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ABSTRACT

This study examines the types, uses, and roles of science assessment in a bilingual/biliterate (Spanish/English) elementary classroom in the Honduras during one unit of science instruction. Focus is placed on how one teacher used assessment to a) inform practice; b) evaluate student learning; and c) modify curricula and teaching strategies to meet the needs of bilingual students. (Author/CCM)

ISSUES IN SCIENCE ASSESSMENT IN A BILINGUAL/BILITERATE ELEMENTARY CLASSROOM

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Until recently, assessment of student learning in science was perceived as a method to test what the student had learned at the end of a unit of study and to rank student performance (National Research Council, 1996). Assessments were not viewed as tools that informed elementary science teachers of their practice nor as tools that influenced elementary science teachers' curricula or methodological choices. The goal (American Association for the Advancement of Science [AAAS], 1989; National Research Council, 1996), is for science teachers to change and broaden their views of assessment in science. In the National Science Education Standards (NSES), assessments in science "can take many forms, including observations of student performance during instructional activities; interviews; formal performance tasks; written reports; and multiple choice, short-answer, and essay examinations" (National Research Council [NRC], 1996, p. 84). Science assessments should "probe the extent and organization of a student's knowledge. Rather than checking whether students have memorized certain items of information, assessments need to probe for students' understanding, reasoning, and the utilization of knowledge" (National Research Council, 1996, p. 82). Essentially, science educators have begun to view assessment as an instructional tool rather than merely an evaluative measure.

At the same time science teachers are expected to adopt this new perspective about assessment, they are being confronted with an increasing number of linguistically and ethnically diverse science students. Hispanic/Latino children are one of the fastest growing ethnic minority groups in the US (National Center for Educational Statistics, 1990). The assessment standards in the National Science Education Standards reflect knowledge of this growing diversity in US science classrooms:

> Assessment practices must be fair. Assessment practices must be appropriately modified to accommodate the needs of students with physical disabilities, learning disabilities, or limited English proficiency. Assessment tasks must be set in a variety of contexts, be engaging to students with different interests and experiences, and must not assume the perspective or experience of a particular gender, racial, or ethnic group. (NRC, 1996, p. 85).

The NRC has recognized that assessment practices must accommodate students, like the growing number of Hispanic/Latino students in the US, who do not speak English as their first language. Additionally, the NRC has recognized that assessment practices should be less Euro and Androcentric and more reflective of other groups. Currently, many culturally diverse students, such as native Spanish speakers, "are at the mercy of curriculum test developers who are not knowledgeable about these students' experiences in and out of class. Thus, the tests [end-of-chapter quizzes and standardized tests] do not enable many culturally diverse students to demonstrate their knowledge of science" (Luft, 1998, p. 114). This disadvantage for bilingual students and the NRC's shift away from Euro-Androcentric assessment practices coincides with

Darling-Hammond's (1994) recommendation that assessments should be locally developed by classroom teachers and used more as diagnostic tools rather than static, summative evaluations.

If elementary science teachers are going to help their Hispanic/Latino bilingual students become scientifically literate they need to be familiar with new parameters of assessment. They need to understand how to choose and develop assessments that will allow their bilingual students to demonstrate their knowledge and ways of knowing. Finally, elementary science teachers need to understand how they can use science assessments to a) gather information about the unique learning needs of their bilingual (Spanish/English) students, and b) to understand how this assessment information can help them modify their teaching strategies and curricula to meet the needs of their bilingual science students in their science classrooms.

Purpose and Relevant Background

The purpose of this study was to examine the types, uses, and roles of science assessment in a bilingual/biliterate (Spanish/English) elementary classroom in Honduras during one unit of science instruction. This study focused on how one teacher used assessment to a) inform her practice; b) evaluate student learning; and c) modify her curricula and teaching strategies to meet the needs of her bilingual students.

For the purposes of this study, a bilingual science classroom was defined as an environment where a) teachers made conscious curriculum and methodology choices to emphasize both biliteracy and science content knowledge development, and b) students were developing oral and written communication skills in two languages at the same time. The classroom in this study was bilingual and biliterate (Spanish/English) environment. Students were at various levels of language and literacy development in Spanish and English: their

bilingualness and biliteracy was growing or emerging throughout the year. The teacher in this classroom was bilingual and biliterate (Spanish/English), and had intentionally developed curricular goals and teaching methodologies that were centered on bilingual and biliteracy development.

There are many different types of assessment: summative, formative, on-going, evaluative. This study, however, concentrated on the types, development, purpose and uses of on-going science assessments. This type of assessment is more diagnostic than summative. According to Darling-Hammond (1994) the diagnostic focus of on-going assessment makes it more equitable for minority or bilingual students. Through the use of on-going science assessments teachers are involved in gathering information about their students and using it to reflect on their teaching strategies and address certain problems in their curriculum.

Guiding Questions

Although research questions continued to evolve throughout the study, several guiding questions framed the study:

1. What kinds of assessment practices/tools does this bilingual teacher use during a science unit in her bilingual classrooms to gain understandings about her students' science learning?

2. What interpretations does this bilingual teacher lend to these assessments? (i.e.What do these assessments tell this teacher about her students' science learning? What do these assessments tell this teacher (if anything) about her students' second language (L2) development during science class?)

3. How does this teacher use the information gained from these assessments?

4. How does the information from these assessments affect the curriculum and teaching strategies in subsequent lessons within the science unit?

Methods

Theoretical Framework

Theoretical orientation and role of the researcher. This study was designed with a naturalistic (Lincoln & Guba, 1985) paradigm in mind. I (the 1st author) gathered data in an effort to understand the structure and essence of science assessment for one bilingual elementary teacher who taught in a bilingual/biliterate environment. This implied a phenomenological framework for data collection, data interpretation and data analysis. In using a phenomenological orientation I understood that "Interpretation is essential to an understanding of experience and the experience includes the interpretation" (Patton, 1990, p. 69). I recognized that each person's individual experiences influences his/her interpretation of the phenomena. I did not expect to find one, unanimous vision of how to effectively use assessment in a bilingual science classroom. Instead, I sought to focus mainly "on what people experience and how they interpret the world" (Patton, 1990, p. 70).

My role as a researcher, therefore, can best be described as "participant"; I actively took part in creating and influencing some aspects of the assessment experience that I researched. I experienced part of the phenomena under investigation because I helped the teacher become more aware of her science assessment practices and how to use them constructively to inform her science teaching practices. According to Wilcott (1990) I gathered my data "amongst my subjects rather than on my subjects" (p. 25).

Research Site

I have included a detailed description of the research site to clearly illustrate the classroom environment where the study was conducted. Furthermore, a thorough understanding of the research site will help delineate appropriate implications as well as limitations in this study.

The research site, the Anna Blanca Simon Bilingual School, is located in Zamorano, Honduras. At the time of the study the Anna Blanca Simon Bilingual School (ABSBS) served students in grades K-3 as well as nursery and pre-kindergarten students. By the year 2000 it will serve students through 6th grade. All of its classrooms are located within the college campus of a private, agricultural college (PAC). ABSBS was founded five years ago by parents who are employed by PAC in collaboration with teacher educators at a Research I university in the United States. ABSBS is a private school supported by parent fees, grants from PAC and private donations. All of the students have parents who are employed by the college in some manner. This does not mean, however, that all ABSBS students are Honduran. Many students have parents from countries in Central America, North America, Europe or South America. ABSBS students come from a wide range of economic backgrounds: some live in mud brick, one room houses with outdoor plumming and others live in neighborhoods with gardners. About half of the students live with parents one of whom is bilingual and biliterate (Spanish/English) and has an advanced degree (Masters or Ph.D.) in science. The other half of the students come from monolingual and monoliterate homes; Spanish is the first and only language that their parents speak and read. Some of the students from monolingual homes have parents with advanced degrees in science.

A bilingual learning environment at ABSBS is one "in which they [students] are encouraged to think, communicate, write, read, and learn in English and in Spanish...Bilingual children at ABSBS School become proficient and comfortable using both languages" (Anna Blanca Simon Bilingual School Planning Project, 1995, p. 4). The cultural context at ABSBS respects students' Latino heritage and their first language (Spanish). As a result, students are empowered to feel good about their emerging bilingualness as well as encouraged to become life-long science learners. These innovative perspectives create a unique environment at ABSBS--one that is not replicated in any other school in the region. ABSBS is considered to be a model of what bilingual elementary education in Honduras could become. Additionally, because its philosophy and teaching methodologies are based on current innovative practices used in many US. elementary schools, it could also become a model of how to adapt mainstream teaching practices and curriculum to meet the needs of bilingual elementary students in the US.

Data Collection

I collected data in a multi-age grades 2/3 bilingual elementary classroom at the Anna Blanca Simon Bilingual School in Zamorano, Honduras. The study took place during one science unit on rocks and minerals that was approximately 4 weeks in length. It was part of an on-going curriculum development project between the Anna Blanca Simon Bilingual School and it US university partner.

Interviews. I conduced formal, tape recorded interviews using a semistructured and open ended format. For each formal interview I developed guiding questions based on field observations, my written reflections and previous interviews. Additional questions that were asked during each interview were derived from the teacher's responses. Informal, non-tape

recorded conversations frequently occurred after school. These conversations/interviews were a natural part of reliving the most interesting or puzzling classroom moments of the day. Some of the ideas from these informal interviews were recorded in my reflection journal.

Observations. Every day, during classroom instruction as well as during field trips, I observed and recorded student actions, teacher actions and student-teacher interactions. My observations were guided by my research questions, but because of my commitment to grounded theory (Strauss, 1987) my observations remained open to themes and critical incidences outside these framing questions.

Journals. I kept a daily reflection journal as did the classroom teacher (my participant)[1]. The teacher and I agreed to write our reflections and questions in these journals after every lesson. However, the only entry that the teacher wrote directly after the introductory lesson was her first entry. All other entries were reconstructed during the last week of data collection. Although I believe that all the teacher's entries are valid reflections and recollections of the lessons, I feel the length of time between the lesson and the recorded reflection caused some ideas and reflections to be lost and blurred.

Participants

The teacher, Soñia[2], who participated in this study was selected based on her willingness to participate, her complete fluency in Spanish and English, her active involvement in the larger, on-going curriculum project with the US university partner and her status as primary (grades 1-3) elementary teacher. At the time of the study, Soñia was starting her fourth year of teaching at

[1] The participant is not the second author. The second author is the advisor to the 1st author.
[2] Psydonyms are used in place of all teacher and student names.

ABSBS. One week prior to the study, Soñia complete her masters degree in education through a U.S. affiliated and accredited university program[3].

Preliminary Data Analysis

Grounded theory and internal case analysis best describe the methods of analysis used during and after data collection. One theme that arose during data collection was the concept of purposeful assessment. In several different interviews, Soñia and I discussed the meaning of purposeful assessment. Soñia and I disscussed a critical classroom event during one after school debriefing session. The reflections that Soñia' shared with me that afternoon caused her to modify her teaching plans for the upcoming day. This event signaled the emergence of another theme. In essence, a combination of grounded theory and ethnographic evaluations were used in data analysis. Additionally, data from interviews, field notes and reflection journals was triangulated to support the validity and reliability of the priliminary analysis.

Limitations

The uniqueness of the research site makes this study both interesting and limiting. I have not worked with or visited an elementary science classroom in the United States where close to 75% of the students live with parents who are practicing scientists with upper level science degrees. As with most case studies, the value in this one lies in the reader's ability to make her/his own connections and identify appropriate applications to their own research or teaching. Additionally, it may be difficult for many readers to relate to a bilingual classroom environment set against the backdrop of a developing country.

[3] It was not the same university connected with the ABSBS project.

Secondly, for three consecutive months prior to this study I was involved in the daily routine of teaching in Soñia' classroom. We shared many ideas about science teaching before the study began. This sharing may have influenced Soñia actions as well as predisposed me to certain themes. Additionally, knowing some of Soñia' ideas before the study may have caused me to be unaware of the need for idea clarification and explanation. I tried to eliminate these blind spots by listening to Soñia' interviews during data collection and discussing any unclear ideas in the following interview.

Lastly, two problems with the data set limited the scope and detail of the data. First, the inconsistency of data gathering opportunities created one of the biggest challenges in this study. Although Soñia agreed to teach the rock and mineral unit at least four days a week, there were several times when she went up to eight days without teaching science[4]. Additionally, she was unavailable for interviews for over two weeks during the study. This severely hampered data collection opportunities. Second, all but one of Soñia journal reflection entries were written during the last week of the study; several weeks or days after the lessons occurred. Although all the journal entries are indeed her personal reflections, the time lapse between teaching and reflecting affected the detail and depth of the reflections. Additionally, I did not get to read Soñia' written reflections during the study because they did not exist. This hampered member checking and idea clarification. I tried to combat this by using the interviews for this purpose.

Discussion

[4] The eight days without science reduced data collection opportunities by about 25%. Data was collected for a total of five weeks.

During preliminary analysis many interesting findings about one teacher's science assessment practices with bilingual/biliterate (Spanish-English) students arose from the data. In regards to assessment tools, Soñia most frequently used informal, on-going assessments, such as anecdotal notes on individual students. In one of our beginning lessons, the goal of these anecdotal notes was to "see how detailed these observations were [the students' observations of rocks] and to see in which senses they relied to make their observations" (Soñia, 10/14/97-EJ)[5]. Accordingly, Soñia listed student names on index cards and recorded the descriptive vocabulary and the senses they used in observing and classifying their rocks. In note-taking format, Soñia recorded that "John-use hard, related to smell of a familiar place. Used a hearing test. Juan Carlos-Color, brightness, hard. No texture or shape. Chet-texture, smell, heavy, darker tone, shiny, temperature," (Soñia, 10/14/97-EJ). The last two note cards in this series were used to record general, whole-class assessments: "Students depend more on sight. They smell when reminded to use other senses. None have use of hearing. Weight was not included in their observations," (Soñia, 10/14/97-EJ). It is interesting that these general assessments do not match some of the individual assessments that she made. One student used weight to describe his rocks and one student used a hearing test to describe the sound of his rock. When asked about this conflict between written data and her conclusions Soñia said that she also used her non-recorded observations to make conclusions. This was often the case in subsequent lessons. Soñia used non-recorded, oral information gathered by listening to students share and explain their ideas to make many of her whole class assessments. Interestingly, Soñia made conscious choices about when she wanted her students to share their ideas orally and when she wanted to have students

[5] 'EJ' signifies that the quote came from Soñia' personal reflection journal.

record their ideas in a journal. Soñia did not, however, use students' written ideas to make her general assessments. She viewed assessment almost exclusively as data that was shared orally in class and that she recorded mentally or in her own writing, not written data recorded by students.

Although on-going assessments can be included as an integral part of a science lesson, Soñia did not include any of her on-going assessment strategies, time frames, or goals as part of her lesson plans; rather they were spontaneous assessments. When asked to define purposeful assessment (NRC, 1996) Soñia said that "purposeful assessment is assessment that is used by the teacher...to provide some type of information....If an assessment is given (to students), but not used by the teacher then it is not purposeful" (Soñia, 11/97-I)[6]. It was "the attention you give to the information you gather [that] is the important thing. It doesn't matter which many ways you can gather information. If it is there and you don't interpret it and use it for the benefit of your children it's just going to be information [i.e. not assessment]," (Soñia, 12/1/97-I). When asked if assessment had to be planned ahead of time to be purposeful Soñia replied "Assessment can be [created or conducted] on the spot or planned ahead of time but it all depends on how you use the data" (Soñia, 12/1/97-I). Soñia was firm in asserting that the purposefulness of a assessment in science was defined by how or if the teacher used it, rather than if it was formal or informal, planned or spontaneous, summative or on-going assessment. Purposefulness was tightly framed by the action of using the assessment data rather than the construction or intent of assessments.

Soñia' idea of purposeful assessment was closely connected to the ways she used the data from her assessments: "What you need to do is take whatever you can find and get from your students and then try to interpret and then make your instructional decisions for there to reteach,

move forward, to stop, to do something else and that's what I feel is purposeful assessment" (Soñia, 12/1/97-I). One of Soñia' central uses of assessment was as a tool to inform her teaching strategies. After one class period focused on rock hardness testing and classification, Soñia reflected on some of the confusion she noticed during group work time. She had "a group that mixed step 2 and 3 of the process[7] and did not scratch all of the samples for the penny test. I also felt that some were confused between a scratch and a streak. I tried to use *rayon*[8] and *ralla*[9] to make this clear for them, and even if some of them got it I feel the goals of the activity were not completely reached," (Soñia, 11/25/97-EJ). It was apparent to her that most students did not understand the testing procedure that she had outlined for classifying rocks and minerals according to hardness. In response, Soñia committed to "try to reteach tomorrow using a more organized way of working to help them," (Soñia, 11/25/97-EJ). That evening she developed a graphic organizer that she used during her next lesson to help students organize their testing procedure. Soñia drew this graphic organizer on large chart paper and placed in the front of the classroom so everyone could have access to it. Soñia felt that "this helped the students. They were able to go and check where they were supposed to be working [regarding their hardness testing procedures] and they kept coming to check it [the graphic organizer]," (Soñia, 11/26/97-EJ). Soñia used her informal, on-going assessment data to inform her teaching strategies. She modified her teaching plans to meet the needs of the students. Her focus on listening and observing students during work time and interpreting these actions lead to new, more effective

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[6] 'I' signifies that the quote came from an interview.
[7] A process for classifying the hardness of a controled set of rocks. Soñia wrote the hardness classifying process on the chalk board.
[8] Streak (in Spanish).
[9] Scratch or scrape (in Spanish).

teaching and learning strategies. In Soñia classroom, one of the most powerful uses of "purposeful assessment" is as a tool to indicate needed changes in teaching strategies and methods.

Implications and Conclusion

This study has the potential to inform science educators regarding the challenges of using informal, on-going assessment in bilingual and non-bilingual elementary science classrooms. Additionally, this study revealed some of the challenges of meeting the learning needs of bilingual/biliterate students in science. Identifying these challenges could help science educators modify their assessment practices and teaching strategies to more appropriately meet the needs of their bilingual/biliterate elementary students.

Yager and Penick (1983) have suggested that a variety of issues regarding teachers' limitations can contribute to a general lack of science literacy. Many teachers may have limited experience working with bilingual students and be unaware of their unique science assessment needs. Their limitations may cause bilingual students to feel excluded or misunderstood; trying to learn science with teachers and students who may not understand or accept their science ideas. Helping elementary teachers identify, plan, and use assessment practices that inform teachers when they need to modify their teaching strategies can contribute to science learning that is accessible and supportive to all students.

Science for all (AAAS, 1989) is a goal that all science educators are trying to achieve. More studies that a) address the science assessment needs of bilingual or multicultural students and b) reveal useful and inclusive science assessment practices for teachers with bilingual or

multicultural students, need to be conducted before we can say that we have truly created a science learning environment for *all* students.

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