CRESST REPORT 767

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Graduate School of Education & Information Studies
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Abstract

The present study piloted a survey-based measure of Opportunity to Learn (OTL) and Academic Language Exposure (ALE) in fourth grade science classrooms that sought to distinguish teacher practices with ELL (English language learner) and non-ELL students. In the survey, participant teachers reported on their instructional practices and the context in their science classrooms. A small sub-sample was also observed teaching a lesson in their classroom on two occasions. The pilot data were used to investigate basic psychometric properties of the survey: specifically (a) the dimensions underlying the survey items, in particular whether OTL and ALE are distinct or overlapping features or dimensions of science instruction and (b) the match between information reported by teachers in the survey, and that collected by classroom observers. Qualitative analyses of observation and teacher open ended responses in the survey informed the interpretation of the quantitative analysis results and provided useful insights for refining the survey instrument to better capture the classroom experiences of ELL students.

Introduction

The *No Child Left Behind Act of 2001* (NCLB, 2002) makes clear that states, districts, schools, and teachers must hold the same high standards for English language learners (ELLs) as for all other students, and that they are accountable for assuring that all students, including ELL students, meet high expectations. One of the problems that test developers and users face in validating the content area assessments for ELL students is to determine the extent to which the scores reflect differences in the levels of student achievement, and whether they are affected by a myriad of classroom and school environmental factors. Among these factors, differences in Opportunity to Learn (OTL) and Academic Language Exposure (ALE) may be particularly influential in the case of ELLs. Most states do not monitor opportunities to learn systematically for ELL students in content areas such as mathematics and science, and still fewer know about their exposure to academic language, even though both aspects of the learning environment can influence student performance and thus affect the interpretability and validity of academic assessments (see Baker et al., 1995; Boscardin, Aguirre-Muñoz, Chinen, Leon, & Shin, 2004; Herman & Abedi, 2004; Stevenson & Stigler, 1992).

The opportunity of ELL students to learn content area material and be to exposed to the cognitively demanding language of academic contexts can be seen as part of the larger concern for educational equity and access experienced by minority students in the United States (e.g., Callahan, 2005; Darling-Hammond, 2007), a particularly important agenda in an era of increased accountability and large-scale assessment (Moss, Pullin, Gee, Haertel, & Young, 2008). Specifically in the case of linguistic minority students' access to high-quality education, lowered academic expectations and tracking practices used with ELL students in response to their lower levels of language proficiency are agued to have deleterious effects on their school performance (Callahan, 2005). The K–12 schooling experiences of ELL students of course go on to impact their access to higher education opportunities (Gándara, 2005). Knowing more about ELL students' opportunity to learn content and receive exposure to academic English compared with those of their English-proficient or native-English-speaking peers can contribute to the ongoing discussion of how best to increase educational access for minority students.

Background: ELL Student Performance, Opportunity to Learn, and Academic Language Exposure

Multiple recent research efforts have probed the validity of assessments used with ELL students, by investigating various technical features including alignment with state standards, differential item functioning (Oller & Damico, 1991), and use of accommodations (e.g., Abedi, Hofstetter & Lord, 2004) among others. The broad picture that emerges from these studies suggests that much is left to be done to ensure the reliability and validity of the available information about ELL students' academic achievement.

One issue less commonly explored when investigating test validity for ELL students is Opportunity to Learn (OTL). In general, concern with OTL arises from the notion that students should be adequately exposed to the contents they are tested on. The precise definition on OTL depends directly on the interpretation of the term "adequately"; existing definitions range from narrow (i.e. OTL as a set of item-level coverage indicators to ensure comparability in international assessments) to broad (i.e. OTL as encompassing the educational experiences of students in the school, including curriculum, resources, teacher quality, instructional practices, and remediation efforts; see e.g., Abedi, Courtney, Leon, Kao & Azzam, 2006; Herman & Abedi, 2004; Tindal & Haladyna, 2002).

Although a broader definition of OTL may pose major challenges of conceptualization and operationalization, it also seems clear that a serious attempt at understanding the performance of ELL students in standardized assessments must include a careful look at their educational experiences in the school or classroom. The key validity question concerns the degree to which ELL students' test scores reflect *real* variation in achievement, or may be explained in terms of systematic differences in the opportunities to learn they are offered. For example, opportunity to learn the expected content material may be reduced if ELL students are taught at a slower pace, miss content classes for language instruction (i.e., attend ESL pull-out classes, or are simply not taught to the same depth of knowledge as native English-speaking students [Boscardin, et al., 2004; Francis, Lesaux, & August, 2006; Francis, Rivera, Lesaux, Kieffer, & Rivera, 2006; Gutiérrez, & Jaramillo, 2006; Herman, Klein, & Abedi, 2000]).

Cruz (2004) provides an exhaustive list of the different ways in which a highly complex command of the English language is demanded of students in order to carry out cognitive tasks in school:

> We want them to understand lectures and participate in academic conversations. We want them to comprehend challenging texts, make informed decisions based on information they have read, form rational opinions, and offer focused interpretations. We expect them to write with clarity, conviction, color, and sophisticated thought. In short we want them to express themselves intelligently, articulately, and thoughtfully (p. 14).

Thus, student performance may be impacted when they lack exposure to these academic uses of English. The low exposure may be attributed to the inaccessibility of the language used to teach content, the lack of explicit teaching of academic vocabulary and grammatical structures specific to the content areas, and unfamiliarity with the diverse range of language functions such as descriptions, explanation, summarizations, etc., used in academic settings (e.g., Bailey, Butler, Stevens & Lord, 2007; Scarcella, 2003; Schleppegrell, 2004).

Traditional classroom measures based on teacher reports of content coverage may not provide sufficient information about OTL in the case of ELL students. District and school programming ELL students receive in order to become sufficiently proficient in English varies widely and may greatly impact the degree of student access to content. For example, they may receive near exclusive instructional focus on English language development, or instead content-based ELD instruction, or even content instruction in a bilingual, native language, or English-only context. Moreover, they may receive instruction from a teacher who currently has little or no training in the teaching of ELL students (NCELA, 2008).

Because of their limited mastery of the language, ELL students may not be exposed to academic language in English to the same extent as other students in the classroom, and thus may not be as familiar with content-specific vocabulary, academic grammatical structures and academic language functions. A focus of the current study is investigating whether ALE is a separate construct, or can be seen as a particular kind of OTL.[1] These constructs are discussed in further detail below.

Research Questions and Methodology

The main goal of this study was to develop and pilot a survey-based instrument to measure Opportunity to Learn and Academic Language Exposure in science classrooms, specifically as it relates to the educational experiences of ELL students. With the data collected, we additionally set out to investigate whether OTL and ALE are distinct features of teacher practice in science classrooms, or can be thought of as part of a broader dimension of instruction. We address the following specific research questions:

1. Are there differences in the levels of OTL and ALE teachers report offering to ELL and non-ELL students in science classrooms?
2. What OTL and ALE *factors* (*dimensions*) underlie the survey items in each section of the survey? Do OTL and ALE factors identify distinct features of classroom practice?
3. Is there correspondence between OTL and ALE as reported by teachers in the survey, and information obtained through direct classroom observations?
4. Do participant teachers see the survey as providing a complete picture of OTL/ALE for ELL students in their classroom? What insights for improving the survey can be extracted from survey and observation data, and teacher reflections and comments?

To address these research questions we adopted a mixed-methods approach; we carried out statistical analyses to investigate the psychometric properties of the teacher survey (i.e. item variance, correspondence between surveys and observations, and interrelationship among different survey items and sections). We complemented these quantitative analyses with qualitative case studies of five respondents teaching science in their classrooms; the case studies provided rich contextual data to inform our interpretations of the quantitative results. The sample, instrumentation, and analytic methods are discussed in the following sections.

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[1] Student achievement is not only influenced by exposure to OTL and ALE in the formal school setting, but also at home or in out-of-school learning contexts. These are outside the scope of the current study, but are identified here as an important area of future research.

Sample

We recruited 4th-grade science teachers in California and Colorado to participate in the survey pilot in fall 2007 and spring 2008 through announcements in online forums, professional development networks, and directly through district's science offices. Two versions of the survey were created to reflect the standards for 4th grade science in the two states. Of the 97 teachers who initially volunteered to participate in the study and were mailed surveys, we received 53 surveys back, resulting in a response rate of 55%. Participant teachers received a small stipend ($30) in gratitude for their assistance with the project.

In addition to completing the OTL survey, five teachers in three schools in California agreed to allow two observers into their classrooms for in-depth observation for approximately two one-hour periods of science instruction. The five classrooms cover the range of proportions of ELL students that teachers encounter in the elementary grades, from only a handful (7%) to ELL-only (100%). These teachers received a stipend of $125 for their participation.

Constructs

Opportunity to learn. For the purpose of this study OTL was operationalized to encompass a range of factors that determine the kinds of educational opportunities students are exposed to in the classroom. We adapted the four-dimension OTL model first proposed by Stevens (1993) and later used by other researchers (e.g. Wang, 1998; Stevens, Wiltz, & Bailey, 1998). The four dimensions include *content coverage*, *content exposure*, *content emphasis,* and *quality of instructional delivery. Content coverage* refers to the extent of coverage of core content curriculum whereas *content exposure* reflects the amount of time allocated for and devoted to instruction. *Content emphasis*, captures the areas or skills are treated as a major focus in teaching. Finally, *quality of instructional delivery* refers to classroom practices and instructional strategies employed by the teachers in delivering the content (Boscardin et al., 2004; Wang, 1998). Items that capture these four dimensions were included in the two OTL sections of the survey: *Instructional Activities and Configurations* and *Instructional Emphases*.

We complemented these four dimensions with three ELL-specific facets of OTL identified by previous research at the National Center for Research on Evaluation, Standards and Student Testing (CRESST; e.g., Boscardin et al., 2004). Specifically, the *ELL Instructional Strategies* section of the survey included *second language acquisition strategies*, *ELL process strategies*, and *instruction delivery formats*. *Second language acquisition strategies* are used to provide students with tools for either making sense of the linguistic input they receive, or producing linguistic output that meets expectations for academic discourse (Boscardin et al., 2004). *ELL process strategies* are generally used to minimize the amount of linguistic input in instruction; examples include language scaffolding techniques such as use of graphics and students' primary language, and the deliberate use of extra wait time for students' responses. *Instruction Delivery Format* involves the classroom participation structures such as collaborative group work or individual seat work.

Academic language exposure. Our definition of Academic Language Exposure is informed by recent theoretical and empirical work on language acquisition and learning (see e.g. Bailey, et al. 2007; Scarcella, 2003; Schleppegrell, 2004). We define ALE as opportunity to acquire the linguistic features through which content is typically taught, specifically the extent to which students are exposed to the academic vocabulary and grammatical structures specific to scientific contents, and the diverse range of language functions used in academic settings (see e.g., Bailey et al., 2007). The survey contained three ALE sections that distinguished among three dimensions of ALE: *ALE Instructional Strategies*, *ALE Instructional Emphases*, and *Academic Language Functions. ALE Instructional Strategies* refers to the instructional strategies used to promote ALE and included scaffolding techniques used to support student responses during instruction, and opportunities to witness and participate in authentic scientific discourse (e.g., classroom visits from scientists, mock debates). *ALE Instructional Emphases* focuses on teachers' support for the development of student abilities in linguistic areas related to content learning (e.g., development of specialized science vocabulary, conveying science facts, and reading comprehension and writing skills in science). Finally, *Academic Language Functions* covers the different ways in which language is used in the science classroom (i.e. *description, explanation, definition and prediction* of scientific material and ideas).

Instrumentation

The OTL/ALE survey. Our final instrument (the OTL/ALE survey) was informed by the frameworks for OTL and ALE described above, and previous work on measuring OTL and instructional practices at NCES and CRESST (Brewer & Stasz, 1996; NCES, 2006; Borko, Stecher, et. al. 2005; Boscardin et al., 2004). Initial drafts of the OTL/ALE survey were reviewed by a small number of teachers and ELL experts who provided comments on the content, clarity, comprehensiveness, meaningfulness, and formatting of the surveys. The surveys were then modified based on the feedback provided by these reviewers to develop the final pilot survey. The final draft of the survey with nine sections and 103 items in total is presented in Appendix A: two sections (29 items) covered the OTL construct; three sections

(24 items) captured assessment practices; one section (19 items) inquired about ELL-specific instructional practices; finally, three sections (31 items) involved aspects of instruction related to ALE. For each item, two response columns were offered side-by-side for ELL and Non-ELL students respectively (with the exception of the ELL-specific strategies). In addition, the survey collected demographic information from the teachers, information about their professional background, and the classroom and school context.

OTL/ALE observation protocol: The classroom observation instrument was refined from the Academic Language Exposure Checklist (ALEC, Bailey, et al. 2007) developed at CRESST and tried to mirror the content of the OTL/ALE survey to the extent possible (See Appendix B). For rater training, we used existing videotaped science lessons as examples; raters first watched the videotaped lessons and independently rated the lesson using the observation instrument. The independent ratings were then compared between raters and major disagreements discussed and resolved.

Each of the five teachers included in observations took part in three tasks. They first completed the teacher OTL/ALE survey. They were then observed teaching their science lessons in their classroom by two trained observers on two occasions. The observers collected OTL/ALE data using the observation protocol. Finally, the teachers participated in a short debriefing interview during which they were asked to comment on the survey and help us improve it to better capture the experiences of ELL students in their classrooms. Teachers commented on clarity, burden, redundancy and overlap, and on aspects of OTL/ALE missing or not adequately captured in the survey. (See Appendix C).

Reliability of the Observation Data

For the classroom observations, if the independent ratings differed by more than one point, the two observers discussed the disagreement to reach a consensus. The consensus rating was entered alongside the original ratings for posterior reliability calculations.

To investigate the reliability of observational data, we calculated two types of rater agreement indices: *within-one-point agreement* and *exact agreement.* We first computed both inter rater agreement indices separately for each item; then we calculated average indices for each section of the survey and an overall index across sections. Table 1 presents these average agreement indices by section and overall indices for the survey as a whole. *Within-one-point* agreement was high (≥ 0.80) on average in all sections of the observation protocol. For *exact agreement*, there was greater variation across sections with agreement averaging as high as .98 and as low as .47 for specific sections. Detailed results for within-one-point agreement at the item level are presented in the tables of Appendix E. In general the results give confidence that consistency in teacher ratings across observers was adequate.

Table 1

Exact Agreement and Within-One-Point Agreement on Observation Protocols (n = 10).

	Exact agreement				Within-one-point agreement			
Section	Min	Max	Mean	*SD*	Min	Max	Mean	*SD*
Instructional activities & configurations	0.88	1.00	0.98	0.05	0.88	1.00	0.98	0.05
Instructional emphases	0.25	0.80	0.54	0.19	0.70	1.00	0.90	0.10
ELL instructional practices	0.33	0.95	0.66	0.17	0.67	1.00	0.89	0.12
ALE instructional strategies	0.14	0.80	0.47	0.22	0.71	1.00	0.89	0.11
ALE instructional emphases	0.20	1.00	0.55	0.27	0.80	1.00	0.92	0.08
Academic language functions	0.29	0.92	0.58	0.20	0.57	1.00	0.87	0.12
Overall	0.43	0.87	0.63	0.14	0.85	0.98	0.92	0.05

Note. ELL = English language learner, ALE = Academic language exposure.

Analytic Methods

We address the research questions outlined above through a mixed-methods approach combining quantitative and qualitative methods to provide complementary perspectives from the different sources of data. To address the first research question we performed a series of paired mean comparisons to investigate differences the kinds of OTL/ALE that teachers report offering to ELL and non-ELL students (to adjust for inflation in error rates when comparing means for more than 100 items we adopted a conservative alpha level of significance of 0.025.) All descriptive and inferential analyses were carried out using SPSS v.16.0 (SPSS, 2007).

The second research question involves conducting factor analyses to identify underlying constructs in the various OTL and ALE scales, and identifying areas of overlap among items for streamlining the survey. We used Comprehensive Exploratory Factor Analysis (CEFA; Browne, Cudeck, Tateneni, & Mels, 2008) to extract principal components for each scale; we then reanalyzed scales deemed multidimensional using OLS extraction (CF-Quartimax oblique rotation with Kaiser weights), choosing solutions by considering substantive interpretation and model fit (Chi-Squared, RMSEA, and TLI indices.) A second round of factor analysis then investigated the dimensionality of the instructional practices captured by the OTL and ALE indicators constructed in the first step.

To investigate our third research question (whether raters and teachers reported similar levels of OTL/ALE in the classroom), we computed a series of item-level paired mean comparisons between survey and observation data for the five classrooms that participated in observations. For each item in the survey the values reported by teachers were compared to the average rating over raters and observations. Clearly, the small sample of teachers does not allow for meaningful significance testing and thus these data are used in a descriptive sense only.

Addressing the final research question involved using case studies, debriefings, teacher observations, and review of open-ended comments on the survey to provide additional insight and context for interpreting the statistical analyses. Case studies are particularly useful for exploring hitherto poorly understood behaviors in real-life contexts by drawing on multiple sources of evidence such as observations, documents, and interviews (Yin, 2006). By focusing more closely on the interactions of teachers and students in the classroom, our case studies aim to provide a deeper understanding of the individual ways in which teachers provide students with opportunities to learn science and academic language, and the extent to which the survey might be able to capture these teaching practices accurately and validity. The quantitative and qualitative results finally inform a series of recommendations for future refinement of the survey.

Results

Sample Descriptives

The 53 teachers who responded to the survey were generally well qualified, with an average of 8 years of experience teaching science, 4 years at their grade level. Twenty-three teachers had a Bachelor's degree and 27 had a Master's degree. About 40% of respondents (22) held degrees in Education, 22% (12) in the Humanities, 16% (9) in the Social Sciences, and the rest in other areas including the Physical Sciences and Mathematics. All but one teacher was fully credentialed, and 47 held an Elementary credential. Ten teachers held ESL credentials and six held a bilingual credential. Most of the teachers reported being proficient speakers of English only, but 16 were also fluent in Spanish and 3 were also fluent in other languages.

There were large variations in in-service experiences reported by the teachers. The number of science curriculum and science methods courses ranged from 0–40, with an average of 5.6 curriculum courses, and 3.4 methods courses, respectively. General teaching methods in-service courses ranged from 0–60 and averaged 14.3 (*SD* = 16.8) courses. Finally, the number of ELL methods in-service courses ranged from 0–50, averaging 9.6 (*SD* = 11.4) courses.

Respondents reported teaching three science lessons per week on average, each lasting approximately 50 minutes, with a range of 1–5 lessons lasting 20–90 minutes each. The average class size was 26.4 students (*SD* = 7.4), split relatively evenly between boys (12.6) and girls (14.06); on average each classroom had 20 socioeconomically disadvantaged students (or about 75%) and 14 English language learners (more than 50%). Notably, ELL students comprised only 28% and 13% of the general population of 4th grade students in California and Colorado respectively (California Department of Education, 2008; Colorado Department of Education, 2009); because our study (and our survey) targeted OTL/ALE for ELL students specifically, it is not surprising that teachers who volunteered to participate had high proportions of ELL students in their classrooms compared to the general population. There was also considerable variability in student performance across classrooms, with teachers reporting between 0–80 percent of students performing at a Proficient or Advanced level in language arts (*M* = 22%, *SD* = 22), between 6–78 percent of students at a Basic level (*M* = 35%, *SD* =18), and between 0–90 percent of students Below Basic or Far Below Basic (*M* = 41%, *SD* = 25).

Research Question # 1: Teacher Self-Reported Practices with ELL and Non-ELL Students

The tables in Appendix D present descriptive statistics for all sections of the OTL/ALE survey separately for ELL and non-ELL students. A first noteworthy pattern is that teachers by and large report near identical instructional practices with ELL and Non-ELL students: of 103 OTL and ALE items, only 9 differed significantly for ELL and Non-ELL students (at $\alpha = 0.025$.) For both items that inquire about the amount of time spent on instructional activities, and those asking about emphasis of those activities, teacher responses suggest that their practice does not differ systematically for ELL and non-ELL students. Nevertheless, there are a few interesting exceptions where significant differences were detected. With respect to general opportunities to learn, teachers reported that ELL students work more one-on-one with the teacher or as an aide than their non-ELL peers (question 17). Most interestingly, teacher reports reflect a different focus in the evaluation for ELL students: specifically, in evaluating the achievement of ELL students, teachers assigned less importance to understanding of scientific concepts, use of scientific vocabulary, knowledge of scientific facts, and progress relative to class than they did when they evaluated non-ELL students (Question 20). This contrasts with effort, participation, behavior, or “prior ability” which were considered similarly for ELL and non-ELL students. Thus, while teachers reported that ELL students generally receive the same kind of OTL/ALE in the classroom, the foci of evaluation suggest these students may not be expected to demonstrate the same levels of mastery of complex knowledge as non-ELL students. This may be of particular interest considering teacher answers about standards and expectations for students in Question 23 in the survey: 49.1% of teachers reported adapting standards to accommodate students of differing abilities, and 37.7% reported making exceptions or special needs students including ELLs. Overall only 9.4% of teachers hold the same standards for all students without exceptions, while 90.6% makes some kind of allowance for individual students.

While most teachers (over 80%) reported that ELL students do not receive science instruction in their primary language, they also report very little emphasis on “English-only” pedagogical approaches. Finally, in terms of Academic Language Exposure, teachers report less emphasis on developing ELL students’ scientific vocabulary and writing skills (Question 29) compared to non-ELLs. Teachers’ reports also suggest less emphasis on reading comprehension, conveying, and drawing connections among scientific concepts (these differences are not significant at the 0.025 level however). Teacher reports did not differ significantly for ELL and non-ELL students in the remaining sections of the survey.

Research Question #2: Dimensions of Opportunity to Learn and Academic Language Exposure

The next step in the analysis involved use of factor analytic techniques to analyze patterns of inter-correlation on teacher reports of instructional practice to identify potential OTL and ALE *factors* (*dimensions*) underlying the survey items and importantly, the degree of overlap between these OTL and ALE dimensions. Table 2 summarizes the results of exploratory factor analyses conducted for each section of the survey. As discussed in the previous section and as shown in Appendix D, teacher reports of OTL/ALE for ELL and non-ELL students were nearly identical for a large majority of items; the few exceptions involved mostly practices related to student evaluation and will be discussed below. We thus discuss the analyses and results for the ELL group only: Table 2 summarizes the results of the factor analysis carried out for each section (see Appendix E for detailed results, including item loadings and factor intercorrelations.) As shown in the table, we identified four factors underlying the Instructional Activities items in the survey (Question 17) capturing *traditional, reform-oriented,* and *hands-on* approaches to instruction: Moreover, the factors capture relatively independent facets of instruction, with factor intercorrelations ranging from 0.11 to 0.33. Previous studies investigating instruction in science and mathematics have similarly identified so-called reform-oriented and traditional instructional practices (see e.g. Hamilton and Martinez, 2007). This extends to Instructional Emphasis (Question 18) where we identify instructional practices focusing on low and high levels of cognitive complexity (i.e. *memorization*, vs. *understanding* and *connections;* the correlation among the latter two dimensions is high at 0.50). Finally, we found unidimensional factors capturing teachers' approaches to classroom assessment (Question 19) and teacher perceptions of the usefulness of standardized test scores (Question 22). Teachers who do more assessment of one kind tend to also do more of the others[2]; similarly, teachers who find test scores very useful for one purpose tend to find them useful for other purposes too.

Teacher reports of ELL-specific instructional practices (Question 27) cluster around four factors that encompass activities directed at providing support for (a) *content learning*, (b) *student strategies*, (c) *oral language strategies*, and (d) *supplemental material and background*. Interestingly a single unidimensional factor captures the frequency of ALE-focused instructional strategies (Question 28). On the other hand, these activities can emphasize *general* academic language or *specialized scientific* language (Question 29), and although these two factors are strongly correlated (0.66) a unidimensional solution could be appropriate (indeed, 58% of variance is explained for by the 1st factor). Finally, teacher use of academic language functions (Question 30) clusters together functions focused on *organizing information*, *providing information*, and *higher order thinking* processes; again, these three factors are highly correlated with each other, suggesting that teachers who put more emphasis on one kind of language function tend to also do so for other functions (and implying a unidimensional solution might not be unjustified).

As mentioned earlier, the results of factor analysis of OTL and ALE items for the most part apply equally to ELL and non-ELL students. The one exception to this pattern are teacher responses concerning the importance of various criteria for evaluating students (Question 20). As shown in Table 3, in evaluating non-ELL students, teachers consider indicators of content mastery on one hand (scientific vocabulary, facts, and concepts), and on the other a combination of behavioral indicators (i.e. effort, conduct, participation) and relative comparisons to other students in the class and state. However, with ELL students, teachers seem to consider relative progress together with absolute judgments of mastery of scientific contents and concepts. The findings could suggest that teachers adapt their expectations and judgments of mastery with consideration of ELL students' relative status,

[2] Note that this assessment factor does not include standardized tests or informal (on the fly) student questioning. The factor comprises structured classroom assessment practices like quizzes, exams, peer assessment activities, etc).

which would be consistent with teacher reports that they make allowances for students with special needs in the previous section.

Table 2

Factor Analysis of Survey Items

Factors extracted	Survey item
Factors extracted: 4	Instructional activities (Q17) (χ^2_{74} = 101.86, RMSEA = 0.085, TLI = 0.76) *Traditional:* Lectures, Worksheets, Homework, Individual Work, Ability Grouping, Aides *Reform / Technology:* Articles, Discussions, Videos, Software, Internet *Reform / Language modes:* Textbooks, Presentations, Writing *Hands-on & Group:* Activities, Graphics, Paired Work
Factors extracted: 3	Instructional Emphases (Q18) (χ^2_{33} = 54.08, RMSEA = 0.045, TLI = 0.90) *Making Connections:* Relevance, Application, Connections, Background, Interest, Technology *Rote Learning/Memorization:* Test Taking Skills, Memorization *Understanding Science Contents/Concepts:* Scientific Concepts, Science Facts, Labs, Inquiry
Factors extracted: 1*	Assessment Practices (Q19) (χ^2_{20} = 26.72, RMSEA = 0.080, TLI = 0.92; 47% var in 1st PCA factor) *Classroom Assessment:* Quizzes, Tests, Peer Assessment, Self Assessment, Student Work, Other Assessment * Standardized tests, and informal assessments were dropped and considered separately
Factors extracted: 2*	Student Evaluation (Q20) (χ^2_{19} = 35.12, RMSEA = 0.128, TLI = 0.92) *Behavioral:* Previous Ability, Effort, Participation, Behavior, *Content:* Vocabulary, Facts, Concepts, Relative to Class, Relative to Standards *Different solution for Non-ELL students; see Table 3
Factors extracted: 1	Usefulness of Test Scores (Q22) (χ^2_{14} = 60.01, RMSEA = 0.251, TLI = 0.88; 76% var in 1st PCA factor) *Usefulness of Test Scores:* Assessment, Instruction, Feedback, Strengths-Weaknesses, Information to Parents, Class Work, Homework

table continues

Table 2 (*continued*)

Factors extracted	Survey item
Factors extracted: 4	English Language Learner Instructional Practices (Q27) (χ^2_{101} = 147.73, RMSEA = 0.094, TLI = 0.91) *Support content learning:* Scaffolding, Student-Teacher Interactions, Paraphrasing, Wait Time, Feedback *Student strategies*: Student-Student Interactions, Peer-Assessment, Self-Assessment *Oral Language Strategies:* Clarify vocabulary, Adapt Speech, English only, Translation, Allow Primary Language, Use Primary Language, Practice English. *Materials/Background:* Supplementary Materials, Adapt Text, Adapt Tests, Cultural Background
Factors extracted: 1	Academic Language Exposure Instructional Strategies (Q28) (χ^2_{14} = 16.35, RMSEA = 0.057, TLI = 0.99) *ALE Strategies:* Links, Scaffolding responses, Scaffolding expectations, Clarify concepts, Scientific Discourse, Language Objectives, Practice Academic Language
Factors extracted: 2	Academic Language Exposure Instructional Emphases (Q29) (χ^2_{26} = 59.22, RMSEA = 0.157, TLI = 0.89; 57% variance in 1st factor) *General Academic language:* General Vocabulary, Grammar, Listening, Reading, Essay Writing *Specialized Academic language:* Science Vocabulary, Scientific Writing, Convey Concepts, Use Evidence, Draw Connections
Factors extracted: 3	Academic Language Functions (Q30) (χ^2_{52} = 53.47, RMSEA = 0.023, TLI = 1.00; 58% variance in 1st Factor) *Sorting/organizing information:* Classifying, Comparing/Contrasting, Sequencing, Enumerating *Providing information:* Explanations, Descriptions, Definitions, Sequencing Steps, Labs, *Higher order thinking:* Causal Reasoning, Predictions, Generalizations, Inferences, Hypothesis

Next we analyzed the patterns of relationship between the factors identified in Table 2 to investigate whether common dimensions may underlie OTL and ALE instructional practices; (i.e. whether OTL and ALE are distinct features of science classrooms or can be seen as part of broader dimensions of instruction). We created indicators as the average of the items associated with each OTL and ALE factor identified in the survey (see Table 2 for the list of indicators and items). We then conducted factor analyses using these indicators as the input variables. There is moderate support for the hypothesis of a common classroom practice dimension underlying the OTL/ALE indicators: 45% of the total indicator variance is accounted for by the first factor in a Principal Component Extraction. Perhaps not surprisingly, this suggests that teachers who tend to report higher levels in the instructional indicators we have termed OTL also tend to report high levels of ALE. However, the patterns of interrelationship suggest that some aspects of instruction are more closely related than others. Specifically, the factor analysis results in Table 4 suggest that the indicators cluster around three factors that respectively reflect traditional approaches to instruction, reform (sometimes called *constructivist*) instructional practices, and ELL-specific practices. Interestingly, language mode practices initially identified as *reform-oriented* (textbooks, presentations and writing) here cluster together with *traditional* instruction.

Table 3:

Factor Analysis. Focus of Student Evaluation (Question 20)

	ELL students $\chi^2_{19} = 35.1$, RMSEA = 0.12, TLI = 0.92		Non-ELL $\chi^2_{19} = 33.3$, RMSEA = 0.12, TLI = 0.94	
Focus of Evaluation	Behavior	Content	F1	F2
Achievement/progress rel. to class	0.15	0.41	0.39	0.13
Achievement/progress rel. to state	0.29	0.21	0.44	0.09
Achievement/progress rel. to prior ability	0.79	-0.11	0.79	-0.12
Effort	0.83	0.00	0.87	-0.05
Class participation	0.83	0.11	0.93	-0.02
Behavior/conduct	0.66	0.16	0.67	0.17
Using scientific vocabulary	0.1	0.70	0.21	0.62
Knowing scientific facts	-0.18	1.06	-0.08	1.05
Understanding of scientific concepts	0.26	0.51	0.38	0.42

Note. ELL = English language learner.

Under this scenario, an emphasis on academic language is one aspect or one dimension of a broader set of reform-oriented instructional practices used by science teachers in their classrooms; these practices emphasize understanding, connections, and higher order levels of cognitive complexity and use of technology. Table 4 also presents a solution where only two factors are extracted from the indicators; in that case *ELL-specific* instructional practices would be grouped together with *traditional* instruction (while the two models fit the data similarly well, interpretation is cleaner with three factors). While ELL-specific practices are by necessity remedial from the standpoint of language, this pattern could be additionally worrisome in suggesting that teachers who emphasize ELL-instruction most (i.e. those with the most ELL students in their science classrooms) may also privilege traditional instructional approaches and target lower level cognitive skills, thus directly impacting the kinds of educational experiences of ELL and non-ELL students in those classrooms.

Table 4

Factor Analysis: Opportunity to Learn (OTL), English Language Learner (ELL), and Academic Language Exposure (ALE) Instructional Practices

	2-Factor solution $\chi^2_{103} = 196.5$, RMSEA = 0.132, TLI = 0.86		3-Factor solution $\chi^2_{88} = 168.2$, RMSEA = 0.132, TLI = 0.86		
Instructional Practice Indicator	Reform	Traditional	Reform	Traditional	ELL
OTL11 (Traditional)	-0.25	0.72	-0.28	0.51	0.37
OTL12 (Technology)	0.45	0.33	0.43	0.17	0.28
OTL13 (Language modes)	0.21	0.24	0.13	0.42	-0.05
OTL14 (Hands-on, group)	0.12	0.22	0.05	0.36	-0.02
OTL21 (Connections)	0.74	0.13	0.69	0.19	0.07
OTL22 (Rote/memorization)	0.06	0.47	0.02	0.38	0.22
OTL23 (Understanding)	0.70	-0.09	0.66	0.04	-0.05
ELL11 (Support x content)	0.22	0.44	0.26	-0.05	0.58
ELL12 (Student strategies)	-0.01	0.73	-0.01	0.28	0.60
ELL13 (Oral language)	-0.01	0.43	0.05	-0.24	0.74
ELL14 (Materials/background)	0.01	0.64	0.02	0.24	0.52
ALE11 (ALE Strategies)	0.54	0.45	0.50	0.27	0.34
ALE21 (General language)	0.32	0.41	0.16	0.86	-0.14
ALE22 (Specialized language)	0.67	0.25	0.59	0.4	0.02
ALE31 (Sorting/organizing)	0.99	-0.24	0.95	-0.06	-0.11
ALE32 (Providing info)	0.86	-0.06	0.88	-0.13	0.12
ALE33 (Higher order functions)	0.75	0.21	0.73	0.14	0.2

OTL/ALE and ELL certification. Teachers with ELL certification in theory could have different conceptions about the performance of ELL students, and the best ways of adapting instruction to better suit the needs of this group. Table 5 presents descriptive statistics and mean comparisons results for the OTL and ALE factors constructed in the previous step as reported by teachers with and without ELL certification. As before, the small convenience sample (here we compare groups of 17 and 36 teachers respectively) greatly compromises not only power but clearly also generalizability; these results can thus only be interpreted as preliminary and suggestive. The comparisons yielded only two significant albeit interesting differences (at alpha 0.05): in evaluating the achievement of ELL students, teachers without ELL certificates reported giving considerable more attention to behavioral outcomes than teachers who hold ELL certificates. In addition, ELL-certified teachers reported more frequent use of Oral Language techniques, including clarifying vocabulary, adapting speech, translation, primary language use, and practicing English, to assist ELL students in their classrooms.

Table 5

Opportunity to Learn (OTL) and Academic Language Exposure (ALE) by English Language Learner (ELL) Certification

		ELL certificate (n = 17)	No ELL certificate (n = 36)	*T*-test
Item	ELL instruction	Mean (*SD*)	Mean (*SD*)	(*p*-value)
Q17F1	OTL11 (Traditional)	2.39 (1.01)	2.48 (0.90)	0.75
Q17F2	OTL12 (Technology)	1.66 (0.72)	1.83 (0.51)	0.38
Q17F3	OTL13 (Language modes)	1.98 (0.77)	1.68 (0.84)	0.20
Q17F4	OTL14 (Hands-on, group)	3.24 (0.86)	3.19 (0.80)	0.87
Q18F1	OTL21 (Rote/memorization)	3.18 (1.01)	3.55 (0.68)	0.19
Q18F2	OTL22 (Understanding)	2.12 (0.99)	1.79 (1.00)	0.27
Q18F3	OTL23 (Connections)	3.49 (1.23)	3.56 (0.90)	0.82
Q19F1	ASS11 (Assessment)	2.37 (0.90)	2.08 (0.75)	0.25
Q20F1	**EVA11 (Behavioral)**	**3.59 (1.23)**	**4.23 (0.67)**	**0.05**
Q20F2	EVA12 (Content)	3.19 (1.03)	3.43 (0.78)	0.40
Q22F1	TST11 (Usefulness of scores)	2.51 (1.59)	3.23 (1.14)	0.12
Q27F1	ELL11 (Support x content)	4.31 (0.62)	4.17 (0.70)	0.46
Q27F2	ELL12 (Student strategies)	3.33 (1.29)	2.93 (1.19)	0.29
Q27F3	**ELL13 (Oral Language)**	**2.76 (1.38)**	**1.86 (1.42)**	**0.04**
Q27F4	ELL14 (Materials/background)	2.84 (1.03)	3.09 (1.11)	0.43
Q28F1	ALE11 (ALE strategies)	3.70 (0.79)	3.87 (0.77)	0.45
Q29F1	ALE21 (General language)	3.88 (0.81)	3.84 (0.77)	0.87
Q29F2	ALE22 (Specialized language)	3.48 (0.89)	3.60 (0.73)	0.63
Q30F1	ALE31 (Sorting/organizing)	3.74 (1.17)	4.01 (0.69)	0.40
Q30F2	ALE32 (Providing info)	3.41 (1.11)	3.82 (0.62)	0.17
Q30F3	ALE33 (High-order functions)	3.24 (1.22)	3.33 (0.75)	0.76

Overlap among items. Appendix G presents detailed results showing the correlations between the items in each of the OTL/ALE scales presented in Table 2. Examination of these correlations suggests areas where teacher self report seem to provide redundant information and can help us streamline the survey by reducing the current number of individual items (103). In analyzing these results for potential candidates for consolidation we considered pairs or groups of items with correlations over 0.60, and a substantial degree of *conceptual* overlap. For example, the item-level correlations for Question 18 point to considerable overlap among *Relevance*, *Application*, and *Connections;* these three items are closely connected conceptually as well and could be encompassed in a single item targeting teachers' efforts to relate science to the real world and to students' personal experiences. Similarly, the correlation between *Background* and *Interest* is high; teachers seem to have interpreted Background in direct relation to the students' own background notions of science, which made it very closely related to efforts to develop their *Interest* in science; these items could either be combined into one, or further clarified what Background scientific knowledge means. Teacher reports in Question 18 also cluster together *knowing science facts* and *understanding science concepts*, apparently combining the two as higher forms of learning and differentiating them from *memorization*. Finally a high correlation suggests that teachers do not differentiate between *inquiry* and *lab activities;* these can either be clarified to clearly distinguish between specific lab skills and scientific method, or combined into a broader item encompassing scientific investigations.

Peer-assessment and *self-assessment* activities (Question 19) also correlate strongly and could also be consolidated into a single item. Similar patterns of high correlation were observed in Question 20 (areas of emphasis for assessment) among items addressing *Effort*, *Participation*, and *Behavior*, and emphasis in *Science Vocabulary* and *Science Facts*; these items could be combined into one. Teachers' responses in Question 22 suggest high overlap among items that capture the usefulness of test scores teacher reports indicate tests are similarly useful for *Achievement*, *Instruction*, *Feedback*, and *Identifying areas of strength*; finally, a very high correlation exists between *Class work* and *Homework*. Of the list of oral language strategies in Question 27 *allowing students to use* and *using primary language* during instruction exhibit a considerable degree of overlap; similarly high overlap was observed among *scaffolding responses*, *scaffolding expectations* in Question 28. Under Question 29 *Grammar*, *Reading* and *Listening* could potentially be captured through a single item in a streamlined version of the survey. Finally, a large degree of overlap was observed between a number of language functions in Question 30: *classifying*, *comparing*, and *sequentially organizing information* could be consolidated into a single item; also, a high correlation exists among *explanation*, *description*, *labeling* and *organizing in sequential steps*. Finally, high overlap exists among items that capture *Inference* and *Hypothesis*.

Overall, an examination of the patterns of item intercorrelation suggests several areas where the survey might be streamlined considerably; The net number of items could be reduced by as many as 30-35 items for a reduction of about 1/3rd of the survey).

Question # 3: Correspondence between OTL/ALE in Surveys and Observations

As described in the methods section, prior to investigating agreement between surveys and observations, we investigated the consistency of observation ratings by examining inter-rater agreement indices across observers and observation occasions and at both the item and survey section level). Agreement within-1 point was consistently high across sections of the observation protocol (see Table 1), suggesting that our observation-based ratings capture teacher practice with a reasonable degree of consistency (i.e. reliability).

Appendix F presents detailed results describing the extent of correspondence between teacher self reports of OTL/ALE and observer ratings. The tables show the average observer ratings of teachers' instructional practices across observations, and compare these to the five teachers' own reports of their approach to instruction in the survey. In addition, the tables show the degree of agreement (within one) between teacher and observer reports (inter rater observation agreement is also shown for comparison).

As a general rule, the results indicate that teachers generally reported much higher levels of OTL/ALE than classroom observers. Agreement was higher in terms of general instructional activities (Question 17); however, the items in this scale were recoded to a 0-1 scale in the survey to match the observation protocol and thus agreement here is at a much coarser level (i.e. the presence or absence of a certain practice in any kind or amount in a given classroom).[3] In all the remaining sections of the survey and protocol, the results reflect lower ratings from observers than reported by teachers. This was the case across the board in the sections of *Instructional Emphasis* (mean observer rating of 1.69, compared to an average of 3.40 in teacher reports), ALE strategies (mean rating 2.47, mean teacher report 3.74), ALE instructional emphasis (2.15 vs 3.86) and academic language functions (1.63 vs. 3.86). The results with ELL-specific practices follow the same pattern (1.45 vs. 3.66) with the exception of use of *English-only instruction*, for which observers ratings indicate a much more pervasive practice (mean: 4.2 equivalent to a rating just under *always/a lot*) than reflected in teacher reports (mean: 1.8 equivalent to a little). Teacher reports appear particularly

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[3] Teachers who rated themselves between 0 and 2 were recoded as 0 and teachers who rated themselves between 3 and 5 were recoded as 1.

unreliable for this item: four of the five had reported that students did not receive any instruction in their native language (question 23) and that textbooks were available in English only (question 26).

Strikingly, across sections, observers ratings were 1.88 on average, compared to average teacher reports of 3.70. Clearly, the results can only be considered as preliminary and should be interpreted with great caution, the comparisons are based on a very small sample of five teachers, preventing generalization of the results, and more detailed analysis of the measurement properties of the observation protocol through advanced psychometric techniques (i.e. Generalizability Analysis) to identify sources of variance in ratings of teacher practice. Thus, we can only speculate as to whether the disagreement reflects different understanding of the items by teachers and observers, limited number of classroom visits, teacher over- or under-reporting of instructional activities and emphases due to memory or social desirability effects, or a combination of all these. Researchers concerned with issues of reliability and validity in the measurement of instruction and classroom practice have identified instances of each of these factors (see e.g. Shavelson, Webb, Burstein, 1985; Kennedy, 1991). Nevertheless, the consistency in the degree and direction of the differences does seem to at least provide strong suggestive evidence of a specific kind of disagreement between teachers and observers, which should be considered for further exploration of teacher practices as they relate to OTL and ALE for ELL students. Specifically, teachers report that their ELL and Non-ELL students are exposed to nearly identical levels of OTL/ALE in their classrooms, but their reports of amount, emphasis, and kinds of instruction are not confirmed by observers who visited the classrooms on two occasions, and who generally report lower average levels on most instructional practice items for both ELL and non-ELL students.

Question # 4: Insights for improving the Survey; Qualitative Data

The five classrooms observed are described as individual case studies that integrate the multiple sources of data we collected on each of them. The multiple sources included the two observation sessions that yielded four complete observation protocols from two observers at each session, the teachers' survey responses, the teachers' open-ended comments to the survey, if any, and the debriefing interviews for each teacher once the observations were completed. Two sets of two classrooms represent high-contrast cases in terms of the number of ELL students they educate, with one additional classroom containing close to an equal number of ELL and Non-ELL students.

The two classrooms with low numbers of ELLs (taught by Mrs. Troy and Mr. Grahame) were in an elementary school that has just 18% Latino students enrolled, with 12% of students school-wide participating in the free or reduced-price lunch program, and only 7% school-wide identified as ELL students (statistics reported by the Standardized Testing and Reporting [STAR] program of the California Department of Education, 2008). The school's Academic Performance Index (API) score of 887 for 2008 far exceeded the California statewide target of 800.[4] On the other hand, the two classrooms with high number of ELLs (taught by Ms. Gomez and Ms. Llosa) were from a school that enrolls 99% Latino students, all are in the free and reduced-price lunch program, and 90% are identified as ELL students. The school's API of 734, while not yet reaching the State target, exceeded the 2008 growth target set for the school by 54 points (expected growth was 6 points). Finally, the classroom with approximately equal ELLs and Non-ELLs (taught by Ms. Sato) was located in a school with 89% Latino students, 62% of students school-wide enrolled in the free or reduced-price lunch program, and 41% of students school-wide are identified as ELL students. The school's API of 724 exceeded the 2008 growth target (five points) set for the school by one point.

Clearly, the three classrooms that contain the largest number of ELL students in these case studies are located in schools that have greater economic disadvantage and lower overall academic performance than the two classrooms with fewer numbers of ELL students. However, this is not a result of poor classroom selection but of the existence of few schools that have high numbers of ELL students also reporting low numbers of students participating in a free or reduced-priced lunch program and a high API score. Often ELL students are from immigrant families with lower than average incomes, and they tend to attend schools with lower overall academic performance (Fry, 2008). Our understanding of these case study classrooms will therefore need to be tempered by the social and economic disparities experienced by students across these different schools. (Just one each of the low- and high-ELL classrooms are presented below; the remaining two classrooms are presented in Appendix H).

Science Instruction in Mrs. Troy's Classroom (Low # of ELL Students).

Background. Mrs. Troy has been teaching for 10 years which is just above the mean for the survey sample. She has a Master's degree in Education and Theatre and holds an elementary teaching credential. She has been teaching science at the 4th grade for just 2 years which puts her below half the number of years of experience of the teachers in the survey

[4] While the State target was 800, the 2008 State average API for elementary schools was in fact 776.

sample. Mrs. Troy has also had fewer specialized training courses (i.e., Science and ELL methods) than the sample overall, with just two to three courses of each. However, she reports attending "countless" general pedagogy and teaching methods courses. She is not proficient in any language other than English.

Mrs. Troy's classroom comprises 30 students, thus larger by four students than the survey average. She declined to report the numbers of boys versus girls and our observation protocol did not explicitly solicit this information. However, observers do not recall an obvious imbalance in the number of boys and girls for this classroom. This teacher also did not report the percentage of students who are at or above "Proficient" or fall at or (far) below "Basic" on the California Standards Test (CST) for English language arts (ELA). Mrs. Troy reported that no students came from economically disadvantaged backgrounds which is consistent with the STAR program demographics described above. This class has just two (7%) ELL students. According to the debriefing interview with Mrs. Troy, one is at a high level and the other is at a moderate level of English proficiency. In terms of science instruction, the class receives three to four lessons per week. A typical lesson varies from 45–60 minutes. Our observation sessions were based on two 45-minute lessons with two different pairs of observers. Lessons took place in a purpose-built science lab at the first observation and in the regular classroom at the second observation. The lab classroom had a large lab bench at the front of the room for teacher demonstrations and six work tables with high stools around which students could form small groups. In her debriefing interview, Mrs. Troy reported that the two lessons we observed were typical of her instruction throughout the school year.

Opportunity for science learning. When we observed the science lessons in the late spring of 2008, Mrs. Troy reported that most of the California Standards for Science had been covered by either herself or her co-teacher (i.e., another case study participant teacher Mr. Grahame) who specialized in the areas of Geology and other Earth sciences. She was half way to completing the standards associated with electricity after which all the science content standards for 4th grade would have been covered. Much of the sixth strand of the standards that focuses on the scientific method was reported to be covered with every science lesson (e.g., Science Content Standard 6.c. "Formulate and justify predictions based on cause-and-effect relationships."). During our observations, Mrs. Troy taught the properties of helium, carbon and hydrogen atoms (i.e., neutrons, electrons and protons) at the first session and the effects of electrically charged objects at the second session. We unanimously saw being used or available for use a variety of resources including science books, worksheets, kits, magazines (e.g., the National Geographic), computer and video resources, concept posters and science vocabulary charts, with the exception of a teaching assistant and district lesson plans. Indeed, Mrs. Troy reported having very well-resourced science classes, only lacking a teaching assistant and district level lesson plans.

All four observers noted a variety of classroom activities taking place, including teacher directed instruction, students' conducting hands on activities involving making model representations and discussing science in small groups, and culminating in completing worksheets individually. During these science classes, we consistently noted strong emphases on science conceptual understanding, basic science facts, background knowledge, conducting inquiries, and developing students' interest in science. For example, we witnessed the explicit encouragement of hypotheses testing amongst the students as they worked in small groups to build models to represent the different atoms they were assigned. However, we consistently (across observers and observations) saw less emphasis on relevance of science to society, on drawing connections between concepts and on applications to everyday life. Mrs. Troy herself reported frequent use of a comparable wide repertoire of instructional practices (e.g. lecturing, use of worksheets, hands-on activities, discussing science, creating graphic representations and working in pairs or groups) that emphasize conceptual understanding, conducting inquiry, basic science facts, background knowledge, and developing students' interest in science etc., with indeed a lesser emphasis on relevance of science to society, on drawing connection between concepts and on applications to everyday life. Our observations also bore out little or no emphasis by Mrs. Troy on test-taking skills and rote memorization of previous test questions. We witnessed no separate treatment of ELL students and Mrs. Troy reported that she makes no distinctions in her teaching practices with ELL and Non-ELL students.

The only assessment practices observed were question and answer routines initiated by the teacher. In fact, Mrs. Troy's self-reported assessment practices focus on formative assessment approaches using student responses to her questions, along with peer and self assessment, and student work in order to monitor achievement in science. In terms of what she finds important to evaluate in science, Mrs. Troy reported that achievement relative to the rest of the class, state standards and a student's previous performance are all very important in evaluating students. Understanding scientific concepts was also very important in her opinion; other factors such as effort, class participation, behavior and knowing science facts were only slightly less important aspects for evaluation.

ELL-specific science instruction: Observers consistently reported a narrow repertoire of possible ELL instructional strategies, with reliance on scaffolding student understanding of English via modeling and use of graphics and by providing many opportunities for student to teacher interactions that encouraged elaborated responses. Observers noted that the teacher used an English-only approach to instruction, never using a student's primary language, or incorporating primary language materials. In her responses to her survey, Mrs. Troy reported teaching the same science content to ELL and Non-ELL students. She did, however, report that although the same academic standards apply for everyone, she makes exceptions for students with special needs such as limited English proficiency. Her ELL specific practices include pairing her ELL students with a native English speaker, and contrary to our observations she reported frequently using a multitude of other ELL instructional strategies such as use of extra wait time, supplementary ELL materials, and paraphrasing. During her debriefing interview Mrs. Troy also indicated that she would check in with the moderate-level proficiency ELL student which was not a practice expressly stated amongst the options on the survey. As an English-only speaker, Mrs. Troy pointed out that she cannot use any student primary language strategies in her science teaching or provision of texts etc., yet she rated herself low on use of an English-only approach which may suggest ambiguity with this item or at least a different interpretation from that of the observers.

Academic language exposure. The observers were generally in strong agreement that Mrs. Troy quite frequently used many of the academic English instructional strategies on the observation protocol, particularly scaffolding techniques such as providing model responses to her questions to make her expectations explicit (e.g., "My hypothesis is…and why I think so…."), as well as provided opportunities for students to practice academic uses of language orally and in writing. During both observations, we noted moderate to high emphasis on developing student abilities across most domains of academic English including listening and reading comprehension skills in science. We did not observe extended (essay) writing in science. There was a relatively strong emphasis across the two sessions on students being able to convey basic facts, as well as explain and justify scientific ideas using evidence. Indeed, the use of language was frequently for higher-order thinking skills such as prediction, inference making, causal reasoning and hypothesis generation and less often used for less cognitively demanding tasks such as labeling and classifying science phenomena, although this may have been more pronounced during the lab session.

These observations are largely echoed in Mrs. Troy's survey responses. She reported that she very often uses all the academic English strategies except authentic uses of science or tandem explicit language objectives which she rated as moderately used only. Like the observations, she reported that her teaching emphasizes student development of the higher-order language abilities related to communicating science (i.e., conveying, explaining and justifying scientific notions and ideas) and that she placed slightly less emphasis on developing specific language skills such as science vocabulary and reading. She also reported an emphasis on science essay writing, which was however not confirmed by the observers. In terms of academic language functions, Mrs. Troy did not discriminate among them very much, rating them all as (very) frequently used.

Summary. Overall, the observer ratings bare close resemblance to those of Mrs. Troy's reported practices on the survey with the exception that the teacher survey ratings were almost always slightly higher than the observer ratings. Contrary to our observations, Mrs. Troy reported frequently using a multitude of ELL instructional strategies. However, there was greater agreement between our observations of academic language exposure and Mrs. Troy's reported use of academic English instructional strategies and emphases, with the frequent use of language for higher-order thinking skills. In her debriefing interview Mrs. Troy indicated that she thought the survey captured her instructional practices in science very well. However, she reported that it wasn't clear what she was supposed to enter for the survey item on assessment that requested percentages of students scoring at different levels on their prior CST ELA.

Science Instruction in Ms. Gomez's Classroom (High # ELL Students):

Background. Ms. Gomez has been teaching for 4 years which is half the average number of years found in the survey sample overall. She has a Master's degree in Education and holds an elementary teaching credential. She is proficient in Spanish and English. She has been teaching science at the 4th grade for 3 years which is just a year short of the average for the survey sample. Ms. Gomez did not report the number of in-services courses she might have taken.

There are 25 students in Ms. Gomez's classroom which is close to the norm for the survey sample. She has many more girls (16) than boys (9). All 25 students have ELL status and all are reported to be from economically disadvantaged backgrounds, both of which, recall, are consistent with the demographics for this school which is located within an industrial neighborhood of a large inner-city. This teacher also did not report the percentage of students who are "Proficient" or fall at or (far) below "Basic" on the CST for ELA. The class receives just two to three science lessons per week typically lasting between 45–60 minutes each. Our observations were actually based on one 70-minute lesson and one 60-minute lesson with one observer consistent across the two pairs of observers. Lessons took place in the regular classroom which was decorated to represent an under sea world and contained learning centers (i.e., dedicated areas of the classroom) set up for science, reading, etc. In her debriefing interview, Ms. Gomez described her usual practices and the two sessions were typical of this routine.

Opportunity for science learning. The science curriculum at Ms. Gomez's school has been created by teachers working in conjunction with the California Science Center and educational consultants. The curriculum covers different topics of science in-depth at different grade levels rather than revisiting the same topics each year. Therefore the California Standards for Science that focus on rocks and minerals had been covered during 2nd grade, and electricity was the focus of a future grade. When we visited in the early spring of 2008, the class had completed all the standards that were the target of 4th grade and at the first session were focusing on representing living organisms through various media. At the second session, the focus was on ecosystems and conservation of the ocean in particular.

With the exception of the teacher showing an illustration of coral from a science book and some scanned sheets of pictures from which the students could model coral, we saw no other use of resources. Some other kinds of resources were visibly available for use, including science magazines, lab materials, computer and video resources, student-made concept posters and science vocabulary charts. This inventory of resources is somewhat inconsistent with Ms. Gomez's report on the survey, particularly the availability of a teaching assistant, ESL/Bilingual aide, district lesson plans and worksheets which we had understood to be lacking from direct questioning during the classroom visits.

Both sessions followed a similar instructional routine with the teacher first providing instruction and discussing science at length with the students as a whole. The students then conducted hands on activities individually (session one) or in small groups (session two) to create play-dough and wire models of different types of coral and a poster about saving the oceans, respectively. The two sessions we observed had different emphases with the living organisms class (session one) focusing on conducting inquiry, knowing science facts, and building on background knowledge primarily, and the ecosystems class (session two) focusing on relevance of science to society and learning how scientific concepts apply to everyday life. Understanding key science concepts was inconsistently rated by observers. However, all observers unanimously agreed that both classes placed a very strong emphasis on developing children's interest in science.

Ms. Gomez reported a comparable repertoire of instructional practices on the survey. Moreover, at her debriefing interview she reported "a typical lesson consists of a read aloud or some form of text information that leads to a representation of what they have learned." She placed a strong emphasis on all aspects of learning (which at least covers the different emphases reported across the two sessions) and included a moderate emphasis on test-taking skills and rote memorization of previous test questions which we did not witness first hand. There was strong consensus between the two observers and between the observers and her survey report that Ms. Gomez focuses on formative assessment approaches using student responses to her questions, along with student work in order to monitor achievement in science. She reported that it is very important to evaluate a student's progress relative to previous performance and that it is also very important to evaluate understanding of scientific concepts, effort, class participation, and use of scientific vocabulary. Ms. Gomez had access to both state and district test scores for her students and reported finding these assessment data largely very useful for all the purposes listed on the survey, including to assess students' achievement and progress, adapt instruction and provide feedback to students

ELL-specific science instruction: The repertoire of possible ELL instructional strategies observed during science instruction was largely limited to the frequent use of opportunities for student-to-teacher and student-to-student interactions that encouraged elaborated responses. Some use of scaffolding via use of visuals and diagrams was also consistently observed, as was paraphrasing and use of extra wait time for students to respond. Ms. Gomez appeared to use an English-only approach to instruction, never using a student's primary language, nor incorporating primary language materials

Even though Ms. Gomez is currently teaching ELL students only, she reported that she would teach the same science content in the same manner to both ELL and Non-ELL students. However, she reported adapting the standards to accommodate students of differing abilities. In contrast with our observations, Ms. Gomez reported frequently using all the listed ELL instructional strategies with the exception of allowing students to use their primary language to formulate questions or herself using students' primary language to clarify their queries which she rated as moderate. The only rating that is consistent with those of the observers is the high rating given to the English-only approach. But this is seemingly inconsistent with the teacher's own reported primary language ratings mentioned above. Again, this may suggest the item is being interpreted idiosyncratically.

Academic language exposure. The two sessions yielded very different ratings by the observers, with the class on living organisms and building representations of coral largely showing little academic English instruction. Observers disagreed about the one strategy that might have been frequently used, that was scaffolding techniques to make expectations explicit such as providing model responses. Both observers noted that there was also only one prevalent emphasis during academic English instruction and that was developing student ability in specialized scientific vocabulary. In terms of academic language functions we unanimously saw only evidence of a narrow repertoire mostly used to describe scientific objects with lesser amounts of classifying and comparing/contrasting scientific processes and objects.

In contrast, during the second session observers consistently rated academic English instructional strategies as occurring far more frequently, particularly the teacher making explicit links between new concepts and student background experiences, scaffolding techniques to support student responses as well as making expectations clear and providing opportunities for students to clarify key concepts. We consistently noted a relatively strong emphasis on developing student abilities in listening comprehension skills in science, in explaining and justifying scientific ideas using evidence, and in drawing connections among students' ideas. Academic language functions most frequently observed focused on higher-order thinking skills such as prediction, inference making, causal reasoning and hypothesis generation as well as on some less cognitively demanding tasks such as enumeration and sequencing scientific information. In contrast, Ms. Gomez reported frequently to very frequently employing all listed academic language instructional strategies. She did not discriminate among the student abilities that her teaching emphasizes, rating them all as strong, and she rated all academic language functions as frequently to very frequently used.

Summary. In capturing Mrs. Gomez's science instruction practices, the observer ratings and survey ratings are very similar with the notable exceptions of the reporting of some key resources available in the classroom, and the teacher's reported moderate emphases of some low-level learning goals (e.g., test preparation) that we did not observe. In contrast with our observations of a narrow repertoire, Ms. Gomez reported frequently using all the listed ELL instructional strategies with the exception of strategies using students' primary language. The two observation sessions revealed very different academic language exposures, but even taken together they do not cover the same types or amount of academic language exposure as reported by Ms. Gomez. In her debriefing interview Ms. Gomez suggested the survey would benefit from questions about teacher attempts to integrate additional subjects with science, as well as questions that prompted for the kinds of science projects assigned to students.

Science Instruction in Mrs. Sato's Classroom (Equal # ELL and Non-ELL Students).

Background. Mrs. Sato was the most senior of the case study teachers. She has been teaching for 24 years, but only teaching science at the 4th grade for the past 2 years. She has a Master's degree in administration and holds both elementary and ESL teaching credentials. However, she is not proficient in any language but English. Mrs. Sato reported taking five in-service courses on science content, three for Science teaching methods and general pedagogy, and two for ELL teaching methods.

There are 30 students in Mrs. Sato's classroom, 5 students more than the survey average. There are 18 girls and 12 boys in the class. Six students are reported to come from economically disadvantaged backgrounds, and this class has 13 (43%) ELL students. The majority of students (80%) are at the below "Basic" or far below "Basic" levels on the CST for ELA. A further 14% are at "Basic" and just 6% are at or above the "Proficient" levels. The class is one below the norm for the survey with receiving just two science lessons per week. Lessons were reported to be 40 minutes in length. However, the two observations lasted 50 minutes. The same two researchers observed the classroom on both occasions.

Opportunity for science learning. Mrs. Sato was in the process of teaching the properties of rocks and minerals at the first observation session and other Earth science concepts at the second session in early spring, 2008. When she completed the survey in the late fall of 2007, Mrs. Sato planned to cover the majority of the California Standards for Science having covered only Standard 1.a . (designing and building simple series and parallel circuits). The first session included experimentation with minerals (e.g., discovering their properties, such as graphic producing black marks on paper), and the second session focused on creating a diagram of Earth's layers. The first session used a wider range of resources, including science books, science kits, lab materials, concept posters and science vocabulary charts. The second session employed just concept posters and vocabulary charts. Computer and other technology types were not used at either session but were available in the classroom. A teaching assistant, ESL/Bilingual aide and district lesson plans were not available. These are extremely consistent with Mrs. Sato's survey responses. Mrs. Sato reports having a reasonably well-resourced science class (has available but never uses computer technologies) but in her debriefing interview notes that the first session was not typical in that she did not have the necessary materials for minerals experimentation and had to provide her own.

The two sessions were initiated with a similar instructional routine with the teacher first providing instruction and discussing science with the students as a whole. At the first session students were also referred to a page of text in their science textbooks. The students then conducted a hands-on activity in small groups to carry out their experiments with minerals. In session two, they completed a worksheet by creating and coloring a diagram of Earth's layers. The observers consistently reported that the two sessions had similar emphases on knowing basic science facts, building on background knowledge and developing children's interest in science. The observation of the experiment also had a strong emphasis on how science concepts apply to everyday life.

Mrs. Sato reported a relatively limited set of instructional practices that are consistent with our observations of her classes, with reading a science text book, hands-on activities and working in pairs or groups taking place the most frequently but nevertheless just once per week. However, in contrast to our observations, she only reported low to moderate emphases on all the targets of instruction and consistent with our observations placed no emphasis on using technology as a scientific tool.

We did not observe any assessment practices during the two science classes but Mrs. Sato reported using most frequently weekly assessments such as checklist and rubrics, as well as formative assessment approaches using student responses to her questions, along with self assessment, and student work in order to monitor achievement in science. She reported as primarily only moderately important all the possible areas of evaluation in science class (e.g., progress relative to the class, effort, using science vocabulary, etc.). However, she reported finding standardized test scores that she has access to as useful to a large degree for all the purposes included on the survey, but mainly useful for assessing students' achievement and progress, adapting instruction, provide feedback to students and parents and for identifying areas of strength and weakness.

ELL-specific science instruction. Both observations consistently revealed a narrow repertoire of possible ELL instructional strategies, with reliance on scaffolding student understanding of English via modeling and use of manipulatives, by providing many opportunities for student to teacher interactions that encouraged elaborated responses, by paraphrasing and use of extra wait time. Observers noted that the teacher used an English-only approach to instruction, never using a student's primary language, or incorporating primary language materials. Although Mrs. Sato has relatively large numbers of both ELL and Non-ELL students in her class, she reported the same responses for teaching ELL students as for teaching Non-ELL students. Nor does she group her students differently because of language proficiency, rather she groups her students by how well they get along together (i.e., for behavior reasons). She reported that while the same academic standards apply for everyone, she makes exceptions for students with special needs such as limited English proficiency. In her debriefing interview, Mrs. Sato reported that both her ELL students and her Non-ELL students have low proficiency in English and she has to go slowly, use a lot of repetition and lots of defining of even simple words.

There are both consistencies and inconsistencies in what observers noted and Mrs. Sato's reported use of ELL instructional strategies. While there is a high degree of correspondences for use of scaffolding and providing opportunities for student-to-teacher and student-to-student interactions that encourage elaborated responses, as well as deliberate use of wait time and use of paraphrasing at the second session, ratings for other strategies showed less correspondence. The most noteworthy are Mrs. Sato's report of using some primary language during instruction and correspondingly virtually no English-only approach. Observers saw no primary language usage and consistently rated as "always" on the item about the use of an *English-only* approach.

Academic language exposure. At both sessions, the observers were in agreement that Mrs. Sato moderately used many of the academic English instructional strategies, particularly making explicit links between new concepts and students' background and past learning, using scaffolding techniques to support student responses as well as making teacher expectations explicit. She provided frequent opportunities for students to practice academic uses of language both orally and in writing. During session one and the mineral experimentation, Mrs. Sato also frequently made language objectives explicit in addition to science knowledge objectives. During both observations, we consistently noted a strong emphasis on developing student specialized vocabulary in science, as well as moderate emphases on listening comprehension skills and on students being able to convey basic facts. Language Mrs. Sato used, most frequently functioned to describe, compare/contrast, label, and define, and in the case of diagramming Earth to also explain geologic processes, rather than function in support of higher-order thinking skills, such as prediction or hypothesis generation. This is surprising given the experiment conducted on different types of minerals.

Although Mrs. Sato's reported academic English instructional strategies largely mirror those of the observers in terms of type and frequency, there are inconsistencies between the observations and Mrs. Sato's report on the degree of emphases of instructional practices and which academic language functions are employed. She did not discriminate across emphases at all, reporting all as moderate. She also reported moderate usage of language functions and discriminates among them only slightly by reporting a little less use of classifying, comparing/contrasting, and causal reasoning. In both her response to the open-ended prompt for further comment on the survey and in her debriefing interview, Mrs. Sato reported that she has less time to teach science than she used to have. Some of the items mentioned on the survey she felt she simply did not have time for. This is despite the recent addition of science to the required annual assessments (NCLB, 2002). She also reported that the ELD program that she is required to teach incorporates science but the content is not linked to the 4th grade California Science Standards.

Summary. Overall, the limited set of instructional practices that were observed at both sessions are consistent with Mrs. Sato's survey report. However the narrow repertoire of ELL instructional practices observed is not replicated by the survey responses in which Mrs. Sato reports frequently using a variety of strategies including student primary language strategies while she herself reported not being proficient in any language but English nor has the help of a bilingual aide. Measures of academic language exposure varied in the degree of agreement between observers and survey responses, with strong agreement between observed and reported frequency and type of academic language strategies, but far less agreement on the emphases of instructional practices and academic language functions due to a lack of discrimination between items on the survey

Summary and Implications for Survey Development

In this section we summarize the results of our study and discuss the lessons learned and implications for further development and validation work. We presented the results of piloting work aimed at refining and validating a survey-based measure of Opportunity to Learn (OTL) and Academic Language Exposure (ALE) in Science. Our study was based on a small pilot sample for surveys (53 teachers) and a smaller subsample for classroom observations (5 teachers) and thus the results can only be interpreted as preliminary and suggestive of next validation steps for the survey instrument. However, some of the results point to areas that seem to hold potential for contributing to our understanding of ELL instruction, and of the educational experiences of ELL students in general, and thus warrant future investigation.

Summary of Quantitative Results

1. Teachers largely report very similar instructional practices with ELL and Non-ELL Students. However, ELL students may not be expected to demonstrate the same levels of mastery of complex knowledge as others: our sample of teachers reported giving less attention to understanding concepts, using scientific vocabulary, knowing scientific facts, and learning progression relative to other students in the class when evaluating ELL students.

2. Our comparison of survey reports for teachers with and without ELL certification yielded few significant differences (though they were affected by low power due to small sample size). However, the differences observed are interesting: ELL-certified teachers report less emphasis on behavioral outcomes when evaluating ELL students, and greater emphasis on helping ELL students through oral language interventions (e.g. clarifying vocabulary, adapting speech translation, or allowing primary language).
3. Teacher reports of their own instructional practices differ consistently and substantially from those of observers who visited their classrooms. Specifically, teachers consistently report more frequent use of a large number of instructional approaches, and greater emphasis on many aspects or dimensions of instruction than was apparent to the observers during their classroom visits. Granted, differences in frequency could partly reflect the periods covered by the reports (all year for teacher reports in the survey, two visits for the observers); however, these differences are consistent, if not greater, for items that capture instructional emphases on OTL and ALE (as opposed to frequency). Overall, the results seem to suggest a social desirability effect that results in teacher reports of their own instructional practice that are consistently more positive than reported by observers.
4. Item Factor Analysis of the within sections of the survey yielded a series of OTL/ALE factors reflecting instructional practices and emphasis. Some of these mirror the results of previous studies that have reported factors capturing traditional and reform-oriented instruction. The FA results were similar for ELL and Non-ELL students with one exception: in evaluating ELL students' teachers consider the student behavior on one hand, and relative performance and understanding of scientific on the other. With Non-ELL students, mastery of substantive content is considered on its own, and relative comparisons and behavioral outcomes are a separate dimension. It is not clear how this difference should be interpreted, however, since teachers may combine absolute and relative criteria for different purposes in evaluating ELL students (i.e. a comparison to other ELLs could compensate for low absolute performance; but a comparison to the rest of the class may tend to penalize ELL students).
5. Factor Analysis of the OTL/ALE indicators suggests that instructional practices targeting Academic Language (ALE) tend to occur and be emphasized in classrooms alongside reform-oriented instructional practices such as a focus on understanding and making connections among concepts or using technology to support learning. This suggests that the nature of ALE practices is closely related to instruction that focuses on and targets higher-level cognitive processes and understanding of contents. The close relationship between ALE and some features of quality instruction in science suggests that both ELL and Non-ELL students might benefit when teachers make ALE part of his or her instructional practices in the classroom.

6. Factor Analysis also indicates that ELL-specific instruction is a separate dimension of instruction; however, instructional practices targeting ELL students are more closely related to so called *traditional* instructional approaches, and instruction that targets low level learning (e.g. memorization of facts) than they are to reform-oriented approaches. This trend would seem to be exemplified by a comment from a teacher in the open ended section of the survey who said about ELL instruction: “Unfortunately I don't have low ELL students, so I don't have to do much extra for them. I do have a low class in general, so I use some ELL techniques in my overall teaching.” While perhaps not surprising these kinds of perceptions (if widespread) would nonetheless be worrisome as they inherently equate instructional approaches that address language limitations with instruction that targets low achieving students.
7. The patterns of intercorrelation suggest that the survey may be streamlined considerably by consolidating as many as one third of items that provide redundant information.

Lessons Learned from the Case Studies and the Survey Responses

While inconsistency between observations and teacher survey responses could be a function of the small number of science lessons observed (i.e. any narrow repertoires witnessed could reflect a lack of opportunity to see a teacher’s full range of strategies in just two sessions), the quantitative results overall suggest that social desirability may play a role in teacher reports of their own practice. Another reason for inconsistency may be a lack of discrimination in rating items (i.e., circling all items as high emphasis without realizing the “directionality” of some items is reversed); or even misinterpretation of items.

(a) For example, “English-only” was meant as indicative of complete reliance on English without support for students in their primary language. Observers saw little use of the students’ primary language and rated all teachers highly on this item. However, teachers seemed to have misunderstood this item. Two teachers rated themselves as low on this item which obviously didn’t correspond with the observer ratings. One of these teachers reported using some primary language during instruction although she also reported being only proficient in English and not having a bilingual aide. Another rated herself high on English-only which is consistent with the observer ratings but inconsistent with her own report of using primary language in instruction. Finally, the quantitative analysis also indicate some confusion or inconsistency in teacher reports for this and related items: most teachers reported not offering ELL students any science instruction in their primary language, but they also reported very little emphasis on an “English only” pedagogical approach.

(b) Interestingly, in the three case studies, there was greater correspondence between observer and teacher reports of instruction for science and academic language than for ELL strategies. We are examining how these sections were constructed to determine whether they may have primed teachers to over-report on their usage of ELL instructional strategies. Items for ELL practices appear to consist of more concrete practices (e.g*., "Use of supplementary ELL materials including dictionaries and thesauruses"*), whereas the science and academic language practices appear to be more abstract and require more careful interpretation, such as the determining the importance to students for *"Learning about the relevance of science to society"* and emphasizing *"Explicit links between new concepts and students background experiences and past learning."*

(c) The case studies also revealed that teachers tended not to discriminate on the frequency of the different academic language functions, while the observers reliably detected teaching practices that favored some academic language functions over others. In the future we might take one of two possible approaches: either requiring teachers rank order the academic language functions for importance, or giving teachers a mechanism to more concretely report how often they include these functions in their science classes. For example, teachers could be asked to report how often they use these functions in their lesson plans as part of their descriptions of science objectives or tasks.

(d) Teacher reactions to and feedback about the survey on the open ended prompt for comments (Question 31) were highly informative, often helping illuminate aspects of their instruction or their classroom or school context that may not have come across in the survey. These often had direct implications for refinement of the survey.

Many teachers felt that the survey covered their instructional practices adequately and there were no suggestions of important aspects of ELL instruction omitted:

> Your survey appears to focus pretty accurately on the needs and circumstances of second language learners…Overall, I thought the survey was well done and covered many aspects of the subjects. It made me really think and reflect about my teaching of science…The survey was easy to complete and reminded me of many effective teaching practices which I can employ to promote success in my students. Thanks

However, some comments point to potential sources of misunderstanding that could have resulted in inconsistencies in teacher reports: "I'm not sure the questions were direct enough to get the information you needed." And "Some questions weren't clear in regards to… I wasn't sure what was really being asked."

Other comments speak directly to the importance of the local classroom and school context for understanding ELL instruction in science. These ranged from the specific mix of ELL students to the local policy or curricular context. Many teachers suggested adding space for explaining and providing context for their answers.

> At our school, our science time is also our low-emergent reader's intervention time….Our school has 22 languages. (This might be a good question for Section I, because it makes a big difference if all if your ELLs are of the same lang.)…This survey could be more effective if there are more questions relating to the school where we work.

Furthermore, a number of teacher comments emphasize the problems in treating ELL students as a homogeneous group. There is great variance within ELL students in terms of background and performance and this can have direct implications for instruction. Moreover, the proportion or specific characteristics of ELL students may help explain the lack of variance in teacher practices observed.

> On the ELL-Specifics practices it was hard to answer because I have different levels of ELLs…Perhaps a question about the differing ELL proficiencies would be helpful. Also grouping all my ELL students together to answer several of your questions was hard. All students are taught very similarly - then additional instruction is given as needed.

Some comments directly suggest a number of sensible improvements to the survey.

> There is a large gap between once a month and once a week. It makes it hard to choose…Perhaps a change or adaptation of the survey could be instead of having an ELL vs. Non-ELL section, maybe you could have a space for teachers to add adaptations or accommodations, if any, do you make for your ELL.

The second comment in particular is thoroughly supported by our quantitative findings showing little distinction in teacher reports for ELL/Non-ELL students.

Finally, a common thread was the length of the survey: (e.g., "Many of the questions were repetitive." "Too Long." "Very redundant." "$30 is not enough money to fill out this long and tedious survey.") These comments are actually quite reasonable and not surprising; in developing the survey we decided to include items that we considered potentially interesting even if we had questions about how respondents would interpret them, or if they appeared to overlap with other items. In our directions to the survey we forewarned the respondents that redundancy in items may exist in some cases, but that we were trying out different approaches to get at the same kinds of information. Future versions of the survey can focus on those items that yielded sufficient and reliable information in our efforts to better understand the academic opportunities of ELL students.

To conclude, the development of valid measures of OTL/ALE could be of great help in studying and clarifying the relationship between key dimensions of instruction and student academic achievement, particularly in the case of ELL students. It is also potentially important as a tool for investigating instructional practice and policies that seek to improve the educational experiences of ELL students in the U.S. These tools can also be extended to understand instruction more generally as well as the experiences of English proficient/native speakers, who may nevertheless face inequities in Opportunity to Learn and/or Academic Language Exposure in their schools leading to disadvantages for academic success.

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Appendix A:
Teacher Survey of Science Instruction (CA Version)

I. TEACER AND CLASSROOM INFORMATION

1. Including this year, how many years have you been a teacher? ______ years

2. Including this year, how many years have you been teaching science at this grade? ______ years

3. What is the highest degree you have attained? (Check one)

❑ Associate	❑ Master	❑ PhD
❑ Bachelor	❑ EdD	Other _______________

4. What was your major area of study for that degree? (Check one)

❑ Humanities	❑ Mathematics	❑ Biological Sciences
❑ Social Sciences	❑ Physical Sciences	Other _______________

5. What kind(s) of teaching credential(s) do you hold? (Check all that apply)

❑ Elementary	❑ Bilingual	❑ Emergency
❑ Secondary	❑ ESL	Other _______________

6. How many in-service courses have you attended focusing on:

Science contents/curriculum	_____
Science teaching methods	_____
General pedagogy/teaching methods	_____
Teaching methods for ELL students	_____

7. Are you proficient in a language other than English? (Check all that apply)

❑ No	❑ Cantonese	❑ Vietnamese
❑ Spanish	❑ Mandarin	Other _______________

8. Based on the CA Standards Test (CST) ELA test, what percentages of students in your science class are:

_____ % Below Basic or Far Below Basic	_____% Basic	_____% At or Above Proficient	= 100%

9. How many total students do you teach in this science classroom? _______

10. How many girls and boys are there in your science classroom? _______ girls _______ boys

11. How many of those students are English Language Learners (ELL students)? _______

12. How many of your students are from economically disadvantaged backgrounds? _______

13. How many science lessons do your students receive per week? _______

14. How long is each science lesson? _______ minutes

II. CURRICULAR CONTENT COVERAGE

15. Please indicate below the coverage of 4th grade science standards in your class. (Check one for each response)

4th Grade Science Standard	*Didn't cover and don't plan to cover*	*Covered*	*Plan to cover*	*Approximate number of lessons spent/to be spent on the topic*
1. Electricity and magnetism are related effects that have many useful applications in everyday life. As a basis for understanding this concept students will know:				
a How to design and build simple series and parallel circuits by using components such as wires, batteries, and bulbs.	❑	❑	❑	# of lessons ____
b How to build a simple compass and use it to detect magnetic effects, including Earth's magnetic field.	❑	❑	❑	# of lessons ____
c How electric currents produce magnetic fields and how to build a simple electromagnet.	❑	❑	❑	# of lessons ____
d The role of electromagnets in the construction of electric motors, electric generators, and simple devices, such as doorbells and earphones.	❑	❑	❑	# of lessons ____
e Electrically charged objects attract or repel each other.	❑	❑	❑	# of lessons ____
f Magnets have two poles (north and south) and that like poles repel each other while unlike poles attract each other.	❑	❑	❑	# of lessons ____
g Electrical energy can be converted to heat, light, and motion.	❑	❑	❑	# of lessons ____
2. All organisms need energy and matter to live and grow. As a basis for understanding this concept students will know:				
a Plants are the primary source of matter and energy entering most food chains.	❑	❑	❑	# of lessons ____
b Producers and consumers (herbivores, carnivores, omnivores, and decomposers) are related in food chains and food webs and may compete with each other for resources in an ecosystem.	❑	❑	❑	# of lessons ____
c Decomposers, including many fungi, insects, and microorganisms, recycle matter from dead plants and animals.	❑	❑	❑	# of lessons ____

4th Grade Science Standard	Didn't cover and don't plan to cover	Covered	Plan to cover	Approximate number of lessons spent/to be spent on the topic
3. Living organisms depend on one another and on their environment for survival. As a basis for understanding this concept students will know:				
a Ecosystems can be characterized by their living and nonliving components.	❑	❑	❑	# of lessons ____
b In any particular environment, some kinds of plants and animals survive well, some survive less well, and some cannot survive at all.	❑	❑	❑	# of lessons ____
c Many plants depend on animals for pollination and seed dispersal, and animals depend on plants for food and shelter.	❑	❑	❑	# of lessons ____
d Most microorganisms do not cause disease and that many are beneficial.	❑	❑	❑	# of lessons ____
4. The properties of rocks and minerals reflect the processes that formed them. As a basis for understanding this concept students will know:				
a How to differentiate among igneous, sedimentary, and metamorphic rocks by referring to their properties and methods of formation (the rock cycle).	❑	❑	❑	# of lessons ____
b How to identify common rock-forming minerals (including quartz, calcite, feldspar, mica, and hornblende) and ore minerals by using a table of diagnostic properties.	❑	❑	❑	# of lessons ____
5. Waves, wind, water, and ice shape and reshape Earth's land surface. As a basis for understanding this concept students will know:				
a Some changes in the earth are due to slow processes, such as erosion, and some changes are due to rapid processes, such as landslides, volcanic eruptions, and earthquakes.	❑	❑	❑	# of lessons ____
b Natural processes, including freezing and thawing and the growth of roots, cause rocks to break down into smaller pieces.	❑	❑	❑	# of lessons ____
c Moving water erodes landforms, reshaping the land by taking it away from some places and depositing it as pebbles, sand, silt, and mud in other places (weathering, transport, and deposition).	❑	❑	❑	# of lessons ____

4th Grade Science Standard	Didn't cover and don't plan to cover	Covered	Plan to cover	Approximate number of lessons spent/to be spent on the topic
6. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations. Students will:				
a Differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.	❑	❑	❑	# of lessons ____
b Measure and estimate the weight, length, or volume of objects.	❑	❑	❑	# of lessons ____
c Formulate and justify predictions based on cause-and-effect relationships.	❑	❑	❑	# of lessons ____
d Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.	❑	❑	❑	# of lessons ____
e Construct and interpret graphs from measurements.	❑	❑	❑	# of lessons ____
f Follow a set of written instructions for a scientific investigation.	❑	❑	❑	# of lessons ____

III. INSTRUCTIONAL RESOURCES

16. Are the following resources/materials/support used in your classroom? (Check one for each response)

	Yes	*No (But Available in Class)*	*No (Not Available in Class)*
Science books	❑	❑	❑
Science newspapers/magazines	❑	❑	❑
Science kits	❑	❑	❑
Lab equipment/materials	❑	❑	❑
Computers	❑	❑	❑
Science-specific software	❑	❑	❑
Internet	❑	❑	❑
Video resources	❑	❑	❑
Science vocabulary charts	❑	❑	❑
Concept posters	❑	❑	❑
Procedure posters	❑	❑	❑
Dictionaries for students	❑	❑	❑
Thesaurus for students	❑	❑	❑
Teaching assistant	❑	❑	❑
ESL/bilingual aide	❑	❑	❑
District provided lesson plans	❑	❑	❑
Worksheets	❑	❑	❑
Other (specify: _____________)	❑	❑	❑

IV. GENERAL INSTRUCTIONAL PRACTICES

17. Approximately how frequently do the students in your science class do the following? (Circle one for each response)

	ELL Students						Non-ELL Students					
	Never	*1-2 times a year*	*Once a month*	*Once a week*	*A few times a week*	*Every day*	*Never*	*1-2 times a year*	*Once a month*	*Once a week*	*A few times a week*	*Every day*
Listen to a lecture/ Teacher-directed instruction	0	1	2	3	4	5	0	1	2	3	4	5
Read a science textbook	0	1	2	3	4	5	0	1	2	3	4	5
Read science articles in magazines or newspapers	0	1	2	3	4	5	0	1	2	3	4	5
Complete worksheets	0	1	2	3	4	5	0	1	2	3	4	5
Conduct hands-on activities or manipulate materials	0	1	2	3	4	5	0	1	2	3	4	5
Discuss science	0	1	2	3	4	5	0	1	2	3	4	5
Homework	0	1	2	3	4	5	0	1	2	3	4	5
Watch videos	0	1	2	3	4	5	0	1	2	3	4	5
Present oral science reports	0	1	2	3	4	5	0	1	2	3	4	5
Complete a written science report	0	1	2	3	4	5	0	1	2	3	4	5
Use science-related software	0	1	2	3	4	5	0	1	2	3	4	5
Use science-related internet resources	0	1	2	3	4	5	0	1	2	3	4	5
Create graphic representations (drawings, diagrams, models, etc.)	0	1	2	3	4	5	0	1	2	3	4	5
Work on individual projects	0	1	2	3	4	5	0	1	2	3	4	5
Work on projects in pairs or groups	0	1	2	3	4	5	0	1	2	3	4	5
Work in groups arranged by ability	0	1	2	3	4	5	0	1	2	3	4	5
Work one-on-one with a teacher or an aide	0	1	2	3	4	5	0	1	2	3	4	5
Other (_________________)	0	1	2	3	4	5	0	1	2	3	4	5

18. Considering the time you are able to devote to teaching science in your classroom, to what extent do your instructional practices emphasize the following for students: (Circle one for each response)

	ELL Students						Non-ELL Students					
	No Emphasis	.	.	.		*Strong Emphasis*	*No Emphasis*	.	.	.		*Strong Emphasis*
Learning about the relevance of science to society	0	1	2	3	4	5	0	1	2	3	4	5
Knowing basic science facts and terminology	0	1	2	3	4	5	0	1	2	3	4	5
Understanding key science concepts	0	1	2	3	4	5	0	1	2	3	4	5
Developing test-taking skills	0	1	2	3	4	5	0	1	2	3	4	5
Memorization of previous test questions	0	1	2	3	4	5	0	1	2	3	4	5
Learning how scientific concepts apply to everyday life	0	1	2	3	4	5	0	1	2	3	4	5
Using overarching concepts to draw connections between different science topics	0	1	2	3	4	5	0	1	2	3	4	5
Building on background scientific knowledge	0	1	2	3	4	5	0	1	2	3	4	5
Developing laboratory skills and techniques	0	1	2	3	4	5	0	1	2	3	4	5
Conducting inquiries or investigations in science (set up hypothesis, collect and analyze data)	0	1	2	3	4	5	0	1	2	3	4	5
Developing children's interest in science	0	1	2	3	4	5	0	1	2	3	4	5
Using technology as a scientific tool	0	1	2	3	4	5	0	1	2	3	4	5
Other (____________________)	0	1	2	3	4	5	0	1	2	3	4	5

19. **Considering the time you are able to devote to teaching science in your classroom,** approximately how frequently do you use or do the following to assess student achievement in science? (Circle one for each response)

	ELL Students						Non-ELL Students					
	Never	*1-2 times a year*	*Once a month*	*Once a week*	*A few times a week*	*Every day*	*Never*	*1-2 times a year*	*Once a month*	*Once a week*	*A few times a week*	*Every day*
Teacher-made quizzes	0	1	2	3	4	5	0	1	2	3	4	5
Chapter (unit) end tests	0	1	2	3	4	5	0	1	2	3	4	5
Other assessments (e.g., checklists, rubrics)	0	1	2	3	4	5	0	1	2	3	4	5
Trial standardized tests or released test items	0	1	2	3	4	5	0	1	2	3	4	5
Use of student responses to questions, student explanations, and the observation of student interactions for assessment purposes during instruction	0	1	2	3	4	5	0	1	2	3	4	5
Student work (e.g., science journals, portfolios, homework)	0	1	2	3	4	5	0	1	2	3	4	5
Peer assessment	0	1	2	3	4	5	0	1	2	3	4	5
Student self-assessment	0	1	2	3	4	5	0	1	2	3	4	5
Other (________________)	0	1	2	3	4	5	0	1	2	3	4	5

20. How important are the following for evaluating students in your science class? (Circle one for each response)

	ELL Students						Non-ELL Students					
	Not Important	.	.	.		Very Important	Not Important	.	.	.		Very Important
Achievement/ progress relative to the rest of the class	0	1	2	3	4	5	0	1	2	3	4	5
Achievement/ progress relative to State Standards	0	1	2	3	4	5	0	1	2	3	4	5
Achievement/ progress relative to the child's previous learning (or performance)	0	1	2	3	4	5	0	1	2	3	4	5
Effort	0	1	2	3	4	5	0	1	2	3	4	5
Class participation	0	1	2	3	4	5	0	1	2	3	4	5
Behavior/conduct	0	1	2	3	4	5	0	1	2	3	4	5
Using scientific vocabulary	0	1	2	3	4	5	0	1	2	3	4	5
Knowing scientific facts	0	1	2	3	4	5	0	1	2	3	4	5
Understanding of scientific concepts	0	1	2	3	4	5	0	1	2	3	4	5
Other (__________________)	0	1	2	3	4	5	0	1	2	3	4	5

21. Do you have access to individual standardized test scores for the students in your class? (Check all that apply)

- ❑ Yes, from Statewide assessments
- ❑ Yes, from District assessments (e.g. benchmarks)
- ❑ Yes, from other assessments (____________________)
- ❑ No (SKIP TO QUESTION 23)

22. How useful do you find the student standardized test scores for the following? (Circle one for each response)

	ELL Students						Non-ELL Students					
	Not Useful	.	.	.		*Very Useful*	*Not Useful*	.	.	.		*Very Useful*
Assess student achievement and progress	0	1	2	3	4	5	0	1	2	3	4	5
Adapt/guide instruction	0	1	2	3	4	5	0	1	2	3	4	5
Provide feedback to students	0	1	2	3	4	5	0	1	2	3	4	5
Identify areas of strength and weakness	0	1	2	3	4	5	0	1	2	3	4	5
Provide information for parents	0	1	2	3	4	5	0	1	2	3	4	5
Assign additional or different work in class	0	1	2	3	4	5	0	1	2	3	4	5
Assign additional or different homework	0	1	2	3	4	5	0	1	2	3	4	5
Other (__________________)	0	1	2	3	4	5	0	1	2	3	4	5

23. What are your policies for teaching and evaluating students in your classroom? (Check one)

- ❑ The same academic standards apply for everyone in my classroom, no exceptions
- ❑ The same academic standards apply for everyone, but I make exceptions for students with special needs (e.g. disabilities, limited English proficiency)
- ❑ I adapt the standards to accommodate students of differing abilities

V. ELL-SPECIFIC PRACTICES

24. Are students in your science classroom grouped differently because of language? (Check all that apply)

- ❑ Yes, each ELL student is paired with a native English speaker
- ❑ Yes, ELL students are grouped together by language proficiency level
- ❑ Yes, all ELL students are placed in one group regardless of proficiency and native language
- ❑ Yes, ELL students with the same language (e.g. all Spanish-speakers) are placed in one group
- ❑ No, Students are not grouped differently because of language

25. Are ELL students given science instruction in their primary language?

- ❑ YES
- ❑ NO
- ❑ OTHER (Explain:____)

26. Are ELL students given science text books in:

❑ English ❑ Their Primary Language

27. How often do you use (or to what extent do you rely on) the following English language learner (ELL) instructional strategies in your science class? (Circle one for each response)

	Never / Not at All	.	.	.	.	*Always/ A lot*
Use scaffolding techniques to support students' understanding of English (e.g. think-aloud /modeling, graphics, realia, manipulatives)	0	1	2	3	4	5
Provide opportunities for student-to-teacher interactions that encourage elaborated responses	0	1	2	3	4	5
Provide opportunities for student-to-student interactions that encourage elaborated responses	0	1	2	3	4	5
Provide activities for students to practice English using new skills, concepts, and vocabulary	0	1	2	3	4	5
Provide opportunities for students to clarify English vocabulary in their primary language	0	1	2	3	4	5
Provide opportunities for peer assessment of English proficiency	0	1	2	3	4	5
Provide opportunities for student self-assessment of English proficiency	0	1	2	3	4	5
Use supplementary ELL materials, including dictionaries and thesauruses	0	1	2	3	4	5
Adapt my English speech and language to all levels of English proficiency (differentiated instruction)	0	1	2	3	4	5
Adapt texts and assignments to all levels of English proficiency	0	1	2	3	4	5
Use tests for ELL students with low levels of language demand (differentiated assessment)	0	1	2	3	4	5
Identify and provide feedback about students' weaknesses in English language (e.g. vocabulary, grammar)	0	1	2	3	4	5
Use "*English Only*" approach during instruction	0	1	2	3	4	5
Use simultaneous translation of English to primary language during instruction	0	1	2	3	4	5
Explicitly incorporate students' home culture and background experiences in school activities	0	1	2	3	4	5
Allow students to use their primary language in formulating questions	0	1	2	3	4	5
Use students' primary language to clarify students' queries	0	1	2	3	4	5
Use paraphrasing to make input comprehensible	0	1	2	3	4	5
Use deliberate pauses (wait time) to allow students to respond	0	1	2	3	4	5

VI. ACADEMIC LANGUAGE PRACTICES

Academic English language is the language (i.e., vocabulary, grammar and discourse patterns) used for teaching content-area knowledge. It can be specific to a single discipline (e.g., specialized vocabulary such as *electro-magnetic*, or *ecosystem*), or it may be more generalized across several disciplines (e.g., general academic vocabulary such as *produce, analyze, outcome*).

28. **Considering the time you are able to devote to teaching science in your classroom,** how often do you use (or alternatively, to what extent do you rely on) the following academic English instructional strategies? (Circle one for each response)

	ELL Students						Non-ELL Students					
	Never / Not at All	.	.	.		*Always / A lot*	*Never / Not at All*	.	.	.		*Always / A lot*
Explicit links between new concepts and students' background experiences and past learning	0	1	2	3	4	5	0	1	2	3	4	5
Scaffolding techniques to support students' responses (e.g., provide a mix of challenging open-end questions and less challenging yes/no questions).	0	1	2	3	4	5	0	1	2	3	4	5
Scaffolding techniques to make explicit teacher expectations for students' responses (e.g., provide model responses, explicit teaching of necessary grammatical structures for elaborated responses).	0	1	2	3	4	5	0	1	2	3	4	5
Providing opportunities for students to clarify key concepts in science	0	1	2	3	4	5	0	1	2	3	4	5
Providing opportunities for students to witness the authentic discourse of scientists (e.g., video, classroom visits from botanists etc.) and participate (e.g., mock debates) in scientific discourse	0	1	2	3	4	5	0	1	2	3	4	5
Explicit language objectives, in tandem with science knowledge/skill objectives	0	1	2	3	4	5	0	1	2	3	4	5
Providing opportunities for students to practice uses of academic language in science (e.g., new general academic vocabulary and new scientific vocabulary, grammatical structures such as comparatives, nominalizations, and discourse level skills) both orally and in writing	0	1	2	3	4	5	0	1	2	3	4	5

29. Considering the time you are able to devote to teaching science in your classroom, to what extent do your instructional practices emphasize the following for students: (Circle one for each response)

	ELL Students						Non-ELL Students					
	No Emphasis	.	.	.		*Strong Emphasis*	*No Emphasis*	.	.	.		*Strong Emphasis*
Student ability to develop general academic vocabulary	0	1	2	3	4	5	0	1	2	3	4	5
Student ability to develop specialized scientific vocabulary	0	1	2	3	4	5	0	1	2	3	4	5
Student ability to develop necessary grammatical structures to both talk and write about science	0	1	2	3	4	5	0	1	2	3	4	5
Student ability to develop active listening skills/comprehension	0	1	2	3	4	5	0	1	2	3	4	5
Student ability to develop reading comprehension skills in science	0	1	2	3	4	5	0	1	2	3	4	5
Student ability to develop scientific writing skills	0	1	2	3	4	5	0	1	2	3	4	5
Student ability to develop essay writing skills using science topics	0	1	2	3	4	5	0	1	2	3	4	5
Student ability to convey basic scientific concepts accurately and effectively	0	1	2	3	4	5	0	1	2	3	4	5
Student ability to use evidence to explain and justify scientific notions and ideas	0	1	2	3	4	5	0	1	2	3	4	5
Student ability to draw connections among students' ideas	0	1	2	3	4	5	0	1	2	3	4	5

30. Considering the time you are able to devote to teaching science in your classroom, indicate how often you used the following *academic language functions* (i.e., ways in which you used language for teaching science): (Circle one for each response)

	ELL Students						Non-ELL Students					
	Never / Not at All	.	.	.		*Always* / A lot	*Never / Not at All*	.	.	.		*Always / A lot*
Explanation of science processes	0	1	2	3	4	5	0	1	2	3	4	5
Description of objects or phenomena	0	1	2	3	4	5	0	1	2	3	4	5
Definition of scientific vocabulary and phrases	0	1	2	3	4	5	0	1	2	3	4	5
Classifying scientific phenomenon	0	1	2	3	4	5	0	1	2	3	4	5
Comparing/Contrasting scientific processes or objects	0	1	2	3	4	5	0	1	2	3	4	5
Causal reasoning with scientific phenomena (cause and effect)	0	1	2	3	4	5	0	1	2	3	4	5
Sequencing or organizing extended scientific information	0	1	2	3	4	5	0	1	2	3	4	5
Sequencing steps of scientific procedures or experiments	0	1	2	3	4	5	0	1	2	3	4	5
Labeling of scientific processes or objects	0	1	2	3	4	5	0	1	2	3	4	5
Enumeration (listing) of science facts and processes	0	1	2	3	4	5	0	1	2	3	4	5
Prediction of scientific outcomes	0	1	2	3	4	5	0	1	2	3	4	5
Generalization of scientific processes or facts to other scientific phenomena	0	1	2	3	4	5	0	1	2	3	4	5
Inference making based on scientific knowledge	0	1	2	3	4	5	0	1	2	3	4	5
Hypothesis-generating based on scientific facts	0	1	2	3	4	5	0	1	2	3	4	5
Other________________	0	1	2	3	4	5	0	1	2	3	4	5

OVER PLEASE

31. As a final step we would like to ask for any ***thoughts, comments or suggestions*** you might have about the survey, its contents, format, or organization. One of the purposes of this project is to develop a survey that reflects teacher practices and student experiences in the classroom as accurately as possible. If you think of any ways in which the survey or any of its sections could be improved to better reflect classroom practice (e.g. by clarifying confusing or ambiguous questions, or adding aspects of teacher practice), we would be grateful if you share them with us.

Thank you for your participation!

Appendix B:
Classroom Observation Protocol

Date: ____________________________ Time: ___________________________
Observer: _________________________ Teacher: _________________________
School & RM#: ____________________ Subject area: ______________________
Grade: ____________________________ Lesson duration: ___________________

Content Coverage

1. Which science topics and standards were taught during the class? (See Appended list of possible science topics from state standards.) Please familiarize yourself with Appendix, ask teacher to clarify during debriefing if necessary, and record the need.

Classroom Physical Setting/Participation

2.1 Using the space provided below, please draw the physical layout of the classroom setting.

2.2 How was the classroom configured? (Check all that were observed. Add time specificity as record, e.g., 1/2 of session)

- ❑ Whole Class
- ❑ Small Groups
- ❑ Pairs
- ❑ Individual Work
- ❑ One-on-one with Teacher/Teacher's Aid

2.3 Were ELL students configured differently? If so, how did they differ (e.g. one ELL student paired with one English-only student, ELL students with the same first language background placed in one group)? Clarify with teacher any groupings that are not clear.

2.4 What is the general participation pattern of students responding to questions in the science class?

(Circle only one answer)

❑ Small core group participates ❑ Half the class participates ❑ Call on/encourage everyone to participate

Classroom Context (If possible, please fill in the information before class starts.)

3.1 How many total students were present in the classroom? ________

3.2 How many of those students present are ELL? (Confirm with teacher) ________

Availability and Use of Instructional Resources

4.1 For the following questions, please check the materials/resources that were **USED** in the classroom. (Check one)

	Yes	*No (But available in the classroom)*	*No (But available based on teacher report)*	*No (Not available based on teacher report)*
Science books	❑	❑	❑	❑
Science newspapers/magazines	❑	❑	❑	❑
Science kits	❑	❑	❑	❑
Lab equipment/materials	❑	❑	❑	❑
Computers	❑	❑	❑	❑
Science-specific software	❑	❑	❑	❑
Internet	❑	❑	❑	❑
Video resources	❑	❑	❑	❑
Science vocabulary charts	❑	❑	❑	❑
Concept posters	❑	❑	❑	❑
Procedure posters	❑	❑	❑	❑
Dictionaries for students	❑	❑	❑	❑
Thesaurus for students	❑	❑	❑	❑
Teaching assistant	❑	❑	❑	❑
ESL/bilingual aide	❑	❑	❑	❑
District provided lesson plans	❑	❑	❑	❑
Worksheets	❑	❑	❑	❑
Other (specify: ____________________)	❑	❑	❑	❑

Classroom Activities & Configuration

5.1 What activities did students engage in? (Check all that apply)

❑	Listen to a lecture/ Teacher-directed instruction
❑	Read a science textbook
❑	Read science articles in magazines or newspapers
❑	Complete worksheets
❑	Conduct hands-on activities or manipulate materials
❑	Discuss science
❑	Homework (Any activities *except for* assigning homework)
❑	Watch videos
❑	Present oral science reports
❑	Complete written science reports
❑	Use science-related software
❑	Use science-related internet resources
❑	Create graphic representations (drawings, diagrams, models, etc.)
❑	Work on individual projects
❑	Work on projects in pairs or groups
❑	Work in groups arranged by ability
❑	Work one-on-one with a teacher or an aide

Other activities not listed above. (Please specify the new category/categories):

Please write down any relevant information for others reading your observation, or your reflectional thoughts on the protocol.

5.2 Did ELL students engage in different activities from non-ELL students? If so, what activities differed?

Instructional Emphases

6.1 To what extent did classroom instructional practices emphasize the following (See Appendix for definitions of and examples for each item): (Circle one)

	NOTES	ELL Students *No Emphasis → Strong Emphasis*						Non-ELL Students *No Emphasis → Strong Emphasis*					
1. Learning about the relevance of science to society		0	1	2	3	4	5	0	1	2	3	4	5
2. Knowing basic science facts and terminology		0	1	2	3	4	5	0	1	2	3	4	5
3. Understanding key science concepts		0	1	2	3	4	5	0	1	2	3	4	5
4. Developing test-taking skills		0	1	2	3	4	5	0	1	2	3	4	5
5. Memorization of previous test questions		0	1	2	3	4	5	0	1	2	3	4	5
6. Learning how scientific concepts apply to everyday life		0	1	2	3	4	5	0	1	2	3	4	5
7. Using overarching concepts to draw connections between different science topics		0	1	2	3	4	5	0	1	2	3	4	5
8. Building on background scientific knowledge		0	1	2	3	4	5	0	1	2	3	4	5
9. Developing laboratory skills and techniques		0	1	2	3	4	5	0	1	2	3	4	5
10. Conducting inquiries or investigations in science (set up hypothesis, collect and analyze data)		0	1	2	3	4	5	0	1	2	3	4	5
11. Developing children's interest in science		0	1	2	3	4	5	0	1	2	3	4	5
12. Using technology as a scientific tool		0	1	2	3	4	5	0	1	2	3	4	5

Other emphases not listed above (Please specify the new category/categories):

Please write down any relevant information for others reading your observation, or your reflectional thoughts on the protocol.

Assessment Practices

7.1 What assessment practices were used? (Check all that apply)

❑	Teacher-made quizzes
❑	Chapter (unit) end tests
❑	Other assessments (e.g., checklists, rubrics)
❑	Trial standardized tests or released test items
❑	Use of student responses to questions, student explanations, and the observation of student interactions for assessment purposes during instruction
❑	Student work (e.g., science journals, portfolios, and homework)
❑	Peer assessment (e.g. students read each other's homework and provide feedback)
❑	Student-self assessment

Other assessment practices not listed above (Please specify the new category/categories):

Please write down any relevant information for others reading your observation, or your reflectional thoughts on the protocol.

7.2 Were assessments of ELL students different? If so, how did they differ?

ELL Instructional Practices

8.1 Reflecting on the class as a whole, how often, if at all, were the following ELL instructional practices used? (Circle one for each item)

	Never / Not at All	.	.	.	.	*Always / A lot*
1. Use scaffolding techniques to support students' understanding of English (e.g. think-aloud /modeling, graphics, realia, manipulatives)	0	1	2	3	4	5
2. Provide opportunities for student-to-teacher interactions that encourage elaborated responses	0	1	2	3	4	5
3. Provide opportunities for student-to-student interactions that encourage elaborated responses	0	1	2	3	4	5
4. Provide activities for students to practice English using new skills, concepts, and vocabulary	0	1	2	3	4	5
5. Provide opportunities for students to clarify English vocabulary in their primary language	0	1	2	3	4	5
6. Provide opportunities for peer assessment of English proficiency	0	1	2	3	4	5
7. Provide opportunities for student self-assessment of English proficiency	0	1	2	3	4	5
8. Use supplementary ELL materials, including dictionaries and thesauruses	0	1	2	3	4	5
9. Adapt English speech and language to all levels of English proficiency (differentiated instruction)	0	1	2	3	4	5
10. Adapt texts and assignments to all levels of English proficiency	0	1	2	3	4	5
11. Identify and provide feedback about students' weaknesses in English language (e.g. vocabulary, grammar)	0	1	2	3	4	5
12. Use "*English Only*" approach during instruction	0	1	2	3	4	5
13. Use simultaneous translation of English to primary language during instruction	0	1	2	3	4	5
14. Explicitly incorporate students' home culture and background experiences in school activities	0	1	2	3	4	5
15. Allow students to use their primary language in formulating questions	0	1	2	3	4	5
16. Use students' primary language to clarify students' queries	0	1	2	3	4	5
17. Use paraphrasing to make input comprehensible	0	1	2	3	4	5
18. Use deliberate pauses (wait time) to allow students to respond	0	1	2	3	4	5

Other ELL instructional practices not listed above (please specify):

Please write down any relevant information for others reading your observation, or your reflectional thoughts on the protocol.

ALE practices

9.1. Reflecting on the class as a whole, indicate how often the teacher used the following academic English instructional strategies: (Circle one)

	ELL Students						Non-ELL Students					
	Never / Not at All		.	.	.	*Always / A lot*	*Never / Not at All*		.	.	.	*Always / A lot*
1. Explicit links between new concepts and students' background experiences and past learning	0	1	2	3	4	5	0	1	2	3	4	5
2. Scaffolding techniques to support students' responses (e.g., provide a mix of challenging open-end questions and less challenging yes/no questions).	0	1	2	3	4	5	0	1	2	3	4	5
3. Scaffolding techniques to make explicit teacher expectations for students' responses (e.g., provide model responses, explicit teaching of necessary grammatical structures for elaborated responses).	0	1	2	3	4	5	0	1	2	3	4	5
4. Providing opportunities for students to clarify key concepts in science	0	1	2	3	4	5	0	1	2	3	4	5
5. Providing opportunities for students to witness the authentic discourse of scientists (e.g., video, classroom visits from botanists etc.) and participate (e.g., mock debates) in scientific discourse	0	1	2	3	4	5	0	1	2	3	4	5
6. Explicit language objectives, in tandem with knowledge/skill objectives	0	1	2	3	4	5	0	1	2	3	4	5
7. Providing opportunities for students to practice uses of academic language in science (e.g., new general academic vocabulary and new scientific vocabulary, grammatical structures such as comparatives, nominalizations, and discourse level skills) both orally and in writing	0	1	2	3	4	5	0	1	2	3	4	5

Other strategies not listed above (please specify):

Please write down any relevant information for others reading your observation, or your reflectional thoughts on the protocol.

9.2. Reflecting on the class as a whole, indicate to what extent the teacher's academic language instructional practices emphasized the following (See Appendix for examples for each item): (Circle one)

	ELL Students						Non-ELL Students					
	No Emphasis		.	.	.	*Strong Emphasis*	*No Emphasis*		.	.	.	*Strong Emphasis*
1. Student ability to develop general academic vocabulary	0	1	2	3	4	5	0	1	2	3	4	5
2. Student ability to develop specialized scientific vocabulary	0	1	2	3	4	5	0	1	2	3	4	5
3. Student ability to develop necessary grammatical structures to both talk and write about science	0	1	2	3	4	5	0	1	2	3	4	5
4. Student ability to develop active listening skills/comprehension.	0	1	2	3	4	5	0	1	2	3	4	5
5. Student ability to develop reading comprehension skills in science	0	1	2	3	4	5	0	1	2	3	4	5
6. Student ability to develop scientific writing skills	0	1	2	3	4	5	0	1	2	3	4	5
7. Student ability to develop essay writing skills using science topics	0	1	2	3	4	5	0	1	2	3	4	5
8. Student ability to convey basic scientific concepts accurately and effectively	0	1	2	3	4	5	0	1	2	3	4	5
9. Student ability to use evidence to explain and justify scientific notions and ideas	0	1	2	3	4	5	0	1	2	3	4	5
10. Student ability to draw connections among students' ideas	0	1	2	3	4	5	0	1	2	3	4	5

Other emphases not listed above (please specify):

Please write down any relevant information for others reading your observation, or your reflectional thoughts on the protocol.

9.3 Reflecting on the class as a whole, indicate how often the teacher used the following ***academic language functions*** (i.e. ways in which the teacher used language for teaching science) to ELL and Non-ELL students: (Circle one)

	ELL Students						Non-ELL Students					
	Never / Not at All		.	.	.	*Always /* A lot	*Never / Not at All*		.	.	.	*Always /* A lot
1. Explanation of science processes	0	1	2	3	4	5	0	1	2	3	4	5
2. Description of objects or phenomena	0	1	2	3	4	5	0	1	2	3	4	5
3. Definition of scientific vocabulary and phrases	0	1	2	3	4	5	0	1	2	3	4	5
4. Classifying scientific phenomenon	0	1	2	3	4	5	0	1	2	3	4	5
5. Comparing/Contrasting scientific processes or objects	0	1	2	3	4	5	0	1	2	3	4	5
6. Causal reasoning with scientific phenomena (cause and effect)	0	1	2	3	4	5	0	1	2	3	4	5
7. Sequencing or organizing extended scientific information	0	1	2	3	4	5	0	1	2	3	4	5
8. Sequencing steps of scientific procedures or experiments	0	1	2	3	4	5	0	1	2	3	4	5
9. Labeling of scientific processes or objects	0	1	2	3	4	5	0	1	2	3	4	5
10. Enumeration (listing) of science facts and processes	0	1	2	3	4	5	0	1	2	3	4	5
11. Prediction of scientific outcomes	0	1	2	3	4	5	0	1	2	3	4	5
12. Generalization of scientific processes or facts to other scientific phenomena	0	1	2	3	4	5	0	1	2	3	4	5
13. Inference making based on scientific knowledge	0	1	2	3	4	5	0	1	2	3	4	5
14. Hypothesis-generating based on scientific facts	0	1	2	3	4	5	0	1	2	3	4	5
15. Other____________________	0	1	2	3	4	5	0	1	2	3	4	5

Appended to Protocol:
POSSIBLE SCIENCE TOPICS

1. ***Electricity and magnetism are related effects that have many useful applications in everyday life. As a basis for understanding this concept students will know:***
   a. How to design and build simple series and parallel circuits by using components such as wires, batteries, and bulbs.
   b. How to build a simple compass and use it to detect magnetic effects, including Earth's magnetic field.
   c. How electric currents produce magnetic fields and how to build a simple electromagnet.
   d. The role of electromagnets in the construction of electric motors, electric generators, and simple devices, such as doorbells and earphones.
   e. Electrically charged objects attract or repel each other.
   f. Magnets have two poles (north and south) and that like poles repel each other while unlike poles attract each other.
   g. Electrical energy can be converted to heat, light, and motion.

2. ***All organisms need energy and matter to live and grow. As a basis for understanding this concept students will know:***
   a. Plants are the primary source of matter and energy entering most food chains.
   b. Producers and consumers (herbivores, carnivores, omnivores, and decomposers) are related in food chains and food webs and may compete with each other for resources in an ecosystem.
   c. Decomposers, including many fungi, insects, and microorganisms, recycle matter from dead plants and animals.

3. ***Living organisms depend on one another and on their environment for survival. As a basis for understanding this concept students will know:***
   a. Ecosystems can be characterized by their living and nonliving components.
   b. In any particular environment, some kinds of plants and animals survive well, some survive less well, and some cannot survive at all.
   c. Many plants depend on animals for pollination and seed dispersal, and animals depend on plants for food and shelter.
   d. Most microorganisms do not cause disease and that many are beneficial.

4. ***The properties of rocks and minerals reflect the processes that formed them. As a basis for understanding this concept students will know:***
   a. How to differentiate among igneous, sedimentary, and metamorphic rocks by referring to their properties and methods of formation (the rock cycle).
   b. How to identify common rock-forming minerals (including quartz, calcite, feldspar, mica, and hornblende) and ore minerals by using a table of diagnostic properties.

5. ***Waves, wind, water, and ice shape and reshape Earth's land surface. As a basis for understanding this concept students will know:***
   a. Some changes in the earth are due to slow processes, such as erosion, and some changes are due to rapid processes, such as landslides, volcanic eruptions, and earthquakes.
   b. Natural processes, including freezing and thawing and the growth of roots, cause rocks to break down into smaller pieces.
   c. Moving water erodes landforms, reshaping the land by taking it away from some places and depositing it as pebbles, sand, silt, and mud in other places (weathering, transport, and deposition).

6. ***Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations. Students will:***
   a. Differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.
   b. Measure and estimate the weight, length, or volume of objects.
   c. Formulate and justify predictions based on cause-and-effect relationships.
   d. Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.
   e. Construct and interpret graphs from measurements.
   f. Follow a set of written instructions for a scientific investigation.

DEFINITIONS AND EXAMPLES FOR INSTRUCTIONAL EMPHASIS

Item	Definition	Example
Learning about the relevance of science to society	Emphasizes ways in which society is influenced by scientific discovery and advances.	How electricity affected communication; how medical inventions affect lifespan.
Knowing basic science facts and terminology	Emphasizes definition, memorization, recall, and comprehension.	Recite and define specialized science vocabulary such as “photosynthesis”, “water cycle”, etc.
Understanding key science concepts	Emphasizes synthesis, analysis, evaluation, and application.	Explain how electricity works; identify faulty argument; use representations to model scientific concepts
Developing test-taking skills	Emphasizes formal testing rules, conventions, and/or strategies.	Activities that are explicitly marked as test prep, i.e. mimicking the testing conditions such as timing the students or asking the students to close their books, should receive a high rating; activities that meet the criteria but are not explicitly marked may receive a lower rating.
Memorization of previous test questions	No further definition needed.	NA
Learning how scientific concepts apply to everyday life	Emphasizes connections between in-class activities and specific real-world activities.	Explain how the electrical circuits work for the light-bulbs to light up when the switch is turned on.
Drawing connections between different scientific concepts	Emphasizes abstract concepts and processes that can be identified across contexts; emphasizes explanation of relationships between different science models or representations, and identification of patterns after data analysis.	Explain the connection between photosynthesis and food chain.
Building on background scientific knowledge	Emphasizes building on or referring back to prior classroom knowledge, and using previously-learned factual or procedural knowledge, e.g. same methodology, to learn a new scientific concept.	Referring back to previous lesson on cloud formation to explain the water cycle concept; applying the same steps and methodology, such as experimental design and data collection procedure, to conducting another science project of a different topic
Developing laboratory skills and techniques	Emphasizes correct laboratory practices, manipulation of materials, and technical/mechanical skills.	How to use lab equipment such as a microscope
Conducting inquiries or investigations in science (set up hypothesis, collect and analyze data)	Emphasizes generating questions and devising strategies to investigate them.	Work on a science project: plant seeds in different conditions, make hypothesis about the end product, collect growth data, conduct data analysis, and draw conclusions.
Developing children’s interest in science	Emphasizes child-appropriate activities and contexts that promote children’s engagement.	Ties activities to pop culture, uses contests and games, etc.
Using technology as a scientific tool	Emphasizes the use of technology, such as lab equipment (but excluding simple lab materials such as tubes and food coloring) and computers, as a tool for *doing* science. (Note: As opposed to using technology, such as the internet, simply to access information.)	Use microscope to investigate the soil collected from different environments; use GPS devices to identify or visit certain rare plant/animal sightings and observe long-term changes.

EXAMPLES FOR ACADEMIC LANGUAGE INSTRUCTIONAL PRACTICES

Item	Example
Student ability to develop general academic vocabulary	Practices that focus on teaching vocabulary that cuts across academic disciplines (e.g., *produce, analyze, report)* and having students produce this in their speech and writing and comprehend them in others' speech and in printed texts
Student ability to develop specialized scientific vocabulary	Practices that focus on teaching vocabulary that is science discipline-specific (e.g., *photosynthesis, electromagnet, sedimentary rock*) and having students produce this in their speech and writing and comprehend them in others' speech and in printed texts
Student ability to develop necessary grammatical structures to both talk and write about science	Practices that focus on sentence forms and constructions (e.g., *if…then* clauses to convey clausal connections; superlative and comparative forms such as *smallest, smaller* to convey contrasts) and having students produce these forms in their speech and writing and comprehend them in others' speech and in printed texts
Student ability to develop reading comprehension skills in science	Practices that deliberately teach making meaning of science texts and having students use reading comprehension strategies as they read science texts (e.g., metacognitive strategies such as identifying main ideas, monitoring own comprehension during reading etc.)
Student ability to develop scientific writing skills	Practices that teach science writing (e.g., expository, informational genre), having students produce their own writing in a science context (e.g., learn the correct organization of reports, experiments, arguments etc.).
Student ability to convey basic scientific concepts accurately and effectively	Practices that teach the need for clear communication of basic science information and having students accurately retell basic science facts and terminology
Student ability to use evidence to explain and justify scientific notions and ideas	Practices that explicitly teach the composition of good explanations of science concepts based on evidence and justifications for scientific arguments and having students communicate their explanations and justifications following acceptable scientific conventions
Student ability to draw connections among students' ideas	Practices that focus on helping students to make links between their own and each others' scientific ideas and reasoning

Appendix C:
Debriefing Interview

1A. How representative of your typical instruction during the year for this science classroom were the two lessons we observed? (in terms of contents, instructional practices, activities, etc.)

1B. If not, how were these lessons not representative (and why)?

2. Is there something about the context of this classroom and its (ELL) students that we should know that would help us better understand your instructional practices?

3. How well do you think the content of the survey captures your instructional practices in the science classroom?

4. Are there additional things the survey should inquire about in order to get a better sense of teacher instruction and specifically the experiences of (ELL) students in the classroom?

Appendix D:

OTL/ALE Survey Item Descriptives: Comparisons of ELL and Non-ELL students

SECTION IV: GENERAL INSTRUCTIONAL PRACTICES (OTL)

Instructional Activities & Configurations (Question 17)

Approximately how frequently do the students in your science class do the following?	ELL students			Non-ELL students			*t*-test (*p*-val)
	Median	Mean	*SD*	Median	Mean	*SD*	
Discuss science	4	3.89	0.8	4	3.92	0.8	NA
Listen to lecture/teacher instruction	4	3.85	1.1	4	3.87	1.1	.322
Conduct hands-on activities/manipulate	4	3.64	0.7	4	3.63	0.7	NA
Work on projects in pairs or groups	4	3.23	1.3	4	3.23	1.3	1.000
Read a science textbook	3	2.98	1.3	3	2.98	1.3	NA
Complete worksheets	3	2.91	1.0	3	2.92	1.0	NA
Create graphic representations	3	2.77	0.9	3	2.81	1.0	.420
Homework	2	2.40	1.7	2	2.35	1.7	NA
Work in groups arranged by ability	3	2.21	1.9	3	2.25	1.9	.322
Work one-on-one with a teacher or an aide	**2**	**1.92**	**1.8**	**1**	**1.58**	**1.6**	**.013**
Read science articles in magazines/newspapers	2	1.79	1.3	2	1.77	1.3	.322
Watch videos	2	1.62	0.8	2	1.60	0.8	.322
Work on individual projects	1	1.48	1.2	1	1.48	1.2	1.000
Complete a written science report	1	1.28	0.9	1	1.28	0.9	NA
Use science-related internet resources	1	1.19	1.0	1	1.26	1.1	.322
Present oral science reports	1	1.06	0.8	1	1.08	0.8	.322
Use science-related software	0	0.40	0.7	0	0.47	0.9	.322

Instructional Emphases (Question 18)

To what extent do your instructional practices emphasize the following for students	ELL students			Non-ELL students			*t*-test (*p*-val)
	Median	Mean	*SD*	Median	Mean	*SD*	
Developing children's interest in science	4	4.32	0.7	4	4.32	0.7	NA
Understanding key science concepts	4	3.91	0.9	4	3.91	0.9	1.000
Building on background scientific knowledge	4	3.87	1.1	4	3.81	1.1	.182
Knowing basic science facts/terminology	4	3.75	1.2	4	3.75	1.1	1.000
Conducting inquiries or investigations	4	3.60	1.3	4	3.58	1.3	.322
Learning how science applies to everyday life	4	3.36	1.2	4	3.36	1.2	1.000
Using concepts to draw connections	3	3.28	1.1	3	3.28	1.1	1.000
Learning about the relevance of science	3	3.21	1.3	3	3.23	1.3	.322
Developing test-taking skills	3	2.89	1.4	3	2.92	1.4	.322
Developing laboratory skills or techniques	3	2.89	1.5	3	2.89	1.6	1.000
Using technology as a scientific tool	3	2.53	1.3	3	2.51	1.3	.322
Memorization of previous test questions	1	0.91	1.0	1	0.96	1.1	.322

Student Assessment (Question 19)

Approximately how frequently do you use or do the following to assess student achievement?	ELL students			Non-ELL students			*t*-test (*p*-val)
	Median	Mean	*SD*	Median	Mean	*SD*	
Student work	4	3.72	1.0	4	3.72	1.0	NA
Use of student responses/explanations	4	3.49	0.9	4	3.47	0.9	.322
Other assessments	3	2.65	1.1	3	2.65	1.1	NA
Student self-assessment	2	1.94	1.4	2	1.94	1.4	NA
Teacher made quizzes	2	1.66	1.0	2	1.68	1.1	.322
Chapter (unit) end tests	2	1.53	0.9	2	1.51	0.9	.659
Peer assessment	1	1.51	1.5	1	1.53	1.5	.322
Trial standardized tests or released test items	1	1.06	1.0	1	1.06	1.0	NA

Focus of Student Evaluation (Question 20)

How important are the following for evaluating students in your science class?	ELL students			Non-ELL students			*t*-test (*p*-val)
	Median	Mean	*SD*	Median	Mean	*SD*	
Effort	5	4.38	1.0	5	4.38	1.0	NA
Class participation	4	4.15	1.0	4	4.19	0.9	.159
Understanding of scientific concepts	**4**	**3.92**	**1.0**	**4**	**4.06**	**1.0**	**.018**
Achievement/progress relative to prior ability	4	3.79	1.2	4	3.81	1.2	.322
Behavior/conduct	4	3.77	1.2	4	3.77	1.2	NA
Using scientific vocabulary	**3**	**3.47**	**1.0**	**4**	**3.70**	**1.0**	**.009**
Knowing scientific facts	**3**	**3.34**	**1.0**	**4**	**3.45**	**1.0**	**.033***
Achievement/progress relative to state	3	3.29	1.3	3	3.40	1.3	.057
Achievement/progress relative to class	**3**	**2.74**	**1.6**	**3**	**2.92**	**1.5**	**.017**

Uses of Test Scores (Question 22)

How useful do you find the student standardized test scores for the following?	ELL students			Non-ELL students			*t*-test (*p*-val)
	Median	Mean	*SD*	Median	Mean	*SD*	
Identify areas of strengths and weaknesses	4	3.29	1.6	4	3.33	1.6	.160
Adapt/guide instruction	**3**	**3.26**	**1.3**	**3.5**	**3.36**	**1.2**	**.044***
Provide information for parents	**4**	**3.17**	**1.5**	**4**	**3.24**	**1.5**	**.083***
Assess student achievement and progress	**3**	**2.93**	**1.6**	**3**	**3.05**	**1.6**	**.096***
Provide feedback to students	3	2.81	1.7	3	2.86	1.7	.160
Assign additional or different work in class	3	2.62	1.6	3	2.64	1.6	.660
Assign additional or different homework	3	2.50	1.7	3	2.52	1.7	.570

SECTION V: ELL SPECIFIC PRACTICES (OTL)

ELL Instructional Practices (Question 27)

How often do you use the following English language learner instructional strategies in your science class?	Median	Mean	*SD*
Use wait time to allow students to respond	5	4.55	0.6
Scaffolding techniques to support English	5	4.40	0.9
Opportunities for student/student interactions	5	4.36	0.7
Opportunities to practice English	4	4.11	1.0
Adapt speech to all levels of proficiency	5	4.11	1.7
Use paraphrasing	4	4.08	0.9
Opportunities for student/teacher interactions	4	4.06	0.8
Incorporate students culture and background	4	3.34	1.5
Adapt texts to all levels of proficiency	4	3.23	1.6
Use “English Only”	4	3.21	2.0
Supplementary ELL materials	3	3.08	1.8
Opportunities to clarify vocabulary	3	3.02	1.7
Provide feedback about students English	3	2.96	1.5
Use tests with low levels of language demand	3	2.70	1.8
Allow primary language in questions	2	2.36	1.8
Opportunities for self assessment of English	2	2.32	1.6
Opportunities for peer assessment of English	2	2.15	1.7
Use primary language to clarify queries	2	2.04	1.8
Use simultaneous translation	0	1.12	1.6

SECTION VI: ACADEMIC LANGUAGE PRACTICES

ALE Instructional Strategies (Question 28)

How often do you use the following academic English instructional strategies?	ELL students 1 factor			Non-ELL students 1 factor			*t*-test (*p*-val)
	Median	Mean	*SD*	Median	Mean	*SD*	
Scaffolding techniques for responses	5	4.47	0.7	5	4.47	0.7	NA
Links between new concepts and background	5	4.40	0.7	5	4.40	0.7	NA
Opportunities for students to clarify concepts	4	4.33	0.8	4	4.31	0.8	.322
Scaffolding techniques for expectations	4	3.98	1.1	4	3.92	1.1	.083
Opportunities to practice academic language	4	3.85	0.9	4	3.85	0.9	NA
Explicit language objectives	3	3.23	1.4	3	3.21	1.4	.766
Opportunities to witness authentic discourse	3	2.49	1.6	3	2.49	1.6	NA

ALE Instructional Emphases (Question 29)

To what extent do your instructional practices emphasize the following for students?	ELL students			Non-ELL students			*t*-test (*p*-val)
	Median	Mean	*SD*	Median	Mean	*SD*	
Ability to develop active listening skills	4	4.26	0.7	4	4.30	0.7	.159
Ability to develop general academic vocab	4	4.09	0.7	4	4.11	0.8	.569
Ability to draw connections among others ideas	4	3.85	0.8	4	3.92	0.8	.044
Ability to use evidence to justify science	4	3.83	1.0	4	3.83	1.1	1.000
Ability to develop grammatical structures	4	3.79	1.0	4	3.91	1.0	.109
Ability to develop reading comprehension skills	4	3.74	1.1	4	3.79	1.1	.083
Ability to convey basic scientific concepts	4	3.72	1.0	4	3.77	1.0	.083
Ability to develop specialized scientific vocab	**4**	**3.58**	**0.9**	**4**	**3.70**	**0.9**	**.023**
Ability to develop essay writing skills in science	**3**	**3.40**	**1.1**	**4**	**3.49**	**1.1**	**.024**
Ability to develop scientific writing skills	3	2.87	1.3	3	2.88	1.3	.322

Academic Language Functions (Question 30)

Indicate how often you used the following academic language functions:	ELL students			Non-ELL students			*t*-test (*p*-val)
	Median	Mean	*SD*	Median	Mean	*SD*	
Prediction of scientific outcomes	4	4.11	1.0	4	4.13	1.0	.322
Explanation of science processes	4	4.06	1.0	4	4.11	1.0	.083
Sequencing or organizing steps	4	4.03	1.0	4	4.08	1.0	.159
Definition of scientific vocabulary	4	3.91	1.0	4	3.91	1.0	1.000
Description of objects or phenomena	4	3.85	1.1	4	3.89	1.1	.159
Inference making based on science	4	3.79	1.0	4	3.89	0.9	.058
Labeling of scientific processes/objects	4	3.75	1.0	4	3.79	1.0	.159
Hypothesis generating based on science	4	3.75	1.0	4	3.81	1.0	.083
Sequencing or organizing information	4	3.60	1.1	4	3.66	1.1	.083
Causal reasoning with science	4	3.47	1.0	4	3.51	1.0	.159
Comparing/Contrasting processes/objects	3	3.36	1.1	4	3.42	1.1	.083
Generalization of scientific facts to other	3	3.32	1.1	3	3.32	1.1	NA
Enumeration of science facts/processes	3	3.26	1.2	3	3.28	1.2	.569
Classifying scientific phenomena	3	2.98	1.1	3	3.00	1.0	.322

Appendix E

Instructional Activities & Configurations (Question 17)

Item/Indicator	Factor: Traditional Instruction	Reform Instruction / Technology	Reform Instruction / Language Modes	Groupwork
Listen to lecture/teacher instruction	0.48	0.03	-0.02	0.13
Read a science textbook	0.03	-0.03	0.80	-0.14
Read science articles in magazines/newspapers	0.19	0.42	0.07	0.01
Complete worksheets	0.48	-0.17	0.28	0.12
Conduct hands-on activities/manipulate	0.35	-0.10	-0.17	0.75
Discuss science	-0.23	0.60	0.09	0.27
Homework	0.68	-0.05	-0.03	0.00
Watch videos	0.08	0.68	-0.08	-0.11
Present oral science reports	0.08	0.20	0.61	0.11
Complete a written science report	-0.09	0.07	0.64	0.13
Use science-related software	-0.04	0.46	0.02	0.06
Use science-related internet resources	0.07	0.33	0.08	-0.10
Create graphic representations	-0.07	-0.03	0.09	0.78
Work on individual projects	0.35	0.27	0.11	0.07
Work on projects in pairs or groups	-0.09	0.26	0.23	0.56
Work in groups arranged by ability	0.52	0.16	-0.14	0.00
Work one-on-one with a teacher or an aide	0.51	0.07	0.08	-0.16

Factor Intercorrelations

	F1	F2	F3	F4
F1	1.00			
F2	0.18	1.00		
F3	0.11	0.33	1.00	
F4	0.08	0.11	0.22	1.00

Instructional Emphases (Question 18)

	Factor		
Item/Indicator	Connections	Rote Learning / Memory	Science Contents / Concepts
Learning about the relevance of science	0.36	0.45	0.21
Knowing basic science facts/terminology	-0.25	0.32	0.96
Understanding key science concepts	0.12	0.05	0.72
Developing test-taking skills	0.02	0.41	0.08
Memorization of previous test questions	0.07	0.64	0.01
Learning how science applies to everyday life	0.75	0.29	0.01
Using concepts to draw connections	0.67	0.35	0.04
Building on background scientific knowledge	0.77	-0.11	0.03
Developing laboratory skills or techniques	0.36	-0.24	0.47
Conducting inquiries or investigations	0.36	-0.48	0.61
Developing children's interest in science	0.75	-0.08	-0.06
Using technology as a scientific tool	0.28	0.07	0.18

Factor Intercorrelations

	F1	F2	F3
F1	1.00		
F2	0.10	1.00	
F3	0.50	0.19	1.00

Student Assessment (Question 19)

	Factor
Item/Indicator	**Assessment**
Teacher made quizzes	0.49
Chapter (unit) end tests	0.43
Other assessments	0.43
Student work	0.77
Peer assessment	0.82
Student self-assessment	0.68

Focus of Student Evaluation (Question 20)

Item/Indicator	Factor	
	Behavioral	Content
Achievement/progress relative to class	0.15	0.41
Achievement/progress relative to state	0.30	0.21
Achievement/progress relative to prior ability	0.79	-0.11
Effort	0.83	0.00
Class participation	0.83	0.11
Behavior/conduct	0.66	0.16
Using scientific vocabulary	0.10	0.70
Knowing scientific facts	-0.18	1.06
Understanding of scientific concepts	0.26	0.51

Factor Intercorrelations

	F1	F2
F1	1.00	
F2	0.61	1.00

Uses of Test Scores (Question 22)

Item/Indicator	Factor
	Assessment
Assess student achievement and progress	0.81
Adapt/guide instruction	0.80
Provide feedback to students	0.85
Identify areas of strengths and weaknesses	0.85
Provide information for parents	0.80
Assign additional or different work in class	0.93
Assign additional or different homework	0.92

ELL Instructional Practices (Question 27)

	Factor			
Item/Indicator	Teacher Strategies	Student Strategies	Print Materials	Oral Language
Scaffolding techniques to support English	0.66	0.11	0.13	-0.11
Opportunities for student/teacher interactions	0.32	0.48	-0.03	-0.12
Opportunities for student/student interactions	0.10	0.31	0.03	0.28
Opportunities to practice English	0.40	0.06	0.07	0.12
Opportunities to clarify vocabulary	0.26	-0.05	0.68	0.31
Opportunities for peer assessment of English	0.24	0.05	0.25	0.65
Opportunities for self assessment of English	0.2	0.01	0.28	0.75
Supplementary ELL materials	0.14	0.52	0.20	0.27
Adapt speech to all levels of proficiency	0.52	0.32	0.25	-0.06
Adapt texts to all levels of proficiency	0.32	0.63	-0.18	-0.03
Use tests with low levels of language demand	-0.13	0.89	0.13	-0.14
Provide feedback about students English	0.10	0.40	0.03	0.22
Use "English Only"	-0.13	0.06	-0.39	0.49
Use simultaneous translation	-0.24	0.20	0.57	-0.03
Incorporate students culture and background	-0.08	0.56	0.06	0.32
Allow primary language in questions	0.25	-0.11	0.76	0.02
Use primary language to clarify queries	0.03	0.05	0.86	0.07
Use paraphrasing	0.74	0.06	-0.02	-0.01
Use wait time to allow students to respond	0.76	-0.05	-0.07	0.18

Factor Intercorrelations

	F1	F2	F3	F4
F1	1.00			
F2	0.23	1.00		
F3	0.28	0.09	1.00	
F4	0.35	0.25	0.27	1.00

ALE Instructional Strategies (Question 28)

Item/Indicator	Factor: Strategies
Links between new concepts and background	0.66
Scaffolding techniques for responses	0.90
Scaffolding techniques for expectations	0.69
Opportunities for students to clarify concepts	0.76
Opportunities to witness authentic discourse	0.54
Explicit language objectives	0.73
Opportunities to practice academic language	0.64

ALE Instructional Emphases (Question 29)

	Factor	
Item/Indicator	General Language	Specialized Language
Ability to develop general academic vocab	0.48	0.33
Ability to develop specialized scientific vocab	-0.03	0.75
Ability to develop grammatical structures	0.79	-0.03
Ability to develop active listening skills	0.77	0.05
Ability to develop reading comprehension skills	0.87	-0.07
Ability to develop scientific writing skills	0.35	0.28
Ability to develop essay writing skills in science	0.78	-0.01
Ability to convey basic scientific concepts	-0.07	0.92
Ability to use evidence to justify science	0.04	0.71
Ability to draw connections among others ideas	0.26	0.50

Factor Intercorrelations

	F1	F2
F1	1.00	
F2	0.66	1.00

Academic Language Functions (Question 30)

	Factor		
Item/Indicator	Providing Information	Higher Order Thinking	Sorting / Organizing
Explanation of science processes	0.39	0.34	0.17
Description of objects or phenomena	0.81	-0.11	0.20
Definition of scientific vocabulary	0.46	0.37	0.03
Classifying scientific phenomena	0.10	-0.07	0.89
Comparing/Contrasting processes/objects	0.13	0.17	0.63
Causal reasoning with science	0.26	0.29	0.37
Inference making based on science	0.08	0.27	0.54
Sequencing or organizing steps	0.88	0.06	-0.10
Labeling of scientific processes/objects	0.80	-0.02	0.13
Enumeration of science facts/processes	0.11	0.36	0.29
Prediction of scientific outcomes	0.28	0.76	-0.25
Generalization of scientific facts to other	0.28	0.27	0.28
Sequencing or organizing information	-0.04	0.78	0.21
Hypothesis generating based on science	-0.09	0.81	0.17

Factor Intercorrelations

	F1	F2	F3
F1	1.00		
F2	0.54	1.00	
F3	0.51	0.63	1.00

Appendix F:
Correspondence Between Teacher Survey Responses and Classroom Observations

SECTION IV: GENERAL INSTRUCTIONAL PRACTICES (OTL)

Instructional Activities & Configurations (Question 17)

Approximately how frequently do the students in your science class do the following? (Item was Recoded to 0-1 Scale)	Average Rating		Agreement	
	Classroom Observers	Teacher Self-Report	Inter-Rater (Observation)	Observation-Survey
Listen to a lecture/ Teacher-directed instruction	1.0	0.8	1.00	0.80
Read a science textbook	0.0	1.0	1.00	0.00
Read science articles in magazines or newspapers	0.0	0.4	1.00	0.60
Complete worksheets	0.6	0.8	0.90	0.80
Conduct hands-on activities or manipulate materials	0.8	1.0	1.00	1.00
Discuss science	0.7	0.8	0.90	0.60
Homework	0.2	0.6	1.00	0.60
Watch videos	0.0	0.0	1.00	1.00
Present oral science reports	0.0	0.0	1.00	1.00
Complete written science reports	0.0	0.0	1.00	1.00
Use science-related software	0.0	0.0	1.00	1.00
Use science-related internet resources	0.0	0.0	1.00	1.00
Create graphic representations	0.5	0.6	0.80	0.40
Work on individual projects	0.5	0.5	0.90	0.50
Work on projects in pairs or groups	0.7	1.0	0.90	1.00
Work in groups arranged by ability	0.0	0.6	1.00	0.40
Work one-on-one with a teacher or an aide	0.0	0.4	1.00	0.60
Section Total:	**0.29**	**0.50**	**0.96**	**0.72**

Instructional Emphasis (Question 18)

To what extent do your instructional practices emphasize the following?	Average Rating		Agreement	
	Classroom Observers	Teacher Self-Report	Inter-Rater (Observation)	Observation-Survey
Relevance to society	1.0	3.6	0.90	0.00
Knowing basic facts	3.0	4.0	1.00	0.80
Understanding key concepts	3.2	4.0	0.75	0.80
Develop test taking skills	0.0	2.6	1.00	0.20
Memorize previous test questions	0.0	1.6	1.00	0.20
Learn how it applies to everyday life	2.0	3.8	1.00	0.60
Draw connections between different concepts	1.1	3.6	0.90	0.00
Build on background knowledge	2.8	3.8	0.70	0.60
Develop lab skills	1.4	3.6	0.70	0.20
Conduct inquiries	2.4	3.8	0.70	0.80
Develop children's interest	3.3	4.0	0.70	0.40
Use technology as a science tool	0.0	2.4	1.00	0.20
Section Total:	**1.69**	**3.40**	**0.86**	**0.40**

SECTION V : ELL SPECIFIC PRACTICES (OTL)

ELL Instructional Practices (Question 27)

To what extent do you rely on the following English language learner (ELL) instructional strategies in your classroom?	Average Rating		Agreement	
	Classroom Observers	Teacher Self-Report	Inter-Rater (Observation)	Observation-Survey
Scaffolding techniques	2.5	4.6	0.70	0.00
Student to teacher interactions	3.4	4.4	1.00	0.60
Student to student interactions	3.2	4.4	0.60	0.40
Opportunities to practice English	2.9	4.4	0.90	0.20
Opportunities to clarify in primary language	0.4	4.2	1.00	0.00
Opportunities for peer assessment	0.6	4.0	0.70	0.00
Opportunities for self assessment	0.2	4.0	1.00	0.00
Use supplementary materials	0.0	4.0	1.00	0.00
Adapt speech	0.9	4.2	0.80	0.00
Adapt texts	0.4	3.2	0.80	0.20
Provide feedback	1.3	3.0	0.70	0.60
Use "English Only"	4.2	1.8	0.80	0.00
Use simultaneous translation	0.1	2.8	1.00	0.25
Link to home culture	1.0	3.8	0.78	0.00
Allow students to use primary language	0.3	2.2	1.00	0.20
Use primary language to clarify queries	0.3	2.4	1.00	0.40
Use paraphrasing	2.3	4.0	0.60	0.20
Use wait time	2.4	4.6	0.80	0.00
Section Total:	**1.45**	**3.66**	**0.84**	**0.17**

SECTION VI : ACADEMIC LANGUAGE PRACTICES

ALE Instructional Strategies (Question 28)

To what extent do you rely on the following academic English instructional strategies?	Average Rating: Classroom Observers	Average Rating: Teacher Self-Report	Agreement: Inter-Rater (Observation)	Agreement: Observation -Survey
Explicit links to past learning	2.9	4.2	0.60	0.40
Scaffolding student responses	3.2	4.2	0.89	0.60
Scaffolding teacher expectations	3.2	3.8	0.88	0.60
Providing opportunities to clarify concepts	2.8	4.2	1.00	0.40
Providing opportunities to witness discourse	0.0	3.0	1.00	0.00
Explicit language objectives	2.3	2.8	0.78	0.80
Providing opportunities to practice English	3.1	4.0	0.70	0.40
Section Total:	**2.47**	**3.74**	**0.84**	**0.46**

ALE Instructional Emphases (Question 29)

To what extent do your instructional practices emphasize the following?	Average Rating: Classroom Observers	Average Rating: Teacher Self-Report	Agreement: Inter-Rater (Observation)	Agreement: Observation-Survey
Academic vocabulary	2.4	4.2	0.80	0.20
Scientific vocabulary	3.1	3.8	0.89	0.80
Grammatical structures	2.0	3.6	1.00	0.20
Reading comprehension	2.5	4.0	0.70	0.40
Active listening	2.2	3.8	0.90	0.40
Scientific writing skills	1.7	3.8	0.63	0.20
Essay writing	0.2	3.6	0.90	0.00
Convey concepts accurately and effectively	2.5	4.0	0.89	0.60
Use evidence to explain	2.6	4.2	1.00	0.40
Draw connections among student ideas	2.5	3.6	0.90	0.40
Section Total:	**2.15**	**3.86**	**0.86**	**0.36**

Academic Language Functions (Question 30)

How often did you use the following *academic language functions*?	Average Rating		Agreement	
	Classroom Observers	Teacher Self-Report	Inter-Rater (Observation)	Observation -Survey
Explanation of science processes	1.9	3.8	0.80	0.00
Description of scientific objects	2.9	3.8	0.60	0.60
Definition of scientific vocabulary	1.6	4.0	0.88	0.20
Classifying scientific phenomenon	0.6	3.4	0.80	0.20
Comparing/contrasting scientific processes	1.8	3.4	0.80	0.40
Causal reasoning with scientific phenomenon	1.5	3.6	0.80	0.20
Sequencing or organizing extended information	1.5	4.0	0.90	0.00
Sequencing steps of scientific procedures	2.5	4.0	0.90	0.40
Labeling scientific processes	0.4	4.0	0.90	0.00
Enumeration of science facts	2.3	4.0	0.88	0.20
Prediction of scientific outcomes	1.7	4.2	0.90	0.20
Generalizing to other scientific phenomenon	0.5	4.0	0.78	0.00
Inference making based on scientific knowledge	1.7	3.8	0.90	0.20
Hypothesis-generating based on scientific facts	2.1	4.0	0.90	0.20
Section Total:	**1.63**	**3.86**	**0.84**	**0.20**

Appendix G:
Patterns of Item inter-correlation by Scale

Intercorrelations For Question 17: Traditional

	Lecture	Worksheets	Homework	Individual	Ability	Aide
Lecture	1.0000					
Worksheets	0.1663	1.0000				
	(0.2387)					
Homework	0.2924	0.4214	1.0000			
	(0.0354)	(0.0017)				
Individual	0.2488	0.1492	0.3752	1.0000		
	(0.0784)	(0.2911)	(0.0061)			
Ability	0.2954	0.2567	0.3404	0.1285	1.0000	
	(0.0335)	(0.0635)	(0.0126)	(0.3640)		
Aide	0.3415	0.2191	0.2229	0.2831	0.2623	1.0000
	(0.0142)	(0.1186)	(0.1123)	(0.0441)	(0.0603)	

Intercorrelations For Question 17: Reform/Technology

	Articles	Discuss	Videos	Software	Internet
Articles	1.0000				
Discuss	0.3411	1.0000			
	(0.0124)				
Videos	0.3396	0.3056	1.0000		
	(0.0129)	(0.0260)			
Software	0.0479	0.3145	0.3833	1.0000	
	(0.7332)	(0.0218)	(0.0046)		
Internet	0.0291	0.3037	0.2122	0.2336	1.0000
	(0.8362)	(0.0271)	(0.1271)	(0.0923)	

Intercorrelations For Question 17: Reform/Language Modes

	Textbook	Present	Write
Textbook	1.0000		
Present	0.4565 (0.0007)	1.0000	
Write	0.4969 (0.0002)	0.5865 (0.0000)	1.0000

Intercorrelations For Question 17: Hands-on & Group

	Activities	Graphics	Pairs
Activities	1.0000		
Graphics	0.5227 (0.0001)	1.0000	
Pairs	0.4108 (0.0023)	0.4785 (0.0003)	1.0000

Intercorrelations For Question 18: Making Connections

	Relevance	Application	Connections	Background	Interest	Technology
Relevance	1.0000					
Application	0.6959 (0.0000)	1.0000				
Connections	0.4458 (0.0008)	0.6778 (0.0000)	1.0000			
Background	0.3280 (0.0165)	0.5515 (0.0000)	0.5201 (0.0001)	1.0000		
Interest	0.2760 (0.0455)	0.4828 (0.0003)	0.4732 (0.0003)	0.6242 (0.0000)	1.0000	
Technology	0.2832 (0.0399)	0.2460 (0.0758)	0.3579 (0.0085)	0.3100 (0.0239)	0.3241 (0.0179)	1.0000

Intercorrelations For Question 18: Rote Learning/Memorization

	Test Skills	Memorization
Test Skills	1.0000	
Memorization	0.4155 (0.0020)	1.0000

Intercorrelations For Question 18: Understanding Science Contents/Concepts

	Concepts	Facts	Labs	Inquiry
Concepts	1.0000			
Facts	0.7400	1.0000		
	(0.0000)			
Labs	0.4282	0.3988	1.0000	
	(0.0014)	(0.0031)		
Inquiry	0.5452	0.3490	0.7518	1.0000
	(0.0000)	(0.0104)	(0.0000)	

Intercorrelations For Question 19

	Quizzes	Tests	Peer	Self	Work	Other
Quizzes	1.0000					
Tests	0.2398	1.0000				
	(0.0837)					
Peer	0.3953	0.3210	1.0000			
	(0.0034)	(0.0191)				
Self	0.2177	0.3970	0.7046	1.0000		
	(0.1173)	(0.0032)	(0.0000)			
Work	0.3550	0.3263	0.6207	0.4730	1.0000	
	(0.0091)	(0.0171)	(0.0000)	(0.0003)		
Other	0.2857	0.1063	0.2026	0.2772	0.3898	1.0000
	(0.0400)	(0.4534)	(0.1498)	(0.0467)	(0.0043)	

Intercorrelations For Question 20: Behavioral

	Previous	Effort	Participation	Behavior
Previous	1.0000			
Effort	0.5842	1.0000		
	(0.0000)			
Participation	0.6072	0.8017	1.0000	
	(0.0000)	(0.0000)		
Behavior	0.5877	0.6302	0.6678	1.0000
	(0.0000)	(0.0000)	(0.0000)	

Intercorrelations For Question 20: Content

	Vocabulary	Facts	Concepts	To Class	To State
Vocabulary	1.0000				
Facts	0.7062	1.0000			
	(0.0000)				
Concepts	0.5404	0.6637	1.0000		
	(0.0000)	(0.0000)			
To Class	0.3855	0.4494	0.2300	1.0000	
	(0.0044)	(0.0007)	(0.0975)		
To State	0.2582	0.2770	0.3558	0.4763	1.0000
	(0.0646)	(0.0468)	(0.0096)	(0.0004)	

Intercorrelations For Question 22

	Achievement	Instruction	Feedback	Strengths	Parents	Classwork	Homework
Achievement	1.0000						
Instruction	0.7611	1.0000					
	(0.0000)						
Feedback	0.7351	0.7417	1.0000				
	(0.0000)	(0.0000)					
Strengths	0.6835	0.6455	0.6912	1.0000			
	(0.0000)	(0.0000)	(0.0000)				
Parents	0.6192	0.6874	0.6485	0.6810	1.0000		
	(0.0000)	(0.0000)	(0.0000)	(0.0000)			
Classwork	0.6918	0.6395	0.7667	0.8056	0.7482	1.0000	
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)		
Homework	0.6728	0.6714	0.7451	0.8040	0.7388	0.9655	1.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	

Intercorrelations For Question 27: Support Content Learning

	Scaffolding	StudentTeacher	Paraphrasing	Wait Time	Feedback
Scaffolding	1.0000				
StudentTeacher	0.5019	1.0000			
	(0.0001)				
Paraphrasing	0.4853	0.4576	1.0000		
	(0.0002)	(0.0006)			
Wait Time	0.5257	0.2996	0.6375	1.0000	
	(0.0001)	(0.0293)	(0.0000)		
Feedback	0.3506	0.4149	0.2906	0.2646	1.0000
	(0.0101)	(0.0020)	(0.0348)	(0.0556)	

Intercorrelations For Question 27: Student Strategies

	StudentStudent	Peer Assess	Self Assess
StudentStudent	1.0000		
Peer Assess	0.2112	1.0000	
	(0.1289)		
Self Assess	0.3105	0.8748	1.0000
	(0.0237)	(0.0000)	

Intercorrelations For Question 27: Oral Language Strategies

	Clarify	Adapt Speech	English Only	Translation	Allow Primary	Use Primary	Practice
Clarify	1.0000						
Adapt Speech	0.5555	1.0000					
	(0.0000)						
English Only	-0.2268	-0.1954	1.0000				
	(0.1059)	(0.1650)					
Translation	0.3792	0.1270	-0.1998	1.0000			
	(0.0056)	(0.3695)	(0.1598)				
Allow Primary	0.6523	0.4661	-0.2521	0.3759	1.0000		
	(0.0000)	(0.0004)	(0.0714)	(0.0060)			
Use Primary	0.6769	0.4799	-0.2217	0.5228	0.7957	1.0000	
	(0.0000)	(0.0003)	(0.1142)	(0.0001)	(0.0000)		
Practice	0.3761	0.5248	0.0762	0.0172	0.2799	0.2305	1.0000
	(0.0055)	(0.0001)	(0.5914)	(0.9036)	(0.0424)	(0.0969)	

Intercorrelations For Question 27: Materials/Background

	Supplement	Adapt Text	Adapt Test	Background
Supplement	1.0000			
Adapt Text	0.5171	1.0000		
	(0.0001)			
Adapt Test	0.5732	0.5569	1.0000	
	(0.0000)	(0.0000)		
Background	0.4840	0.4402	0.4597	1.0000
	(0.0002)	(0.0010)	(0.0005)	

Intercorrelations For Question 28

	Background	Scaff Response	Scaff Expect	Clarify	Witness	Objectives	Language
Background	1.0000						
Scaff Response	0.6246	1.0000					
	(0.0000)						
Scaff Expect	0.4791	0.6990	1.0000				
	(0.0003)	(0.0000)					
ELL	0.5895	0.7158	0.4325	1.0000			
	(0.0000)	(0.0000)	(0.0014)				
Witness	0.2952	0.4509	0.3547	0.3631	1.0000		
	(0.0336)	(0.0007)	(0.0092)	(0.0081)			
Objectives	0.4271	0.5986	0.4726	0.5545	0.5020	1.0000	
	(0.0016)	(0.0000)	(0.0004)	(0.0000)	(0.0001)		
Language	0.3587	0.5035	0.4782	0.4796	0.4121	0.5262	1.0000
	(0.0090)	(0.0001)	(0.0003)	(0.0003)	(0.0022)	(0.0001)	

Intercorrelations For Question 29: General Language Skills

	Gen. Vocab	Grammar	Listening	Reading	Essays
Gen. Vocab	1.0000				
Grammar	0.5531	1.0000			
	(0.0000)				
Listening	0.5724	0.7641	1.0000		
	(0.0000)	(0.0000)			
Reading	0.5362	0.5362	0.6154	1.0000	
	(0.0000)	(0.0000)	(0.0000)		
Essays	0.4134	0.3338	0.3383	0.6339	1.0000
	(0.0023)	(0.0156)	(0.0142)	(0.0000)	

Intercorrelations For Question 29: Specialized Language

	Sci Vocab	Writing	Concepts	Evidence	Connections
Sci Vocab	1.0000				
Writing	0.3422	1.0000			
	(0.0121)				
Concepts	0.6098	0.4867	1.0000		
	(0.0000)	(0.0002)			
Evidence	0.4750	0.3612	0.7343	1.0000	
	(0.0003)	(0.0079)	(0.0000)		
Connections	0.5176	0.3776	0.5555	0.4953	1.0000
	(0.0001)	(0.0058)	(0.0000)	(0.0002)	

Intercorrelations For Question 30: Sorting/Organizing Information

	Classifying	Comparing	Seq Info	Enumeration
Classifying	1.0000			
Comparing	0.7183	1.0000		
	(0.0000)			
Seq Info	0.6688	0.6443	1.0000	
	(0.0000)	(0.0000)		
Enumeration	0.4830	0.4886	0.4573	1.0000
	(0.0002)	(0.0002)	(0.0006)	

Intercorrelations For Question 30: Providing Information

	Explanation	Description	Definition	Seq. Step	Labeling
Explanation	1.0000				
Description	0.6850	1.0000			
	(0.0000)				
Definition	0.5388	0.6023	1.0000		
	(0.0000)	(0.0000)			
Seq. Step	0.5599	0.6926	0.6488	1.0000	
	(0.0000)	(0.0000)	(0.0000)		
Labeling	0.6029	0.7270	0.6105	0.7563	1.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	

Intercorrelations For Question 30: Higher Order Thinking

	CauseEffect	Predicting	Generalizing	Inference	Hypothesis
CauseEffect	1.0000				
Predicting	0.4823	1.0000			
	(0.0003)				
Generalizing	0.4972	0.5250	1.0000		
	(0.0002)	(0.0001)			
Inference	0.5628	0.6523	0.5210	1.0000	
	(0.0000)	(0.0000)	(0.0001)		
Hypothesis	0.6524	0.6309	0.4860	0.7633	1.0000
	(0.0000)	(0.0000)	(0.0003)	(0.0000)	

Appendix H:
Additional High-Contrast Case Studies

Science Instruction in Mr. Grahame's Classroom (Low # of ELL students)

Background information. Mr. Grahame has been teaching for 16 years which is double the mean for the survey sample. He has a Bachelor's degree in Mathematics and holds both an elementary teaching credential and the Crosscultural, Language and Academic Development (CLAD) certificate from the State of California, not surprisingly then, Mr. Grahame is proficient in both Spanish and English. He has been teaching science at the 4th grade for seven years which puts him over the average of just over four for the survey sample. While Mr. Grahame reports taking 10-12 course for general pedagogy and teaching methods, he has also taken fewer specialized training courses (i.e., Science and ELL methods) than the sample overall, with just one-two courses of each.

There are 31 students in Mr. Grahame's classroom, six more students than the survey average. He reports almost equal numbers of boys and girls. The majority of students (87%) are at the "Basic" level on the CST for ELA. A further 13% are below Basic or far below Basic, and just 9% are at or above the "Proficient" levels. Mr. Grahame was not sure whether any of his students came from economically disadvantaged backgrounds, but given he teaches at the same school as Mrs. Troy we can assume that the demographics are comparable in the two classrooms. Four (13%) students were reported to be ELL students at the "advanced beginner" level according to Mr. Grahame. To accommodate these students' learning he reports using lots of manipulatives and speaks Spanish to the students. In terms of science instruction, the class receives three 60-minute lessons per week. Three observers were involved in rating these lessons; one observer was present at both sessions but joined by a different observer each time. In his debriefing interview, Mr. Grahame reported that the two lessons we observed were mostly typical of his instruction (other occasions he has included reading followed by discussion)

Summary. Overall, the observer ratings bare close resemblance to those of Mr. Grahame's reported practices on the survey. With the exception of developing laboratory techniques rated higher by one pair of observers, the teacher survey ratings were almost always slightly higher than the observer ratings. In terms of ***Opportunity for Science Learning*** and consistent with our observations, Mr. Grahame reported a relatively wide repertoire of science instructional practices and a mid to high emphasis on all instructional practices with the exception of a lower emphasis on rote memorization. Unlike most of the survey respondents, Mr. Grahame reported different levels of emphases for ELL and Non-

ELL students: He placed greater emphasis on knowing basic facts and understanding key concepts and how they applied to everyday life for ELL students than for Non-ELL students. In terms of ***ELL-Specific Science Instruction*****,** contrary to our observations, Mr. Grahame reported frequently using a multitude of ELL instructional strategies and no "English-only" approaches.

There was, however, slightly better agreement between Mr. Grahame's report and our observations for ***Academic Language Exposure***, particularly with the wide variety and the mid to high emphases on academic language practices observed at the second session if not at the first session. Again, Mr. Grahame reported spending different amounts of time on certain language functions for ELL and Non-ELL students with slightly less time allotted to most functions with ELLs. While he reported mid to high values for nearly all functions across the two groups of students, the observers reported a focus on a narrower repertoire much less frequently used (i.e., description, definition, sequencing procedural steps, labeling, enumeration, and at the first session hypothesis-generation). Finally, in his debriefing interview, Mr. Grahame gave feedback on the survey itself, indicating that he thought the content was "95% very applicable" of his instructional practices in science.

Science Instruction in Ms. Llosa's Classroom (High # of ELL students)

Background information. With just three years of teaching, Ms. Llosa was the most junior of the case study teachers we observed and thee current school year was the first year she had taught science at the 4th grade. She has a Bachelor's degree in Child Development and holds both elementary and bilingual teaching credentials. Ms. Llosa is proficient in both Spanish and English. While she reported no specific in-service courses she ahs taken she mentioned weekly planning sessions as the source for training in science content and teaching methods as well as ELL teaching methods and general pedagogy and teaching methods.

The composition of Mrs. Llosa's classroom mirrors that of her colleague Ms. Gomez, with 25 students and the 17 girls far exceeding the eight boys. All students are ELL students from disadvantaged backgrounds. Ms. Llosa reported using Spanish that the students already knew in order to make sure they understood science concepts. This teacher also did not report the percentage of students at the different levels of the CST for ELA. Ms. Llosa reports teaching two-four science lessons per week that, at just 35-45 minutes each, last below the sample average of 49 minutes. Three observers were involved in rating these lessons; one observer was present at both sessions but joined by a different observer each time. In her debriefing interview, Ms. Llosa reported that the two lessons we observed were "pretty" typical of her instruction with the format of a “mini-lesson” followed by an activity. Other formats she uses that were not observed in these lessons, included research on computers, read-alouds and watching videos.

Summary. Overall, the observer ratings and those of Ms. Llosa’s reported practices on the survey were very similar. In terms of ***Opportunity for Science Learning***, while the observers rated a subset of the instructional practices (e.g., knowing basic facts, conducting inquiries) reported by Ms. Llosa, the degree of emphases for these was comparably high in many cases. In terms of ***ELL-Specific Science Instruction*****,** Ms. Llosa reported using all the listed strategies nearly always with the exception of “English-only” approaches which she rated as 2. The observers also reported observing a large number of strategies but there was some discrepancy across observers in the values of the ratings (ranging from low to high), although they did agree with each other and with Ms. Llosa on the *non*-exclusivity of an “English-only” approach.

With the notable exceptions of not observing opportunities for authentic scientific discourse or any emphasis on science essay writing skills, there was generally good agreement between our observations of ***Academic Language Exposure*** and Ms. Llosa’s reported use of academic English instructional strategies and emphases. She had a wide repertoire here and this was self-rated as mid to high and largely corroborated by the observers. Ms. Llosa gave a high rating to the use of nearly all academic language functions. The observers reported a slightly narrower repertoire, somewhat less frequently observed (i.e., at the first session, definition, sequencing procedural steps, prediction and hypothesis-generation, and at the second session, comparing/contesting, sequencing information, sequencing procedural steps, enumeration, prediction, inference, and hypothesis-generation).