power-distance cultures are the United States and most Anglo and

Northwest European countries, such as England, Norway, Sweden, and the Netherlands (Hofstede et al., 2010).

Barriers to Questioning: Power Distance and Discourse Patterns

Teachers can apply Hofstede's cultural dimensions theory, specifically, the power-distance dimension, to students' comfort with questioning. Many large-power-distance cultures we see in our American high school science classrooms have Confucian roots. According to Lee and Carrasquillo (2006), Confucianism values absolute obedience to parents, elders, and teachers. In Korea, for example, the authority of the teacher is on the same level as the king, in other words, the highest social position in society. Aldridge, Fraser, Taylor, and Chen (2000) found that Taiwanese students question content and process less than Australian students because of the respect for the teacher. Lee, Chang, and Tsai (2009) explore students' perception of authority in the Taiwanese science classroom. That study found that many students have a preference for a teacher-centered authority, despite the fact that curriculum reforms in Taiwan call for more student-driven learning. Students with a preference for a teacher-centered authority may believe that this is the only effective pedagogical strategy and may not adapt well to an inquiry-based classroom (Lee et al., 2009). In Taiwan, due to the competitive school culture, non teacher-centered methods of teaching such as inquiry are perceived as less effective (Aldridge et al., 2000). A study by Lee and Carrasquillo (2006) confirmed previous studies showing that Korean students view professors as having absolute authority of class. Students who sense what they consider uncertain authority in the classroom may become passive (Lee et al., 2009). Because large-power-distance cultures emphasize silence from students and an imparting of wisdom from teachers, American teachers may encounter a disconnect between their inquiry-based science class environment and student engagement. Student questioning in relation to authority has profound cultural implications in an inquiry-based science class.

Discourse patterns of both asking questions and answering questions have cultural roots. Althen (2003) notes that questioning in the American classroom is a sign that a student is developing; he has "a mind of his own" (p. 108). In the American classroom, a questioning student is admired, as this communicative style is productive rather than receptive. In fact, the back and forth *repartee* communication style, so common in American discourse, facilitates learning the skills of analysis and synthesis as well as applying those skills to the process of discovering new knowledge (Althen, 2003). These discourse qualities reflect small-power-distance cultures.

For students from large-power-distance cultures, this questioning discourse is taboo. Asking questions, for example, is considered rude and disrespectful for large-power-distance cultures. In Confucian cultures, the concept of filial piety prevents students from challenging the authority figure in the classroom (Thomas, 2006). In Japan, students would rather ask each other for clarification than ask a teacher (Flaitz, 2003). Likewise, in Mexico, questions from students are unlikely as the instruction style is teacher-centered and lecture-based (Flaitz, 2003). In most Confucian-influenced cultures, students risk appearing unintelligent if they ask a question, as questions are indications of not knowing the material (Flaitz, 2003). A reason for student silence may come from not knowing how to say something versus not knowing what to say (Johnson, 1997). In fact, Confucianism emphasizes silence and discourages students from asking questions of teachers (Lee & Carrasquillo, 2006). In the American high school

science classroom, where scientific inquiry is central to the nature of science, students who do not master the art of questioning, whether for scientific inquiry or simply for information, the lack of questioning skills is detrimental to learning.

Questioning's counterpart, answering, can also be challenging for students from large-power-distance cultures. Answering techniques utilize varying strategies and purposes for students, some which may be awkward in the American discursive-style classroom. For example, Japanese and Native American answering techniques require thoughtful reflection (Scarcella, 1990). For a Japanese student, not taking time to consider a teacher's question indicates that a question is not worth considering, which is highly disrespectful (Flaitz, 2003). This long period before answering can be misleading in the American classroom, because long silences may be both uncomfortable and an indication that the student does not know the answer (Althen, 2003; Johnson, 2003). Not knowing an answer, however, also has cultural implications. In the Japanese culture, an incorrect answer is not worth the risk of embarrassment. In fact, an incorrect answer reflects poorly on the teacher, who is highly respected. The Japanese saying "If the student hasn't learned, the teacher hasn't taught" (p. 66) indicates a direct failure on the part of the teacher (Flaitz, 2003). Providing an incorrect answer brings shame on a student, which in turn reflects negatively on the family (Johnson, 1997). In a large-power-distance culture which places teachers at the highest level of society, therefore, incorrect answers are strictly avoided.

Certain types of questions used in the American science classroom can be confusing to some students as well. For example, the response to open-ended questions may be bewilderment. Not only is it an unusual type of question for large-power-distance cultures, but the teacher is the sole authority in the classroom, so students are not seen as capable of imparting wisdom on other students (Althen, 2003; Lee & Carrasquillo, 2006). The emphasis on inquiry in the science classroom can be problematic for many students whose culture is other than middle class American.

Solutions and Strategies

The push toward science reform and the importance of inquiry in the science classroom require teachers to be aware of students' experience with questioning. Rather than overlooking the cultural bias toward middle class discursive patterns, Schutz (2008) recommends that educators become bridge builders between classes and cultures. If a teacher acknowledges that students may have different approaches to discursive practices such as asking questions, teachers can be bridge builders and implement classroom strategies appropriate for all students. Students enter school with a variety of experiences and abilities that determine their classroom participation and their first school experiences can further separate students (Good et al., 1987). Teachers must therefore modify the dominant classroom culture to invite participation by all or remediate students to facilitate their ability to participate.

Teachers can be bridge builders by creating an environment in which students are comfortable asking questions. Creating an environment where students feel comfortable can be difficult to create for reasons beyond inadequate cultural backgrounds in discursive interaction. Many teachers have difficulty relinquishing control of the classroom discussion (Carlsen, 1991). Yet, a sense of shared authority can help ease transition from a teacher-centered and controlled class to a more student-centered environment (Lee et al., 2009). The idea of shared authority may be difficult for large-power-distance cultures, but the environment created by the teacher has a large impact on whether or not

students will ask questions (van Zee et al., 2001). For example, establishing small collaborative groups where students interact and question each other may help to develop questioning skills and facilitate a more comfortable environment for questioning (van Zee et al., 2001). Small groups are useful because students may be engaged in questioning of fellow students rather than with the teacher, whose authority they are uncomfortable challenging.

Another solution for promoting questioning skills in science classrooms is for teachers to use explicit strategies to encourage student questioning. For example, allowing sufficient wait time and maintaining teacher silence is one of the techniques advocated by van Zee et al. (2001). Silence in many cultures, such as Japan, is desirable instead of awkward (Althen, 2003). Waiting for up to 10 seconds for a student to answer is therefore appropriate (Echevarria, Vogt, & Short, 2010). Additional teacher strategies to increase student questioning include using a KWL (Know, Want to Know, Learned) chart, encouraging brainstorming (van Zee et al., 2001); modeling questioning (Echevarria et al., 2010), providing question stems or prompts, having dedicated questioning time, and using a journal or online environment for questions (Chin & Chia, 2004). Teachers should be deliberate in their strategies for teaching questioning discourse. For example, a script with appropriate questions and responses, which can model questioning, disagreeing, countering a point, can be practiced with students who need to acquire questioning skills (Echevarria et al., 2010). Also, students generate questions more easily when dealing with familiar topics that they have worked with over a long time (van Zee et al., 2001). Without specific strategies which encourage student inquiry, teachers risk underestimating a student's ability because of differing approaches to questioning (Johnson, 1997).

Finally, cultural training for both teachers and students should not be underestimated. Teachers can provide a more positive learning environment for students when they are familiar with the background of their students. Knowing the power-distance rating of the country of students from other cultures is a starting point; this can be found in Hofstede's (1980) study. Likewise, students need training which explicitly explains the requirements of an American high school science classroom. A teacher's role in the student's training is paramount, as students' perceptions of teachers' absolute authority are embedded in many students' cultures (Lee & Carrasquillo, 2006). Teachers can help their students learn the art of student questioning as long as teachers are armed with cultural knowledge and teaching strategies which apply that knowledge.

Implications for Future Research

Future research should address questions of how nature of science reform efforts impact students who have traditionally been high achievers in science, but who have a more traditional teacher-centered classroom and traditional content-based curriculum, such as in large-power-distance cultures. Do constructivist learning models such as scientific inquiry impact various cultures differently? What strategies might ease the implementation of nature of science learning models in cultures who value the teacher as an authority figure? In addition, training models for teachers and students to learn educational norms should be designed and tested for effectiveness. Teachers will need to be the link and mentor for students to become bi-cultural in the discursive patterns of their own and their new science classroom. These considerations can provide valuable support for teachers to provide an environment where all students can learn science through authentic student-generated questions.

Hofstede's cultural dimensions were not originally designed for educational analysis. However, the application of the cultural dimensions is useful and enlightening when considering the diversity of students in our American classrooms. Hofstede's power-distance dimension, in particular, is clearly appropriate for examining the effect of culture on questioning. With deliberate intervention on teachers' parts, students of all cultures may succeed in scientific questioning in the high school science classroom.

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