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A First Look: Are Claims for Alternative Assessment Holding Up?

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INTRODUCTION

Educational policy makers at the national, state, and local levels continue to act on their beliefs in the power of educational assessment to improve schools. Through new mandated assessments, policy makers believe they can communicate standards; motivate and monitor progress toward attainment of those standards; provide useful feedback to all in the school community; and hold schools, and the teachers and students within them, accountable for improved performance. Their beliefs are bolstered by research showing that traditional testing has encouraged teachers and students to focus on what is tested (Herman & Golan, 1991; Madaus, 1991; Shepard, 1991). Unfortunately, due to the test content on traditional standardized tests, this teaching-to-the-test has resulted in a distortion of the curriculum for many students, narrowing it to basic, low-level skills (Herman & Dorr-Bremme, 1983; Herman & Golan, 1991; Kellaghan & Madaus, 1991; Shepard, 1991; Smith & Rottenberg, 1991). The result: Teachers, administrators, and policy makers across the country are seeking new kinds of assessments whose content will reflect rigorous standards for student accomplishment; thus, these new assessments will encourage schools to teach and students to learn the complex knowledge and problem-solving skills needed for future success.

Unlike traditional tests, new alternative assessments encourage students to think critically and draw their own conclusions to complex problems. Rather than asking students to select answers to short, discrete questions—often devoid of real-world context or application—these new assessments invite students to create extended responses, using multiple modes of representation. New assessments minimize the importance of rigid time constraints; they also encourage students to use tools (such as calculators) to help them in solving the novel problems on the assessment. Students' responses to real-life, "authentic" problems are scored by educators exercising judgment, not by machines reading "bubbles"; students' thinking processes, as well as their products, are often taken into consideration in the scoring rubrics.

Claims for these new kinds of assessments are frequent in the literature and on national conference agendas. One claim is that these assessments truly stimulate students to engage in complex thinking and thus reflect higher standards of excellence than old-style standardized tests. Their ability to target higher level thinking and problem-solving skills makes these assessments suitable targets for instruction. Of course, a critical link in the policy chain is the necessity of having teachers who are prepared to help students develop the complex knowledge and skills that these assessments aim to teach. Another claim is that students will find these assessments more meaningful and motivating than traditional tests. These claims stem from the realistic and complex nature of the problems: *All* students should be encouraged by these types of tasks to show what they know and can do, rather than just those students who are motivated by the external rewards afforded them in high standardized test scores. Finally, a third claim has been that perhaps these new types of assessments will help close the equity gap seen on traditional tests.

While the rhetoric is abundant, due to the relative newness of alternative assessments evidence substantiating the above claims is just beginning to be accumulated. Furthermore, national and state dialogues have been relatively silent about the potential equity issues posed by these new assessments. Some researchers, however, have begun to articulate significant equity issues which need to be investigated for new assessments. For example, the CRESST criteria for judging the quality and validity of an assessment highlight fairness as a major concern (Herman, 1992; Linn, Baker, & Dunbar, 1991). Does an assessment equitably consider the cultural background of all students taking the test? Beyond traditional concerns for stereotyping, bias, and differential item functioning, does an assessment enable all students to demonstrate their real progress and capability? Is it motivating for all students? Winfield and Woodard (1992, 1994) warn that alternative measures are at least as likely as traditional measures to disadvantage students of color; they fear that because there will be time to administer only a relatively small number of alternative assessment tasks, the probability increases that those tasks will unfairly represent tasks more familiar and meaningful to the dominant culture.

Linn et al. (1991) point to additional fairness concerns stemming from students' *opportunity to learn* that which is assessed on alternative assessments. Opportunity to learn (OTL) is defined as the instructional opportunities and access to resources that would enable students to develop the complex thinking and problem-solving skills that are the targets of the new assessments. Since research suggests that disadvantaged students have been the most negatively affected by the traditional test-driven curriculum, these students have probably had the *least* opportunity to develop complex thinking skills and deep understanding (Herman & Golan, 1993). Further, there are concerns that some of the resources and tools that are critical to new ways of teaching and learning—calculators, scientific manipulatives, other instructional artifacts—will be differentially available to schools serving different communities. As a result, some fear that the differences between high and low socioeconomic status (SES) students will be even more dramatic on alternative assessments than on traditional ones.

Overview of the CLAS Study

The study reported here is a preliminary investigation of some of the claims made regarding alternative assessment. Using the California Learning Assessment System (CLAS) Middle Grades Mathematics Performance Assessment as a platform, the study examined how alternative assessment operates in actual practice. Do the claims discussed above hold up? In this paper, we present early findings in three areas:

- Students' *approaches* to novel open-ended tasks as compared to familiar multiple-choice tasks;
- Students' *attitudes* towards novel open-ended tasks as compared to familiar multiple-choice tasks; and
- Students' *opportunity to learn* the skills and tasks on the new assessment, compared across students of different cultural backgrounds and SES levels.

At the forefront of state efforts to design new approaches to assessment, the CLAS provides a good opportunity to investigate such issues. The assessment program features a matrix sampling design, and at the middle grades (eighth-grade level) uses a total of eight mathematics assessment forms. Each assessment form consists of two sections, the first containing two open-ended tasks and the second composed of eight multiple-choice items. The two open-ended tasks are designed to pose authentic, relevant problem situations for students to solve; the multiple-choice items are intended to assess mathematical thinking. In the future, the CLAS plans gradually to phase in other assessment types, such as multiday mathematical investigations and portfolios.

METHODOLOGY

Design of the CLAS Study

The study's original design sought to contrast schools across the state serving diverse school communities. Because of equity concerns, the contrasts of particular interest were between schools serving relatively affluent suburban communities and schools thought to be potentially at risk—those serving inner-city, economically disadvantaged communities and those in more geographically remote rural areas. In addition, because inner-city students were considered most at risk, and because the cultural implications of authentic tasks seemed deserving of inquiry, we deliberately planned to overrepresent inner-city schools and to have majority representation of various cultural minorities (African-American, Latino, and Asian-American). Within each school, we planned to randomly select three eighth-grade math classes for study. These classes were to represent the range of eighth-grade classes typically taught at that school.

Our study design was based on a larger pilot study conducted by the state and largely dependent on their volunteer sample. As a result, our initial design specifications were not fully realized. The final sample consisted of 13 schools across the state, distributed over three broad categories of schools: urban, rural, and suburban. It encompassed 27 teachers (including 66.7% from urban schools, 14.8% from rural schools, and 18.5% from suburban schools) and over 800 students (including 58.4% from urban schools, 20.2% from rural schools, and 21.4% from suburban schools). (See Table 1 for a breakdown of the school sample.)

The urban schools were all economically disadvantaged and reflected a range of ethnic diversity—principally Latino; mixed African-American and Latino; mixed Asian-American and White; mixed White, African-American, and Latino. The suburban schools served predominantly White and some Asian-American high wealth communities. The rural schools were mixed in socioeconomic status and served mainly White and Latino students. See Table 2 for an ethnic breakdown of the students in our sample and Table 3 for breakdown by socioeconomic status indices, based on demographic data supplied by the state.

Table 1

Breakdown of Schools Participating in the CLAS Study

Type of school	Number of schools	Number of classes
Urban	9	24
Rural	2	6
Suburban	2	6

Table 2

Percentage of Students of Each Ethnicity by School Type

Type of school	African-American	Asian-American	Latino	White
Urban	32.8	20.3	25.1	20.5
Rural	—	—	33.3	66.7
Suburban	1.9	25.7	3.8	68.1

Note. Percentages may not sum to 100% due to small Native American populations.

Table 3

Socioeconomic Status of Participating Schools: Percentage of Students Reporting Various Parents' Education Levels by School Type

Type of school	Not high school graduate	High school graduate	Some college	College graduate	Has advanced degree
Urban	22.9	21.0	24.8	23.5	7.8
Rural	6.3	18.8	43.8	25.0	6.3
Suburban	1.3	1.9	16.3	39.4	41.3

Instrumentation

The study utilized six different data sources: (a) classroom observations of CLAS administrations (focusing on special, pilot study CLAS administrations where all students responded to a common form); (b) student surveys; (c) student retrospective interviews; (d) teacher interviews; (e) collection of instructional materials, including samples of classroom assignments and tests; and (f) archival data on student grades, attendance records, and standardized test scores. This paper includes data from the first four sources only.

Classroom observations. Special, pilot-level CLAS administrations were observed by two researchers. Using a standard protocol, observers collected information on administration conditions, students' reactions to the assessment, their engagement level, their use of calculators, and how much time students spent on the assessment (see Appendix for copies of all the instruments).

Student surveys. All students in sampled classrooms completed a survey on the day following the administration of the pilot-level CLAS. The survey solicited students' views on a number of issues, including: students' instructional experience with and preparation for the specific knowledge, skills, and task types encountered on the CLAS; their access to calculators at home and at school; their attitudes towards math in general; and their affective responses to open-ended tasks compared to multiple-choice tasks.

Retrospective student interviews. In-depth student interviews were conducted with six students randomly chosen from each classroom. The individual student interviews allowed researchers to obtain more detailed information on student responses to the open-ended and multiple-choice tasks included in the assessment. Think-aloud protocols asked students to recreate their thinking processes and expectations as they approached and tried to solve one of the two open-ended tasks and the first multiple-choice item included on the common form. The interviews also asked students to explain how they thought each task would be scored, their level of preparation for specific items, and their relative preferences, along a number of affective dimensions, for open-ended versus multiple-choice problems.

Teacher interviews. Finally, teacher interviews were conducted to obtain information about teachers' educational background and teaching experience, particularly in mathematics; their pedagogical practices; their familiarity with and the extent to which they prepared their students for CLAS-type items; calculator instruction and use in their classrooms; and their reactions to the CLAS. In addition, during the interview, teachers were asked to provide researchers with (a) descriptions of major assignments given to students during the year and (b) samples of tests and quizzes given during the year.

Student data. Subsequent to on-site data collection, schools were asked to provide data on individual-level student grades, attendance, and standardized test scores. While not available for this current report, the study also will have access to state data, including actual student performance on the assessment and individual demographic and special program participation information solicited via the Student Information Form.

Data Coding and Reliabilities

Categories for coding responses to open-ended questions on our instruments were derived by reviewing a sample of responses; the major themes and/or key ideas so identified were then operationally defined and used to categorize each response.

Interrater reliability was established by double coding a set proportion of responses, with the proportion varying depending on the complexity of the coding categories. Because of their complexity, all student retrospective interview responses dealing with how students approached individual assessment tasks were coded by two raters; interrater agreement on these questions ranged from 0.69 to 1.0, with a median of 0.91. Only a sample (25%) of the student interview open-ended attitude responses was double-coded since coding categories for these were more straightforward. Interrater agreements on these items confirmed this judgment, as rater agreements ranged from 0.85 to 1.0, with a median of 0.94.

Similarly, 25% of the open-ended responses on the classroom observation forms and teacher interviews were double-coded. Interrater agreements from these coding schemes were similarly high; correlation coefficients ranged from 0.78 to 1.0, with a median of 0.93.

Data Analyses

Data were coded at the individual student and classroom levels, where possible. Analyses then were conducted at either the individual or classroom levels, depending on the specific variable of interest. Individual-level analyses were used to explore students' approaches to the assessment and students' attitudes—areas where individual differences were likely to be predominant. Student responses to individual items also were aggregated into two scales, based on factor analysis results. One scale denoted students' attitudes toward open-ended questions; the other related to their attitudes toward mathematics. Both chi-square and analysis of variance techniques were used to explore differences in individual-level responses by school type.

Our analyses of differences in classroom practices, however, utilized the *classroom* rather than the individual student as the unit of analysis. Thus, data collected from students that explicitly measured classroom-level opportunity to learn (OTL) variables were aggregated as classroom means on these specific measures, and then analysis of variance was used examine differences in classroom experiences by school type (i.e., urban, rural, and suburban). Note that the relatively small sample of teachers and classrooms represents a significant constraint on the power of our analyses and an important caveat in interpreting some of the results that follow.

In the sections below, we present preliminary results on claims made regarding alternative assessment in three areas: students' approaches to novel open-ended and familiar multiple-choice tasks, students' attitudes toward these two types of tasks and toward mathematics in general, and general issues in students' opportunity to learn. Note that additional analyses are continuing, examining in greater detail equity in opportunity to learn and drawing on state data of student performance and demographic data.

RESULTS

The Novel and the Familiar: How Do Students Approach CLAS Mathematics Tasks?

Data on the ways in which students approach tasks on the CLAS and, more particularly, on whether there are differences in how students approach novel open-ended and more familiar multiple-choice items come principally from the observations of CLAS administrations, the teacher interviews, and the student think-aloud interview protocols.

- Observation data collected during the assessment itself were used to characterize students' approaches in terms of how much time students spent working through open-ended problems, how much time they spent on the assessment in general, the kinds of questions students had during the assessment, and when—if at all—students utilized calculators on the CLAS.

- Teacher interview data were used to clarify calculator use during the assessment by indicating how accessible were calculators in students' daily lives, what restrictions teachers put on calculator use in the classroom, and what kind of instruction on calculator use students had received.

- Data from student interviews following the CLAS administration elucidated how students tackled open-ended and multiple-choice CLAS tasks. Which aspects of solving the CLAS tasks did students perceive as important? Did students pursue mathematics-based reasoning to solve the tasks, or did they use a trial-and-error approach? Did student guessing vary by the type of problem they were engaged in solving?

This section strives not only to describe students' approaches to the CLAS in general, but also to compare responses across problem type and across schools: Are there differences in students' approaches to open-ended and multiple-choice problems? Are these differences consistent with the claims made for alternative assessment? And are there differences in how students in different types of schools responded to the CLAS tasks?

Students' Use of Time During the Assessment

Ideally, open-ended problems are designed to engage students in in-depth, complex, and extended thinking, in contrast to typical selected-response items. Because the CLAS was not intended as a timed test, and in fact teachers were instructed to "make special arrangements for students who are still productively engaged at the end of 45 minutes, providing additional time for them to complete their work," observation of the time students actually spent on the assessment gives some indication of their engagement level and the ease with which they completed the novel assessment. In addition, because an open-ended item appeared first on the assessment, observers were able to note how long students spent on that item—or at least whether students spent the time assessment developers had estimated was required for a thoughtful response. The extent to which students used the 15 minutes anticipated for such items provided another indicator of students' engagement in open-ended items.

Table 4 shows the distributions of students in observed classes using at least 15 minutes to complete the first open-ended item. In general, most classrooms had 75% to 100% of their students spending at least 15 minutes on the first open-ended problem. However, results also indicate significant differences in schools serving different types of communities, $\chi^2(8) = 28.92$, $p = .0003$. Whereas in 100% of the suburban classrooms observed, almost all of the students used at least the allotted 15 minutes to answer the first open-ended problem, such extended concentration by most students was observed in only 37% of the urban classrooms. In nearly half the urban classrooms, 50% or more of the students were observed to have moved on earlier in the period. Students in rural classrooms more closely resembled the suburban students, with most students in about three-quarters of the classrooms using the full 15 minutes to answer the first problem.

Table 4

Class Distributions: Percentage of Students Using at Least 15 Minutes to Answer the First Open-Ended Problem by School Type (CLAS Administration Observation Results)*

Type of school	A few students	About 25% of students	About 50% of students	About 75% of students	Almost all students
Urban	4.9	12.2	31.7	14.6	36.6
Rural	0	4.3	4.3	17.4	73.9
Suburban	0	0	0	0	100
Totals	2.4	7.1	16.7	11.9	61.9

*$p < .05$.

Analysis of variance showed similar significant differences, $F(2) = 15.47$, $p < .0001$. On a scale of 1 (*No students in the class used the full 15 minutes*) to 6 (*Almost all students used the full 15 minutes*), the overall mean for all classrooms was 5.24; but, the mean for urban classrooms was 4.67, the mean for rural classrooms was 5.61, and the mean for suburban classrooms was 6.00. An HSD Tukey test indicated significant differences between urban and rural schools ($p < .05$) and between urban and suburban schools ($p < .05$); no significant difference was found between the rural and suburban classrooms. Thus, students in urban classrooms appeared less engaged by and less involved in extended problem solving on the first open-ended question than did other students.

Observers also were asked to estimate the percentage of students who completed the CLAS during the regular assessment period (see Table 5). Overall, in most classrooms, 75% to 100% of the students finished during the allotted time period. Significant differences across school types were again found, $\chi^2(12) = 31.87$, $p = .001$. In almost all suburban classrooms observed (94%), most or all students finished the assessment during the regular assessment period, while in only two-thirds of the urban classrooms did observers report that most students finished during this period. Rural schools showed the lowest completion rate, with most students finishing within the allotted time in only 35% of the rural classrooms observed.

The results regarding time usage on the first open-ended problem may indicate urban students did not fully develop their responses to the open-ended task and perhaps were frustrated by it. Compared to students in other schools, urban students apparently had less to say in response to the first question and

Table 5

Class Distributions: Percentage of Students Completing the CLAS Within the Regular Assessment Period by School Type (CLAS Administration Observation Results)*

Type of school	None	A few students	About 25% of students	About 50% of students	About 75% of students	Almost all students
Urban	5.3	10.5	2.6	2.6	13.2	65.8
Rural	0	4.3	0	17.4	43.5	34.8
Suburban	0	0	0	0	0	94.1
Totals	2.6	6.4	1.3	6.4	19.2	62.8

*$p < .05$.

tended to rush through their response. Among other things, their haste may indicate a lack of background knowledge to fully respond to the items, insufficient experience with such items, and/or a lack of motivation or interest in the item.

The differences that emerge between time spent on the first open-ended item and that spent to complete the entire assessment, at face value, seem contradictory. Although students in urban classrooms seemed to move more quickly through the first open-ended problem than students in suburban or rural classrooms, urban students were less likely to complete the full assessment in the 45 minutes generally allocated to it. Where did urban students spend their time? Is it possible that these students spent much more time on the multiple-choice problems, indicating they had greater difficulty with these items than students in other schools? As shown later in this report, the trial-and-error approach some students used to solve multiple-choice items may have caused them to spend a long time on such problems. It is also possible that students revisited their responses to the open-ended tasks later on in the assessment period, and worked back and forth between the open-ended and multiple-choice items. While it also is conceivable that teachers at the different school types reacted differently to the time constraint, influencing how comfortable students felt in continuing to work past the allotted time period, it does appear that students in rural and suburban schools had more efficient strategies for completing the assessment.

Questions Arising During the Assessment Administration

The kinds of questions students have during the administration of a new assessment provide an estimate of what difficulties they may be experiencing. While data collected during classroom observations indicated that students overall did not ask many questions during the CLAS (mean number of questions per classroom = 1.5, there were significant differences across schools, $F(2) = 3.21$, $p = .045$, (see Table 6). Suburban students asked the most questions (mean of 2.2 questions during the assessment), followed in frequency by urban students (mean of 1.4 questions) and rural students (0.8 questions on average).

For most types of questions (requests for more information, questions about specific math content, negative comments, and so on), no differences between schools were found. Differences, however, did arise in two areas. First, students in suburban classrooms were far more likely than other groups to pose procedural questions, such as “Where do I work the problem out?” or “Where do I start the

Table 6

Questions During the CLAS Administration by School Type (CLAS Administration Observation Results)*

Type of school	Mean number of total questions	% Classes with procedural questions	% Classes with "assumption" questions
Urban	1.44	29.3	43.9
Rural	.83	39.1	39.1
Suburban	2.17	63.6	4.5

*$p < .05$.

multiple-choice?" ($\chi^2(10) = 25.01$, $p = .005$). While posed in less than one-third of the urban classrooms and in about 40% of the rural classrooms, procedural questions arose in almost two-thirds of the suburban classrooms (see Table 6).

Contrary results were found regarding questions about a key term in the "thinking curriculum" for mathematics. The second open-ended question on the common form asked students, among other things, to state their assumptions. As Table 6 indicates, students in less than 5% of the suburban classrooms raised questions about the meaning of this term, but in about 40% of urban and rural classrooms, students asked for clarification, $\chi^2(8) = 15.43$, $p = .05$. Clearly, since questions in general tended to be raised less often in rural and urban classrooms than in suburban ones, the different frequency on the "assumption" issue cannot be attributed to students' propensities for asking questions. Rather, these findings seem to indicate that relative to suburban students, students in rural and urban schools are less familiar with an important concept in mathematical thinking and problem solving: making and using assumptions. Although this may be a problem of technical vocabulary, as opposed to underlying concept understanding, it is clear that some urban and rural students were at a disadvantage when solving the second open-ended task.

Students' Access to and Use of Calculators During Administration

New ideas in the teaching of mathematics emphasize the importance of using tools to help solve problems. In addition, concern for equity demands that mathematical tools such as calculators be available and equally accessible to all students, not just students whose parents can afford them, and that all students be able to approach mathematical problems with such tools in hand. Teacher interviews supplied data on the availability of calculators, students' previous experience with calculators, and the constraints teachers place on calculator use in the classroom. In addition, classroom observations provided information on the extent to which calculators actually were used during the assessment.

According to teacher reports, there were no significant differences across schools in the number of students who have their own calculators: Teachers across all schools claimed that most students have calculators. However, there did appear to be trends across school types in the sources of these tools. Urban teachers reported that their schools provided calculators for almost all students (mean of 4.5 on a 5-point scale where 5 indicates that calculators are provided for all students, and 1 indicates no calculators are provided), while rural (mean of 4.0) and suburban (mean of 3.0) schools tended to provide calculators for only some students, $F(2) = 3.14$, $p = .057$. In contrast, teachers in suburban schools acknowledged that more of their students brought calculators to school from home (mean of 4.3) than those in rural (1.7) and urban (2.9) schools, $F(2) = 6.62$, $p = .004$, (see Table 7).

When asked about their students' competence in using calculators, teachers claimed that most of their students were competent, with no significant differences found among schools. In regards to classroom policies on the use of calculators, more than half the teachers (54.3%) indicated they allowed their students unrestricted use of calculators. Of those teachers who restricted

Table 7

Means Values for Calculator Availability and Calculator Use During the Assessment by School Type (Teacher Interview and CLAS Administration Observation Results)

Type of school	Calculators provided by school[a]	Calculators brought from home[a]	Students using calculators on the CLAS[b]
Urban	4.5	2.9*	2.7*
Rural	4.0	1.7*	2.8*
Suburban	3.0	4.3*	4.8*

Note. 1 = No students, 5 = Almost all students.

[a] Based on teacher interview data.

[b] Based on observation of CLAS administration.

*$p < .05$.

calculator use, almost all (94.1%) sometimes allow students to use calculators on tests. Again, no significant differences were found across schools.

Observation results on availability of calculators similarly indicated no differences across different school types: Almost all students, according to observers, had calculators available to them for the CLAS assessment. During the assessment itself, however, observation data suggested that students in suburban classrooms were significantly more likely than those in rural or urban schools to approach CLAS tasks with calculators in hand, $F(2) = 22.51$, $p < .001$, (see Table 7). In suburban classrooms, almost all students used calculators in completing the CLAS, while in urban and rural classrooms only some students did so.

Observers also noted in which parts of the assessment students were most likely to use calculators—the open-ended or the multiple-choice portions. Consistent with the previous findings, students in suburban classrooms were more likely than those in other classrooms to use calculators across all problems, $\chi^2(6) = 23.76$, $p = .0006$, (see Table 8). In almost all (91%) of the suburban classrooms, students were observed using calculators equally for both the open-ended and the multiple-choice sections of the assessment, while such uniform use occurred in only about half of the urban classrooms and about a quarter of the rural classrooms.

Student Perceptions of Performance Criteria

Because the CLAS contains both novel open-ended and more familiar multiple-choice problems, it provided an opportunity to examine students'

Table 8

Percentage of Classrooms Showing Different Patterns of Calculator Use on CLAS Tasks by School Type (CLAS Administration Observation Results)*

Type of school	Calculators not used	Used mainly on open-ended items	Used mainly on multiple-choice items	Used on both items (half-and-half)
Urban	5	22	22	51
Rural	0	39	35	26
Suburban	0	0	9	91

*$p < .05$.

understandings of the performance criteria for each question type. Clearly, how students approach a given task will be influenced by their expectations for what is required. In the retrospective interviews, students were asked what they thought their teachers would be looking for as they scored student responses to open-ended problems—how would their responses be graded? Parallel questions were posed about the multiple-choice problems. Responses were coded to indicate whether or not students mentioned any of the following dimensions as important in grading: (a) the correct answer, (b) the steps students used to solve the problem, (c) students' use of graphs, charts, or diagrams, and (d) the depth of students' explanations and understanding. Descriptive statistics were calculated to characterize student perceptions of the criteria, and these perceptions were compared across type of task.

Table 9 shows the distribution of students who mentioned each of the four criteria. For novel open-ended items, almost half (46%) of the students mentioned the importance of the quality or depth of their explanations; 51% mentioned attention to their use of diagrams, graphs and other visuals; 26% mentioned that the steps of their solutions would be important; and 26% thought the correct answer was an important element in scoring. In contrast, when asked about the multiple-choice items, 45% of the students indicated that scorers would be looking for the correct answer, while 34% mentioned the steps used to solve the problem (perhaps recognizing that if their method was not correct, they were unlikely to get the right answer). Diagrams were mentioned by only 1% of the students, and the importance of explanation was mentioned by only 16% of the students.

In addition to the information coded from the student interviews, students also were asked directly whether they thought or did anything differently when responding to open-ended problems compared to multiple-choice problems (see Table 10). Two-thirds of the students (66.7%) reported they approached open-

Table 9

Percentage of Students Mentioning Each of the Four Grading Dimensions (Student Interview Results)

Type of task	Correct	Steps	Diagrams	Explanation
Open-ended	26	26	51	46
Multiple-choice	45	34	1	16

Table 10

Percentage of Students Reporting Reasons for Approaching Open-Ended Items Differently From Multiple-Choice Items (Student Interview Results)

Own creation	No choices given	Use diagrams	Give explanations	Think harder
10.7	12.8	11.4	40.0	37.2

ended tasks differently. When asked *why* they reported differences, 40% of the students replied that they had to explain their thinking, and 37.2% reported that they had to think harder on open-ended items. Other answers (each mentioned by about 10% of the students) included the need to create their own answers, the use of diagrams, and the lack of given responses from which to choose. There were no apparent differences by school type.

It appears then that students do perceive different expectations for their responses on open-ended versus multiple-choice problems. Multiple-choice items are associated with the use of appropriate algorithms and the determination of a correct answer; open-ended items—on the other hand—are allied with the use of diagrams and the need to explain one's results. Students apparently are aware that open-ended tasks require a different type of approach than do the more familiar multiple-choice tasks.

Lines of Reasoning

Another aspect of students' approaches to CLAS tasks is the line of reasoning students use when solving the tasks. Do students pursue a mathematics-based reasoning approach to solve a given problem, or do they use a nonmathematically-oriented trial-and-error or guessing approach? Are there differences in how students approach novel open-ended tasks and how they approach familiar multiple-choice tasks?

Student retrospective interview responses were coded for type of reasoning students used, and descriptive statistics were calculated. "Mathematics-based reasoning" was defined as that which utilized disciplinary concepts (rightly or wrongly) or strategic lines of reasoning based on mathematical thinking—for example, students who reasoned about a problem "Well, the area of the larger square minus the smaller square should give you the shaded area and to get area from perimeter you . . ." Random trial-and-error approaches, in contrast, were nonlogical from a mathematics perspective—for example, taking the numbers in a problem and trying to play with them in some way to come up with an answer given in the multiple-choice alternatives:

> Well, first I tried to multiply them, but that wasn't an answer, then I thought about adding them but that didn't work either, so then I subtracted them which gave me 6 and then I divided by 2 because there were two of them and the number 3 was an answer.

These latter types of responses were combined with responses from students who admitted guessing. For the open-ended problems, students overwhelmingly followed some mathematics-based reasoning approach (whether correct or incorrect) rather than using a trial-and-error or guessing approach: Only 3% of the students' responses were coded as guesses. In contrast, 31% of the students used a trial-and-error or guessing approach on the multiple-choice items. These results are displayed in Table 11. Differences were also found across school types, with urban students more likely to guess on multiple-choice tasks than other students and suburban students more likely to use a correct line of reasoning, $\chi^2(4) = 44.18$, $p < .00001$.

Students also were asked in the interviews whether they guessed on tests. Over 80% of the students reported guessing on tests, and the results, shown in Table 12, showed nonsignificant trends across school types, $\chi^2(2) = 5.63$, $p < .06$. Two-thirds of suburban students reported guessing on tests, compared to 80% and over 85% of rural and urban students, respectively. When asked on which type of problem—open-ended or multiple-choice—they guessed more, students reported guessing more on multiple-choice problems, by a margin of 82.6% to 13.4%, with 4.1% of the students reporting there was no difference (see Table 13). No significant differences were found across school type for this response. When asked *why* they guessed more on the indicated problem, over 60% of the students reported that they guessed more on multiple-choice problems because the answer choices for these problems were available. Coding of students' comments during the retrospective interviews indicated that 35% of all students mentioned using the multiple-choice response alternatives as prompts to help them solve the problem.

Table 11

Percentage of Students Using Guessing or Mathematics-Based Reasoning Approach (Student Interview Results)

Type of task	Used trial-and-error or guessing approach	Used mathematics-based reasoning approach
Open-ended	3	97
Multiple-choice	31	69

Table 12

Percentage of Students Who Reported Guessing on Tests by School Type (Student Interview Results)*

Type of school	Guess on tests
Urban	85.7
Rural	80.6
Suburban	68.6
Total	82.0

*$p < .05$.

Table 13

Percentage of Students Who Reported Guessing More by Type of Problem (Student Interview Results)

Type of task	Guess more
Open-ended	13.4
Multiple-choice	82.6
No difference	4.1

Students reported a variety of ways they used the given alternatives to prompt their responses: Some students reported using the alternatives to check their work; others indicated selecting the "closest" alternative to the answer they had computed; and still others reported guessing from the given alternatives. A number of students also indicated they used the possible alternatives as a starting point, working backwards from these alternatives to the initial problem.

Summary

From the data presented, we can begin to paint a picture of how students approach the mathematics tasks found on the California Learning Assessment System. Our observations show differences in how long students spend on the open-ended tasks, on the one hand, and on the assessment as a whole, on the other. Students in low-SES urban schools appear to move through the open-ended items more quickly, but spend a longer time overall than students in other schools in the sample. In addition, students in low-SES urban schools experienced greater difficulty with the definition of a key term in mathematical thinking used in the CLAS directions ("assumption"), but asked fewer questions overall than other students. That they report guessing more on tests is perhaps another indicator that urban students are less prepared for the assessment than their peers. Fortunately, calculator accessibility and preparation was high for all students; however students in higher SES suburban schools tended to use their calculators throughout the assessment whereas students in urban schools tended to use them more sporadically.

Turning to comparisons across task types, students seem to understand the differences in approach necessitated by open-ended versus multiple-choice problems. They know that open-ended problems emphasize students' use of explanatory materials (e.g., graphs, charts, diagrams, and the quality of their explanations) and focus less on algorithms and the correct answer. Students seem to follow a mathematics-based reasoning approach—correct or otherwise—in responding to open-ended items; they approach multiple-choice items both logically and by using trial-and-error or guessing. Students use these alternatives in various ways to prompt their responses, marking different approaches to solving multiple-choice tasks than the more novel open-ended tasks.

What Are Students' Attitudes Toward Different Assessment Tasks and Mathematics?

As indicated in the introduction, the literature surrounding alternative assessment suggests that students will find alternative assessments more meaningful and motivating than traditional multiple-choice tasks and, furthermore, that students who engage in authentic tasks are likely to be more motivated to learn in school. Because the math CLAS uses both open-ended and multiple-choice questions, it provided an opportunity to investigate student attitudes towards these two different types of questions and toward math in general. Student surveys asked students a series of questions about their comparative reactions to open-ended and multiple-choice tasks and their attitudes toward mathematics. In addition, the retrospective interviews queried students about their relative perceptions of the two types of tasks, the reasons for their responses, their feelings about what they liked best and least about open-ended problems, and what advice they would offer another student who had to prepare for an assessment like the CLAS. Student responses were compared both across type of problem and by type of school.

Student Attitudes Towards Open-Ended Versus Multiple-Choice Problems

Students find open-ended tasks more challenging. Over half the students surveyed (55.3%) felt that open-ended problems made them try harder than multiple-choice questions, while only 11.2% reported they had to try harder on multiple-choice questions. (The remainder attributed no difference in effort to the two types of questions.) In addition, chi-square analysis indicated statistically significant differences by type of school, with students in rural schools less likely than other students to believe that open-ended tasks required more effort, $\chi^2(4) = 14.25$, $p = .007$ (see Table 14).

Students who participated in the retrospective interviews were even more united in their belief that open-ended questions are harder or more challenging to answer than multiple-choice questions. The vast majority (83.3%) reported that open-ended questions are more challenging, including 94.3% of the suburban students, 82.9% of the rural students, and 80.7% of the urban students. Asked why, nearly half of these students (48.9%) mentioned that open-ended questions are more challenging because they cause students to think harder, are more difficult, or are more complicated to answer. In addition, approximately one-third (37.4%) of the students pointed out that open-ended questions required them to explain their answer by showing their work, or to communicate their math knowledge verbally. About one-fourth of the students stated that open-ended questions are more challenging because students have to create an answer on their own (22.3%) or because alternative answers are not provided (23.6%) (see Table 15).

Table 14

Percentage of Students Reporting the Type of Question That Causes Them to Try Harder by School Type (Student Survey Results)*

Type of school	Multiple-choice	Same	Open-Ended
Urban	13.2	30.3	56.5
Rural	13.0	38.9	48.1
Suburban	4.5	36.4	59.1
Totals	11.2	33.5	55.3

*$p < .05$.

Table 15

Percentage of Students Giving Reasons Why Open-Ended Items Make Students Think Harder or Are More Challenging Than Multiple-Choice Items (Student Interview Results)

Harder	Explanation	Own creation	No choices
48.9	37.4	22.3	23.6

Students' perceptions of the relative challenge in open-ended versus multiple-choice tests, in short, mirror the intentions of proponents and developers of alternative assessments: Such items apparently require students to actively accomplish complex tasks. In addition, students may feel more challenged because alternative assessment is a relatively new approach, and thus students are less familiar with these types of questions and the processes they entail.

Students find open-ended tasks more interesting. Slightly more than half of the students surveyed—and almost two-thirds of those expressing a preference—indicated that open-ended questions were more interesting to solve than multiple-choice questions (see Table 16). Analyzing by type of school, a chi-square test shows that rural students are less likely than other students to express preferences for open-ended questions ($\chi^2(4) = 19.44$, $p = .0006$). Asked what they liked best about open-ended questions, interviewed students reported that they liked being able to create their own answer and having an opportunity to explain their answer and use graphs or diagrams in their responses; they also liked that the questions were challenging (see Table 17).

Table 16

Percentage of Students Reporting the Type of Question They Find Most Interesting by School Type (Student Survey Results)*

Type of school	Multiple-choice	Same	Open-Ended
Urban	27.2	21.0	51.8
Rural	41.0	19.3	39.8
Suburban	23.6	15.5	60.9
Totals	29.2	19.4	51.4

*p < .05.

Table 17

Percentage of Students Reporting What They Like Best About Open-Ended Problems (Student Interview Results)

Own creation	Explain	Harder	Graphs
13.8	26.7	28.6	11.9

Claims stating that open-ended problems are more relevant and thus more motivating to students than traditional problems are bolstered by these results. In addition, these findings are encouraging since alternative assessments strive to tap higher order cognitive processes or problem-solving skills and to encourage students to create or produce a response.

Liking is another matter. While the majority of students surveyed (60.8%) reported they were not frustrated by problems with more than one answer, only 39% of the students surveyed stated that they liked problems with no obvious solution. In addition, only 17.1% agreed that they liked problems that take a lot of time to solve. Suburban students reported being less frustrated than other students by problems with more than one solution, $F(2) = 4.37$, $p = .013$; no significant differences were found by type of school on the other two survey questions.

Confirming these responses, survey results indicate that more students prefer multiple-choice questions (60.3%) compared to the 17.4% who reported liking open-ended problems better (see Table 18). While still a minority, students

Table 18

Percentage of Students Reporting the Type of Question They Like Better by School Type (Student Survey Results)*

Type of school	Multiple-choice	Same	Open-ended
Urban	61.6	23.3	15.1
Rural	60.5	24.1	15.4
Suburban	56.9	17.8	25.3
Totals	60.3	22.2	17.4

*$p < .05$.

in suburban schools were more likely to express a preference for open-ended tasks than other students, $\chi^2(4) = 10.39, p = .034$.

Similar patterns were found in the interview results: Just over half of the students interviewed (53.6%) stated they liked multiple-choice tasks better than open-ended tasks. The reasons these students gave for liking multiple-choice questions included that these questions were easier (57.5%) and that the choices were given (40.7%). Reasons given for disliking open-ended questions included the need to explain answers, problems in understanding the questions, the difficulty of the questions, and the lack of clarity or enough information given in the questions (see Table 19).

Thus, it seems that although students report open-ended items to be more interesting, they still prefer multiple-choice items. Students' beliefs that multiple-choice problems are easier stem partly from the availability of response choices for these types of problems; in addition, multiple-choice problems may be perceived as easier because of students' familiarity with these types of items as compared to the relative newness of open-ended items.

Table 19

Percentage of Students Reporting What They Like Least About Open-Ended Questions (Student Interview Results)

Harder	Explain	No understanding	Not clear/Not enough information given
41.9	19.0	9.6	8.1

Students find multiple-choice items easier to understand. Because students frequently felt that open-ended questions were more difficult, it is not surprising to find that almost two-thirds of the students interviewed (64.6%) felt that in multiple-choice questions it was easier to understand what to do than in open-ended questions. Of the students reporting that multiple-choice questions make it easier to understand what to do, they attributed this ease to the choices offered (38.8%), the questions being easier (25.4%) or stated more clearly (17.9%), and the lack of a requirement to explain their answers (11.9%) (see Table 20). Students' responses, in fact, are similar to some of the criticisms that have been mounted against multiple-choice questions (e.g., neglect of complex thinking and problem solving). The familiarity of the multiple-choice format may also play a role in students' beliefs that these types of questions make it easier to understand what to do.

Consistent with their opinions about which type of problem makes it easier to understand what to do, more surveyed students felt they did better on multiple-choice questions (68.3%), compared to those reporting they did better on open-ended questions (14.2%), $\chi^2(4) = 9.47$, $p = .05$, (see Table 21). The familiarity of the multiple-choice format may again account for part of the reason for this judgment.

Table 20

Percentage of Students Reporting Why They Feel Multiple-Choice Questions Make It Easier to Understand What to Do Than Open-Ended Questions (Student Interview Results)

Choice offered	Clear	Easier	No explanation
38.8	17.9	25.4	11.9

Table 21

Percentage of Students Indicating the Type of Question on Which They Felt They Did Better (Student Survey Results)*

Type of school	Multiple-choice	Same	Open-ended
Urban	69.1	15.8	15.1
Rural	69.6	14.3	16.1
Suburban	65.3	24.4	10.2
Totals	68.3	17.4	14.2

*$p < .05$.

Students hold mixed opinions on which items best show their knowledge/abilities. The student survey and the student interview results yielded somewhat contradictory views of students' feelings about whether multiple-choice or open-ended questions best let them show what they know about math. Survey results found students about evenly split between multiple-choice and open-ended tasks, with significant differences found among the school types. Chi-square results, $\chi^2(4) = 21.38$ $p = .0003$, suggest that rural students are more likely to favor multiple-choice items: Over half the rural students surveyed indicated that multiple-choice items let them show their mathematics knowledge better than open-ended items. Urban students are more evenly split, while suburban students report open-ended items best let them show what they know about math (see Table 22).

However, interviewed students (who reviewed their responses to the multiple-choice and open-ended tasks prior to responding to this question) were more likely to believe that open-ended questions better enabled them to show what they know. Over half of the students (54.8%) so indicated, with no significant differences found by type of school. Almost two-thirds (64.6%) of these students stated that open-ended questions allowed them to explain their answers. Additionally, students reported that open-ended questions best let them show what they know about math because the questions were more challenging (20.4%), they did not provide choices for answers (12.4%), and students were allowed to create their own answers (8.0%).

Inconsistent findings between survey and interview responses are puzzling. It may simply be that students are unsure which type of question best lets them

Table 22

Percentage of Students Reporting What Type of Question Best Lets Them Show What They Know by School Type (Student Survey Results)*

Type of school	Multiple-choice	Same	Open-ended
Urban	38.1	24.4	37.4
Rural	54.9	20.4	24.7
Suburban	31.8	26.1	42.0
Totals	40.2	24.0	35.8

*$p < .05$.

show what they know because they are as of yet unfamiliar with how understanding of open-ended problems is assessed. In contrast, the manner in which multiple-choice responses are scored is clear and straight-forward.

Students give a variety of advice. At the close of the interview, students were asked what advice they would offer another student who had to prepare for an assessment like the CLAS. Students volunteered a variety of strategies, typically drawing from the preparation they themselves had experienced (see Table 23). Students most frequently mentioned the importance of studying course material, including practicing homework problems and reviewing notes. Students also mentioned metacognitive and test-taking strategies such as re-reading the assessment problems and checking their answers. In addition, students stated they would advise peers to pay attention in class, to listen to the teacher, to work hard in class, to make an effort, to stay calm, and to concentrate. No significant differences in advice given were found by school type.

Student Attitudes Towards Mathematics

Based on the survey results, students generally expressed modestly positive attitudes toward mathematics. The majority of the students agreed moderately or very much with the statements that they liked math (61.0%) and that they were good in math (65.4%), and they were almost unanimous in their belief that math

Table 23

Percentage of Students Mentioning Advice to Peers (Student Interview Results)

Type of advice	Mention advice
Study	62.6
Metacognitive	16.1
Class	14.2
Effort	13.7
Relax	6.6
Think	9.5
Take time	3.3
Easy	1.9
Hard	1.4

would be useful to them in the future (91.2%). There were no apparent differences in student attitudes associated with different types of schools.

Although students appeared to have positive attitudes toward mathematics and their mathematical abilities, they expressed less enthusiasm for their mathematics instruction. In response to the statement that learning math is mostly memorizing, the majority of students in urban and rural schools agreed moderately or very much; significantly fewer students from suburban schools held such a view (45%), $\chi^2(6) = 16.96$, $p = .009$. In addition, the majority of the students agreed that they did not like computational problems (52.8%) or projects that require math (63.0%) (see Table 24). With the exception of the item on memorization, no significant differences for these attitudes were found across school types.

Overall Attitudes Toward Mathematics and Open-Ended Items

As mentioned earlier, individual attitude items from the student survey were aggregated into two subscales. The first subscale was composed of items related to students' attitudes toward mathematics ($\alpha = .77$). The items that made up this scale were taken from students' responses to a question that asked them how well they agreed with several statements about mathematics. The items used for the first subscale were:

Table 24

Students' Attitudes Toward Mathematics: Percentage of Students Expressing Moderate or Strong Agreement by School Type (Student Survey Results)

Student attitude	Urban	Rural	Suburban
Like math	62.2	61.7	56.8
Good in math	64.0	64.2	69.9
Useful in future	90.9	90.5	92.0
Mostly memorizing	56.9*	59.2*	44.8*
Do not like computational problems	56.0	45.1	52.0
Do not like projects that require math	63.2	58.7	66.5

*$p < .05$.

- "I like math."
- "I am good in math."
- "I like to do computation problems."
- "I like to do math problems that don't have an obvious solution."
- "I like to do problems that take a lot of time to solve."
- "I like to work on projects that require me to use math."
- "I think math will be useful to me in the future."

The second subscale was a summary indicator of students' attitudes toward open-ended items ($\alpha = .63$). These items asked students to choose between open-ended and multiple-choice items where 1 was *Multiple-choice*, 2 was *About the same*, and 3 was *Open-ended* on the following items:

- "Which type of question did you find most interesting?"
- "On which type of question do you think you did better?"
- "Which type of question do you think showed better what you know about math?"
- "Which type of question did you like better?"

Confirming patterns in results of individual items, there were no differences by type of school in students' attitudes toward mathematics, but there were differences by school type in students' liking of open-ended problems. As Table 25 shows, students in rural schools were significantly less positive in their attitudes toward open-ended items than were students in other schools, $F(2) = 7.40$, $p = .0007$.

There was a modest relationship between students' attitudes toward mathematics and their liking of open-ended items ($r = .21$, $p < .01$). The relationship between students' attitudes and their performance will be investigated further, when performance data from the state become available.

Table 25

Students' Overall Attitudes Toward Mathematics and Open-Ended Items: Summary Subscales by School Type (Student Survey Results)

Overall attitude	Urban	Rural	Suburban
Like math	17.74	18.18	18.10
Like open-ended items	7.23*	6.69*	7.62*

*$p < .05$.

Summary

In general, students' perceptions of open-ended items are consistent with major aims of proponents and designers of alternative assessment: Students find such items more interesting and challenging than multiple-choice items and recognize that open-ended items require them to think harder, explain their thinking, and communicate their understanding of mathematical knowledge. At the same time, however, students do not necessarily like such challenges. In fact, students express a preference for multiple-choice items: They find multiple-choice items easier to understand and believe that they perform better on such items. Students in the rural schools in our sample were the least positive about open-ended items, while suburban students were relatively the most positive. These preferences may in part be due to the relative newness of open-ended items as compared to the comforting familiarity of multiple-choice items. Turning to student attitudes toward mathematics, students in all schools were only moderately positive about mathematics, but quite positive about the value of the discipline in their future. No differences were found across school type in these general attitudes.

What Is the Nature of Students' Opportunity to Learn the CLAS Content and Skills?

One of the study's key issues focused on students' opportunity to learn the complex mathematical thinking, communication, and problem-solving skills that the CLAS seeks to assess, and more specifically whether students in all schools—regardless of background and SES level—have equal opportunity to learn that which is assessed. Included in our definition of "opportunity to learn" were access to resources such as qualified teachers and appropriate instructional tools; access to the types of instructional content and processes likely to help students develop required knowledge and skills; and direct preparation and practice for CLAS-type assessments. We expected students who had different classroom experiences to have different perceptions of their own preparedness for the CLAS and to show different achievement levels on the assessment itself. We thus compared students' opportunity to learn across school types to address this hypothesis.

Access to Quality Resources

With regard to access to quality resources, the study gathered data from teachers on their preparation to teach mathematics, including their undergraduate fields, whether or not they were credentialed to teach mathematics, years of experience teaching mathematics, participation in recent professional development that would likely prepare them in the content and instructional practices of a "thinking curriculum" in mathematics, and preparation for the CLAS itself. Also examined was access to appropriate instructional materials, including calculators and recent textbooks.

Teacher preparation. Although only half of our teacher sample had either majored (23.1%) or minored (26.9%) in a mathematics field (including engineering and computer science), the majority of teachers (69.2%) were credentialed to teach mathematics. Rural teachers were significantly less likely to have such certification: While 82% of the urban teachers and 80% of the suburban teachers were so certified, only 25% of the rural teachers were. Similarly, suburban and urban teachers were more likely than rural teachers to have majored or minored in mathematics as undergraduates, with no rural teachers claiming an undergraduate degree in mathematics.

Similar patterns emerged when data on in-service education were examined. Overall, 65.4% of the teachers had participated in more than 35 hours of in-service education in mathematics and mathematics education. Urban and suburban teachers were more likely to have participated recently in extended professional development: Seventy-one percent of the urban teachers and 80% of the suburban teachers reported spending more than 35 hours over the last three years in in-service education in mathematics or the teaching of mathematics, while only 25% of the rural teachers reported that level of activity. No differences were found across school type in years of teacher experience teaching mathematics, with a mean of 11 years for the total sample.

Table 26 shows teachers' responses when questioned about their specific preparation for the CLAS. Teachers in general were not highly confident about their preparation to teach CLAS-type objectives, with no more than half the teachers representing each school type expressing that they felt "very well" prepared.

Table 26

Percentage of Teachers Expressing Preparation to Teach the CLAS by School Type (Teacher Interview Results)

Type of school	Not well	OK	Very well
Urban	8.7	60.9	30.4
Rural	16.7	33.3	50.0
Suburban	16.7	33.3	50.0
Totals	11.4	51.4	37.1

Instructional resources. Because the National Council of Teachers of Mathematics (NCTM) standards and the California Curriculum Framework in Mathematics are relatively new, it is unlikely that older texts are well aligned with the reform ideas of the new standards. Recency of texts thus can be seen as an important indicator of access to relevant instruction opportunities. In this regard, teachers' reports of their primary textbooks indicated students in urban classrooms were less likely to have recent texts than those in other schools in our sample, $F(2) = 5.30$, $p = .01$.

Access to calculators. Access to calculators is another indicator of the availability of instructional tools that reflect NCTM standards and the California framework. As described in the section on students' approaches to the CLAS, study data suggest no major differences between schools in students' access to basic calculators, although urban schools were more likely to provide them for students than were rural and suburban schools, and students in suburban schools were more likely to bring them from home. Of note is that for all types of schools, over 90% of the students have calculators at home. However, there is a difference in the type of calculators students have available to them at home: 62.7% of the suburban students have scientific calculators (as opposed to simple calculators) at home while only 43.5% of the urban students and 31.5% of the rural students have such calculators at home, $\chi^2(2) = 24.83$, $p < .0001$. Although scientific calculators are not required for the CLAS, the availability of sophisticated calculators may indicate more familiarity and ease of use with such tools.

Access to Learning Opportunities Appropriate to CLAS-Type Objectives

Perceived fit between instructional practices and the CLAS. Asked how well their instruction aligned with the material on the CLAS assessment, two-thirds of the suburban teachers said that they felt their classroom instruction (including texts, teaching, and assignments) was an “OK” or “Excellent” match with the CLAS assessment. Approximately half of the urban teachers (47.8%) and of the rural teachers (50%) felt their practices matched this strongly. Differences were not statistically significant.

In constrast, rural and urban teachers were more likely than suburban teachers to report that their students keep math portfolios—one of the hallmarks of the innovative practice because they are thought to encourage diversity of mathematics work, including math projects, writing, and investigations. Eighty-seven percent of urban teachers and 83.3% of rural teachers so reported, while only two (33.3%) of the suburban teachers reported having their students keep math portfolios, $\chi^2(2) = 7.92$, $p = .02$.

Student preparation for concepts assessed on the CLAS. Students and teachers were asked to gauge the extent to which their classes had prepared them for some of the math concepts included on the CLAS—focusing particularly on the content areas included on the common CLAS form that was used for the retrospective student interviews. Students were asked how well prepared they thought they were for fractions, area, perimeter, graphing data, distance/time problems, and ratios. Similarly, teachers were asked how much class time was spent on these same areas. Students and teachers alike seem to agree that students were at least somewhat prepared in each of these areas, except for distance/time problems in rural classrooms (Tables 27 and 28). While the patterns are somewhat irregular for teacher reports, for the most part students in the suburban schools tend to feel that they are better prepared in these content areas.

Teaching and instructional strategies which build complex thinking. Alternative assessment is intended to emphasize open-ended problems that require not only a solution but also an explanation of how the student arrived at such a solution; the assessment thus values both complex mathematical thinking and communication. Both students and teachers were asked how often they engage in instructional practices that are associated with the development of these skills. Regarding these, a majority of students reported that they often solve word problems, solve problems that require thinking and that can be solved

Table 27

Percentage of Classes That Spent More Than Six Class Sessions on Content Areas by School Type (Teacher Interview Results)

Content area	Urban	Rural	Suburban
Fractions	73.9	100.0	100.0
Area	47.8	83.3	50.0
Perimeter	40.9	66.7	33.4
Graphing data	78.2	66.7	100.0
Distance/time	34.7	83.4	50.0
Proportional reasoning	73.9	66.7	83.3

Table 28

Mean Comparisons of Student Ratings of Their Preparation in Various Content Areas by School Type (Student Survey Results)

Content area	Urban	Rural	Suburban	$F(2)$
Fractions*	2.68	2.38	2.86	26.92
Area*	2.34	2.32	2.70	16.50
Perimeter*	2.25	2.41	2.72	22.60
Graphing data*	2.34	2.54	2.59	9.15
Distance/time*	2.16	2.28	2.40	5.69
Ratios*	2.11	1.85	2.58	30.65

Note. 1 = Little or none, 3 = Very well.

*$p < .05$.

in more than one way, and use calculators (Table 29). Students were less likely to report working on problems for which they must explain their thinking; that take at least a week to complete; that reflect real-life problems; for which they use rulers, blocks or solids; or that require oral presentations. For comparison purposes, students also were asked how ofen they practice computations: Students in all classroom types, particularly those in suburban classrooms, reported frequent engagement in such practice. Computation practice, in fact, in general was the highest frequency activity of all those queried. No significant differences were found across school type for any of these activities, except for solving problems that take at least a week to complete in which suburban students engage less, $F(2) = 3.63$, $p = .038$.

Table 29

Mean Comparisons of Student Frequency Ratings of Their Engagement in Specific Activities by School Type (Student Survey Results)

Activity	Urban	Rural	Suburban	Totals
Practice computations	4.96	4.33	5.60	4.96
Practice word problems	4.21	4.42	4.59	4.31
Problems solved more than one way	4.31	4.64	4.77	4.44
Problems that require you to really think	4.20	4.83	4.63	4.38
Problems where you explain your thinking	3.54	3.97	3.16	3.55
Problems that take at least a week to complete	2.21*	3.17*	1.58*	2.27
Problems that apply to real life	3.48	3.68	3.58	3.53
Use calculators to solve problems	4.70	4.38	5.01	4.70
Use rulers, blocks, or solids	3.36	3.75	2.96	3.37
Give an oral presentation	2.42	2.99	1.82	2.42

Note. 1 = Hardly at all, 6 = A couple of times a week or more.

*$p < .05$.

Tables 30 and 31 display teachers' and students' responses regarding the frequency of another activity associated with innovative instructional practice: working in small groups. Students were consistently more conservative in their frequency estimates than were teachers, but according to the reports of both teachers, $\chi^2(10) = 24.77$, $p = .006$, and students, $F(2) = 7.80$, $p = .0017$, it is clear that students in suburban classes were unlikely to be engaged regularly in small-group work, while rural students in our sample were most likely to be so engaged.

Table 30

Percentage of Teachers Who Reported Work in Small Groups at Least Once a Week by School Type (Teacher Interview Results)

Type of school	Teachers*
Urban	63.6
Rural	83.3
Suburban	0.0

*$p < .05$.

Table 31

Mean Comparisons of Student Frequency Ratings of Small-Group Work by School Type (Student Survey Results)

Type of school	Students*
Urban	3.40
Rural	4.77
Suburban	2.09

Note. 1 = Hardly at all, 6 = A couple of times a week or more.

*$p < .05$.

We also asked students and teachers how often they worked on assignments that required extended writing (in the query to students, problems which required them to write a paragraph or more). Although student survey differences were not significant, teachers in urban and rural schools were more likely than teachers in suburban schools to report such activity, $\chi^2(10) = 19.39$, $p = .04$, (see Tables 32 and 33).

Table 32

Percentage of Teachers Who Reported Working on Problems Requiring Writing at Least Once a Week by School Type (Teacher Interview Results)

Type of school	Teachers*
Urban	73.9
Rural	83.3
Suburban	66.7

*$p < .05$.

Table 33

Mean Comparisons of Student Frequency Ratings of Working on Problems Requiring Writing by School Type (Student Survey Results)

Type of school	Students
Urban	3.00
Rural	3.49
Suburban	2.17

Note. 1 = Hardly at all, 6 = A couple of times a week or more.

Composite opportunity-to-learn scales. Based on a combination of factor analysis and theoretical assumptions, students' responses regarding specific classroom practices were combined into three overall scales. These provide a more reliable test of differences in students' opportunity to learn. Table 34 displays the scales and the individual items which constitute them; also displayed are the reliabilities (measures of how the scales hold together) associated with each scale, based on Cronbach's alpha (Cronbach, 1951).

The "communication" scale is made up of items that indicate how often students practice problems that require them to communicate how they are thinking. The "applied" scale refers to how often students practice practical problems using applied methods or real-life perspectives. The "preparation" scale focuses on how well prepared students felt for the specific math concepts required on the CLAS common form. Students in suburban schools engaged in less mathematical communication than urban and rural students, $F(2) = 6.05$, $p = .0059$, (Table 35). Students in suburban schools felt better prepared than urban and rural students for selected mathematics concepts required on the common form assessment, $F(2) = 28.73$, $p < .0001$; nonsignificant trends also support the possibility that suburban students practice computations more regularly than other students in our sample. ("Computation" denotes frequency of practice in computation, a single item unrelated to other subscales.)

Table 34

Classroom Learning Opportunity Scales: Composite Items and Reliabilities (Student Survey Results)

Mathematical communication scale (alpha = .66)	
	Problems which require you to explain your thinking
	Work in small groups
	Give an oral presentation
	Problems that require a written paragraph
Applied problem-solving scale (alpha = .69)	
	Practice word problems
	Problems that can be solved in more than one way
	Problems that require you to really think
	Problems that take at least a week to complete
	Problems that apply to real life
	Use rulers, blocks or solids
Topic preparation scale (alpha = .76)	
	Perimeter
	Graphing data
	Distance/time
	Fractions
	Ratios
	Area

Table 35

Opportunity-to-Learn Composite Scales: ANOVA Findings by School Type (Student Survey Results)

	Communication*	Applied	Preparation*	Computation
Urban	12.37	21.76	13.89	4.96
Rural	15.22	24.48	13.81	4.33
Suburban	9.25	22.12	15.86	5.60
Totals	12.32	22.29	14.32	4.96

*$p < .05$.

Homework. Students' responses about the frequency with which they were assigned homework and the difficulty level of that homework provide a possible window into why suburban students tend to report themselves better prepared than other students in our sample (Table 36). Time on homework presumably represents learning time and thus additional opportunity to learn. In this regard, suburban students reported being assigned math homework more often than did urban students, who in turn reported more homework than did rural students, $F(2) = 6.61$, $p = .004$. Whereas suburban students reported having homework four to five nights a week on average, and urban students reported having homework about three nights a week on average, rural students reported homework assignments only once or twice per week on average. No differences were found in the time students reported spending on each homework assignment (30 to 45 minutes on average) or in the difficulty level of that homework ("moderate" on average). The time in the context of frequency of homework, however, means that suburban students spend significant more time per week engaged in mathematics that their urban or rural peers.

Access to learning assistance outside of the classroom. We asked students to report the amount of help they received outside of class from teachers, friends, and family. There were no significant differences across school types in the amount of help students reported receiving from their family, with students reporting on average that they "sometimes" get help from family members.

Table 36

Mean Comparisons of Student Ratings Regarding Homework by School Type (Student Survey Results)

Type of school	How often homework is assigned[a]	How long it takes to finish homework[b]	How difficult homew is[c]
Urban	5.32*	2.57	3.03
Rural	3.54*	2.68	3.02
Suburban	6.58*	2.37	3.18

[a] 1 = Never, 7 = Every night.

[b] 1 = 15 minutes, 5 = More than one hour.

[c] 1 = Very easy, 5 = Very difficult.

$*p < .05$.

Differences were found, however, across school type in help received from teachers, with urban and rural students reporting on average receiving help "sometimes" to "usually" from their teachers while suburban students on average reported only "sometimes" receiving help from their teachers, $F(2) = 8.78$, $p = .0002$. Differences also emerged in patterns of help students reported getting from friends. Rural students reported on average "sometimes" or "usually" getting help from friends, whereas urban and suburban students reported "sometimes" at best (rural mean was 2.46; urban and suburban means were 1.92 and 1.94, respectively; $F(2) = 21.41$, $p < .0001$).

Preparation for the CLAS

Students' perceptions of preparedness. Teachers and students also were queried about their direct preparation for the CLAS. Table 37 shows how well students felt they were prepared for the CLAS. A one-way analysis of variance indicated that suburban students are significantly more confident about their preparedness for the CLAS than urban students, who are more confident than rural students, $F(2) = 29.77$, $p < .0001$. It is possible that—having done well on previous standardized tests—students in suburban schools generally have more academic self-confidence than students in either rural or urban schools.

Teacher reports on direct preparation. Almost all teachers indicated that they engaged their students in specific activities to prepare students for the CLAS. The state provided schools with a "CLAS Mathematics Sampler" to acquaint teachers and students with the type and nature of assessment they would encounter on the CLAS. The Sampler, as the name implies, included sample problems, and teachers were free to assign and work through these problems with

Table 37

Mean Comparisons of Student Ratings of Their Preparation for the CLAS by School Type (Student Survey Results)

Type of school	Preparation for the CLAS*
Urban	2.76
Rural	2.50
Suburban	3.23

Note. 1 = Not at all, 4 = Very much so.

*$p < .05$.

their students. The great majority of teachers interviewed (91%) had both seen the Sampler and used it to prepare their students for the assessment, although rural teachers appeared less likely than other teachers to have done so (Table 38). On average, teachers reported devoting between 3 and 5 class periods (median response) to practice with the Sampler, although it is worth noting that a third of our teacher respondents reported spending 9 or more classroom periods in such efforts.

How well teachers expect their students to do on the CLAS. Teachers were asked to estimate the percentage of their students they expected to do well on the CLAS open-ended and multiple-choice items. For the most part, teachers tended to think that about half of their students would do well on the open-ended portion of the assessment, and that a slightly higher proportion would do well on the multiple-choice items. Suburban teachers held the highest expectations for their students' performance on the multiple-choice items, $F(2) = 4.85$, $p = .014$, (Table 39). On average, suburban teachers expected about 75% of their students

Table 38

Percentage of Teachers Using the CLAS Sampler by School Type (Teacher Interview Results)

Type of school	Used CLAS Sampler
Urban	95.7
Rural	66.7
Suburban	100.0

Table 39

Mean Comparisons of Teachers' Expectations of How Many of Their Students Will Perform Well on the CLAS by School Type (Teacher Interview Results)

Type of school	Open-ended	Multiple-choice*
Urban	3.87	4.09
Rural	3.83	3.67
Suburban	4.17	5.00

Note. 1 = None, 6 = Almost all.

$*p < .05$.

to do well on the multiple-choice portion of the assessment. No significant differences were found by school type in teachers' expectations of their students' performance on open-ended items.

Summary

Our analyses show both similarities and differences across school types in students' opportunity to learn and their direct preparation for CLAS.

With regard to resources, results indicate that the rural teachers in our sample tended to have less background in mathematics than other teachers, both in terms of undergraduate major and in terms of participation in recent professional development activities. In the area of instructional resources, urban schools had relatively less access to recent mathematics texts. No differences were found in terms of availability of calculators, although urban schools tended to provide them for their students while suburban students tended to bring them from home.

In terms of instructional practices, classrooms in all schools tended to place the most emphasis on computational problems, followed by word problems, problems that require thinking or that can be solved in more than one way, and the use of calculators. Less emphasis was placed on problems that require an explanation, problems that take at least a week to complete, real-life problems, and the use of rulers, blocks or solids. Rural and urban students were more likely to be engaged in two other classroom practices that are associated with the development of complex thinking and problem solving: cooperative group activity and extended writing. In contrast, suburban students were more likely to have nightly homework.

Almost all teachers reported spending at least a number of class periods preparing their students for the CLAS. Mirroring teachers' views about the match between their instructional programs and the CLAS as well as teachers' expectations for their students' performance on the assessment, suburban students in our sample felt better prepared than their peers for specific concepts that were present on the CLAS common form and more confident of their preparedness for the CLAS in general.

SUMMARY, CONCLUSION, AND NEXT STEPS

The preliminary findings presented in this report suggest that alternative assessment, as represented by the open-ended tasks included on the CLAS assessment, is achieving at least some of its aims. Students seem to understand the differences in approach necessitated by open-ended and multiple-choice problems. In addition, because they have to explain their thinking and communicate their knowledge in a variety of forms, students find the former type of problem both more interesting and more challenging than traditional forms of assessment. By not giving students alternatives, furthermore, open-ended items clearly inhibit simple guessing strategies and instead encourage students to pursue a mathematics-based reasoning approach to solve problems. This is not to say, however, that students "like" open-ended items more than multiple-choice ones. In fact, they express preference for the latter, perhaps because students find comfort in the familiarity of multiple-choice items, think they will perform better on these items, and better understand how their performance on these items will be assessed.

A majority of teachers in the sample already engage their students at least weekly in many of the instructional activities that the CLAS is intended to encourage: word problems, problems that can be solved in more than one way, problems that require extended writing, use of calculators, problems that require students to really think, and small-group work. However, students perceive that other types of activities associated with a thinking curriculum are less prevalent: Problems in which students explain their thinking, oral representations, projects that take a week or more to complete, use of manipulatives, and real-life problems are less visible in the curriculum. As an additional indicator of their routine practice, teachers clearly expect their students to do less well on innovative, open-ended items than on traditional, multiple-choice ones.

Given the equity impetus to our inquiry, it is encouraging that the urban students in our sample were not limited to a meager "drill and kill" curriculum. Nonetheless, that students in urban classrooms were more likely to have questions about a key concept in mathematical thinking, "assumption," and the fact that they had less access to recent texts raise questions about their preparation. Suburban students clearly feel better prepared for the assessment.

We end by reiterating that the results reported here are preliminary. We are in the process of integrating them with other available data from the state, including actual student performance on the CLAS and individual student demographic data. These will enable us to look more closely at the interrelationships among and between student demographics, instructional practices, attitudes, and performance. Also of interest will be more detailed analyses of potential differences in opportunity to learn according to specific class enrollments—basic eighth-grade math, pre-algebra, algebra—as well as relationships between students' performance on alternative assessment as compared to other, more traditional indicators of their performance.

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APPENDIX

Classroom Observation Instrument

Teacher Interview

Student Survey

Student Interview – Think-Aloud

Data Collector: ____________________________

Classroom Observation
CLAS Middle Grades Performance Assessment
Special Grade 8 Math Study

School: ________________________________ Date: ____________________________

Teacher: _______________________________ Period: ___________________________

Math Course: ___________________________ Time Start: ________________________

A. Administration Context

1. Administration Observed:

   ❑ State-level administration (DAY 1) ❑ Student-level pilot (DAY 2)

2. Student grouping:

   ❑ Regular math classroom ❑ Special grouping: Describe ______________

3. Who administered the assessment?

   ❑ Regular classroom teacher ❑ Other adult: Who? ____________________

4. Number of students taking this assessment: ___________________________

B. Assessment Presentation

1. Did the administrator follow directions? ❑ Yes ❑ No
   If no, note deviation:

2. How many students had questions? ____________________

   Tally: __________________

3. What were the questions about?

4. Did the session include labeling student forms? ❑ Yes ❑ No

5. What time did students start the assessment itself? ____________________

C. During the Assessment Period

1. Do all students have access to calculators? ❑ Yes ❑ No

2. How many calculators are available? ____________________

What is the calculator-to-student ratio (1 calculator for every __ [number] students)? ______________________________________

3. How are calculators made available (e.g., on each student's desk, shared, one per table, in back of room)? __________________________________

4. Were there any operational problems with the calculators (e.g., batteries, malfunction, etc.)? ❑ None observed ❑ A few ❑ Many

5. How many students used calculators? _______________________________

   Tally: _________________

   Over entire period, what percentage of students used calculators?

   ❑ Almost all ❑ About 50% ❑ A few
   ❑ About 75% ❑ About 25% ❑ None

6. For what part of the assessment did students use the calculators?

   ❑ Mostly open-ended ❑ Mostly multiple-choice ❑ About half and half

7. What questions, if any, did students have during the assessment?

8. How did the administrator respond to student questions?

9. How engaged/interested were students in working the open-ended questions?

   (a) Percentage of students appearing very interested:

   - ❑ Almost all
   - ❑ About 75%
   - ❑ About 50%
   - ❑ About 25%
   - ❑ A few
   - ❑ None

   (b) Percentage of students appearing neutral:

   - ❑ Almost all
   - ❑ About 75%
   - ❑ About 50%
   - ❑ About 25%
   - ❑ A few
   - ❑ None

   (c) Percentage of students appearing uninterested:

   - ❑ Almost all
   - ❑ About 75%
   - ❑ About 50%
   - ❑ About 25%
   - ❑ A few
   - ❑ None

10. What percentage of students used most of the 15 minutes (or more) to answer the first open-ended question?

    - ❑ Almost all
    - ❑ About 75%
    - ❑ About 50%
    - ❑ About 25%
    - ❑ A few
    - ❑ None

11. What percentage of students finished during the regular assessment period?

    - ❑ Almost all
    - ❑ About 75%
    - ❑ About 50%
    - ❑ About 25%
    - ❑ A few
    - ❑ None

12. What time did the assessment period end? _______________

    Length of assessment period (not including directions): __________ minutes

13. Were students who didn't finish given a comfortable option for completing the assessment?

    ❑ Yes ❑ Somewhat ❑ No ❑ Not needed

    Explain:

D. After the Assessment Period

1. What comments did the administrator make after the assessment? (Include both formal comments made to the entire class and informal comments made to individual students.)

2. What comments did students make after the assessment? (Include both student-to-administrator comments and student-to-student comments.)

Data Collector: ____________________________

Teacher Interview
CLAS Middle Grades Performance Assessment
Special Grade 8 Math Study

School: ________________________________ Date: ________________________

Teacher: _______________________________ Period: _______________________

Math Course: __________________________

Gender: ❑ Male ❑ Female

Ethnic Background:
❑ African American
❑ American Indian or Alaskan Native
❑ Asian or Pacific Islander
❑ Hispanic
❑ White – not of Hispanic origin

A. Your Background and Experience

1. Your college background:

   Undergraduate major: ____

   Undergraduate minor, if any: ____________________________________

2. The type of teaching credential you currently hold:

   ❑ Certified in Math
   ❑ Certified in Middle School/Junior High Teaching
   ❑ Certified in General Elementary
   ❑ Provisional or Emergency in Math
   ❑ ESL/Bilingual
   ❑ Other (specify): ____

3. Your teaching experience, counting this year:

   a. Years of teaching: _______________ years

   b. Years teaching math in grades 7-12: ______________ years

   c. Years at this school: _____________ years

4. Please indicate the number of quarter or semester credit hours that you have accumulated at the undergraduate and graduate levels in math or math education.

   Number of semester or trimester credit hours: ______________

   Number of quarter credit hours: ______________

5. During the last 3 years, what is the total amount of time you have spent on in-service education in mathematics or the teaching of mathematics? (Include attendance at professional meetings, workshops, and conferences, but do not include formal courses for which you received college credit.)

   ❑ None
   ❑ Less than 6 hours
   ❑ 6 to 15 hours
   ❑ 16 to 35 hours
   ❑ More than 35 hours

B. Your Curriculum and Instruction This Year

In answering these questions, please focus on the class we observed.

6. What was the primary textbook you used in this class?

   a. Title ____

   b. Author ____

   c. Publisher ____

   d. Date of Publication ____

7. What chapters have you covered?

   Chapters: ______________________________

8. Do you use any other printed materials, such as an additional text or supplemental readings, with this class?

   ❑ Yes ❑ No

   If yes: Title Type of Material*

   a. ______________________________

   b. ______________________________

   c. ______________________________

   d. ______________________________

   e. ______________________________

   f. ______________________________

   *(1=textbook; 2=commercially prepared curriculum materials; 3=article from math or science publication; 4=locally developed materials; 5=other)

9. Describe the major assignments (projects, reports, etc.) you've given students this quarter.

10. How much class time did you spend on each of the following topics in your class this year?

	Not covered	1–2 class periods	3–5 class periods	6–10 class periods	More than 10 periods
a. Fractions	1	2	3	4	5
b. Area	1	2	3	4	5
c. Perimeter	1	2	3	4	5
d. Graphing data	1	2	3	4	5
e. Distance/time problems	1	2	3	4	5
f. Proportional reasoning	1	2	3	4	5

11. How often do you ask your students to reflect upon and explain their mathematical reasoning in the following situations?

	Never	Once or twice a quarter	Monthly	Once or twice a month	Weekly	A couple times a week
a. In small groups	1	2	3	4	5	6
b. In written assignments	1	2	3	4	5	6
c. As part of class discussions	1	2	3	4	5	6

12. On the quizzes, tests, and big exams that you give to your students, about what percent of the items are:

	Quizzes/Minor tests	Big exams
a. multiple-choice questions?	______%	______%
b. short-answer questions?	______%	______%
c. open-ended problems?	______%	______%
d. extended investigations taking a whole period or more?	______%	______%
e. other? (specify) ________________________	______%	______%

13. How often are students asked to solve open-ended items similar to those on the CLAS Middle Grades Performance Assessment (i.e., items where there are no obvious solutions and no single correct strategy, and that ask students to explain their reasoning)?

- ❑ Never
- ❑ Once or twice a quarter
- ❑ Monthly
- ❑ Once or twice a month
- ❑ Weekly
- ❑ A couple of times a week

14. Do your students keep math portfolios? ❑ Yes ❑ No

15. Describe how calculators or computers are used in your mathematics instruction, if at all.

If not used, why not?

a. How many of your students have calculators? ________

(1) How many are provided by the school for use in the classroom? ________

(2) How many are brought from home? ________

b. How has the school prepared your students to use calculators?

c. What percent of your class is competent in using a calculator? __________%

d. Do you permit unrestricted use of calculators? ❑ Yes ❑ No

If no, do you permit students to use calculators on tests?

❑ Yes ❑ No

C. Reactions to CLAS

16. Have you seen the Mathematics Sampler or Addendum describing the new CLAS Middle Grades Performance Assessment?

❑ Yes ❑ No

17. Compare your classroom curriculum and instruction to what you expected to be on the assessment:

a. To what extent is your classroom instruction (including texts, your teaching, and assignments) aligned with the new CLAS-type assessments?

❑ Excellent match ❑ Some match ❑ Not sure
❑ OK match ❑ Poor match

(1) How are they similar?

(2) How are they different?

b. What percent of your students do you expect to do well on the open-ended items?

❑ Almost all ❑ About 50% ❑ A few
❑ About 75% ❑ About 25% ❑ None

Please explain the reason for your rating:

c. What percent of your students do you expect to do well on the multiple-choice items?

❑ Almost all ❑ About 50% ❑ A few
❑ About 75% ❑ About 25% ❑ None

Please explain the reason for your rating:

d. Did you use exercises from the Mathematics Sampler or Addendum to prepare your students?

❑ Yes ❑ No

If yes, about how many class periods did you spend on them? ______ periods

e. How did you otherwise prepare your class for the CLAS Middle Grades Performance Assessment?

i. Attitude:

ii. Content:

iii. Procedures:

iv. Assessment-taking strategies:

18. What are your overall reactions to the new CLAS Middle Grades Performance Assessment?

19. How well have you been prepared to teach to CLAS-type objectives?

❑ Very well ❑ So-so ❑ Not well

Explain:

20. Have any of your students been excluded from taking this assessment?

❑ Yes ❑ No

If yes, how many? __________

why?

D. Your Students

21. How are students assigned to this class?

    ❑ Teacher or counselor recommendation
    ❑ Student elective
    ❑ Placement or achievement tests
    ❑ Required
    ❑ Other

    If placed, can students waiver in? ❑ Yes ❑ No

22. How would you rate this class' mathematics achievement level overall?

❑ Top 10%	❑ Above average	❑ Below average
❑ Upper quartile	❑ Average	❑ Lower quartile

Compared to other students in this school?

❑ Top 10%	❑ Above average	❑ Below average
❑ Upper quartile	❑ Average	❑ Lower quartile

Compared to other students in this district?

❑ Top 10%	❑ Above average	❑ Below average
❑ Upper quartile	❑ Average	❑ Lower quartile

Compared to other students in the state?

❑ Top 10%	❑ Above average	❑ Below average
❑ Upper quartile	❑ Average	❑ Lower quartile

23. Is there anything else you'd like to share about your professional opinions or reactions to the CLAS Middle Grades Performance Assessment?

To speed up the processing of your honorarium, please provide your social security number and home address in the space below.

SSN: ____

Name: ____

Home address: ______________________________________

____

THANK YOU FOR YOUR TIME AND THOUGHTFULNESS! *

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* Remind teacher about collection of: (a) a description of the major assignments given to students in class this year (projects, reports, etc.); (b) samples of tests and quizzes given during Spring semester; (c) a copy of the final exam for the class (if available).

Student Survey
CLAS Middle Grades Performance Assessment
Special Grade 8 Math Study

Directions: This is a questionnaire about the CLAS Middle Grades Performance Assessment you took. We want to know about the types of things you've done in your math class that may have helped you on the assessment. We also want to know your reactions to the assessment. There are no right or wrong answers. Just respond as honestly as you can. Please read the following questions with me and mark or write your answers in the spaces provided. Your answers will be confidential.

School: ______________________ Your Name: ______________________

Math Teacher: ______________________ Date: ______________________

Math Course: ______________________ Period: ______________________

1. In your current math class, how often do you:

(Circle one number on each line)

	Hardly at all	Once or twice per semester	Monthly	Every two weeks	Weekly	A couple of times a week or more
a. Practice doing computations?	1	2	3	4	5	6
b. Practice doing word problems?	1	2	3	4	5	6
c. Practice doing problems that can be solved in more than one way?	1	2	3	4	5	6
d. Practice doing problems you have to really think about to come up with a solution?	1	2	3	4	5	6
e. Practice doing problems that ask you to explain (in writing) your thinking?	1	2	3	4	5	6
f. Do math projects that take at least a week to complete?	1	2	3	4	5	6
g. Apply math to real-life, practical problems?	1	2	3	4	5	6

In your current <u>math class</u>, how often do you:

	Hardly at all	Once or twice per semester	Monthly	Every two weeks	Weekly	A couple of times a week or more
h. Work in small groups to answer problems?	1	2	3	4	5	6
i. Use calculators to solve problems?	1	2	3	4	5	6
j. Use rulers, blocks, or solids to explore problems?	1	2	3	4	5	6
k. Give an oral presentation?	1	2	3	4	5	6
l. Answer math problems that require you to write a paragraph or more?	1	2	3	4	5	6

2. How well have your math classes prepared you to answer questions in the following areas?

(Circle one answer on each line)

	Little or None	Somewhat	Very well	Don't know
a. Fractions	1	2	3	DK
b. Area	1	2	3	DK
c. Perimeter	1	2	3	DK
d. Graphing data	1	2	3	DK
e. Distance/Time problems	1	2	3	DK
f. Using ratios	1	2	3	DK

3. How often do you have to do homework for your math class?

- ❑ Every night
- ❑ Four nights a week
- ❑ Three nights a week
- ❑ Twice a week
- ❑ Once a week
- ❑ Only when I don't finish my classwork
- ❑ Never

4. How long does it usually take you to finish a day's math homework?

- ❑ 15 minutes
- ❑ A half hour
- ❑ 45 minutes
- ❑ One hour
- ❑ More than one hour

5. **How would you describe the difficulty level of your math homework?**

❑ Very easy ❑ Pretty easy ❑ So-so ❑ Pretty difficult ❑ Very difficult

6. **When you have problems with your homework, how often do you get help from:**

a. someone in your family?	❑ Almost never ❑ Sometimes	❑ Usually ❑ Almost always
b. a friend?	❑ Almost never ❑ Sometimes	❑ Usually ❑ Almost always
c. a teacher?	❑ Almost never ❑ Sometimes	❑ Usually ❑ Almost always

7. **Do you have access to a calculator at home?** ❑ Yes ❑ No

If so, what kind? ❑ Simple calculator ❑ Scientific calculator

8. **How much do you agree with the following statements?**

(Circle one number on each line)

	Not at all	Somewhat	Moderately so	Very much so
a. I like math.	1	2	3	4
b. I am good in math.	1	2	3	4
c. Learning math is mostly memorizing.	1	2	3	4
d. I like to do computation problems.	1	2	3	4
e. I like to do math problems that don't have an obvious solution.	1	2	3	4
f. I'm frustrated by problems that have more than one correct answer.	1	2	3	4
g. I like to do problems that take a lot of time to solve.	1	2	3	4
h. I like to work on projects that require me to use math.	1	2	3	4
i. I think math will be useful to me in the future.	1	2	3	4
j. I was well-prepared to take the CLAS Middle Grades Performance Assessment.	1	2	3	4

9. The CLAS Middle Grades Performance Assessment you took had open-ended questions, in which you had to explain your answers, and multiple-choice questions. Compare how you felt about these two types of questions in the following areas:

(Circle one number on each line)

	Open-ended	Multiple-choice	About the same
a. On which type of question did you try harder?	1	2	3
b. Which type of question did you find most interesting?	1	2	3
c. On which type of question do you think you did better?	1	2	3
d. Which type of question do you think showed better what you know about math?	1	2	3
e. Which type of question did you like better?	1	2	3

THANK YOU FOR HELPING US!

Data collector: ____________________________

Student Interview
Think Aloud Description of Processes Engaged in Solving Actual CLAS Problems and Reactions

CLAS Middle Grades Performance Assessment

Special Grade 8 Math Study

School: ________________________________ Math Teacher: ______________

Course: ________________________________ Period: ____________________

Student Name: ___________________________ Date: _____________________

Student Number: _________________________

Introduction/Directions: We're interested in learning what eighth graders think about when they do math problems on the CLAS Middle Grades Performance Assessment. We also want to know your reactions to the problems—how you feel about them compared to multiple-choice questions and how well your math classes have prepared you to do well on this assessment. There are no right or wrong answers so just answer as honestly as you can.

I'm going to ask you to try to remember what you were thinking about as you went about answering some of the problems on the CLAS Middle Grades Performance Assessment and then ask you for your reactions. I want you to tell me everything that comes to your mind as you review your work. I'm going to be recording our talk today, okay? All your responses will be confidential. We will not be sharing them with anyone at school.

1. Open-ended question number: ❑ 1 ❑ 2

   A. Using the student's assessment booklet, read the CLAS question with the student, then ask the student:

      (1) What do you think you're being asked to do? (What's being tested here? What are you supposed to do?)

      (2) What do you think the teachers will be looking for when they read your answer? (How do you think this will be graded?)

B. Please share with me how you went about answering the question:

(1) What did you do first? What were you thinking about?

(2) What did you do next? What were you thinking about?

(3) What did you do next? What were you thinking about?

(4) What did you do next? What were you thinking about?

C. How well do you think your math class this year prepared you to answer this question?

❑ Very well ❑ Some ❑ Hardly at all ❑ Don’t know

Specifically why do you think so? (Prompt if necessary to tie to what student mentioned in B above.)

D. How often in your math class have you done:

(1) Problems that don't have an obvious solution?

- ❑ A couple of times a week or more
- ❑ Weekly
- ❑ Monthly
- ❑ Once or twice per semester
- ❑ Hardly at all

(2) Problems that ask that you explain your thinking?

- ❑ A couple of times a week or more
- ❑ Weekly
- ❑ Monthly
- ❑ Once or twice per semester
- ❑ Hardly at all

2. Multiple-choice question 1:

A. Using the student's assessment booklet, read the CLAS question with the student, then ask the student:

(1) What do you think you're being asked to do? (What's being tested here? What are you supposed to do?)

(2) What do you think the teachers will be looking for when they read your answer? (How do you think this will be graded?)

B. Please share with me how you went about answering the question:

(1) What did you do first? What were you thinking about?

(2) What did you do next? What were you thinking about?

(3) What did you do next? What were you thinking about?

(4) What did you do next? What were you thinking about?

C. How well do you think your math class this year prepared you to answer this problem?

❑ Very well ❑ Some ❑ Hardly at all ❑ Don't know

Specifically why do you think so? (Prompt if necessary to tie to what student mentioned in B above.)

3. Think about the two open-ended questions you answered and the multiple-choice questions you answered and then answer the following questions:

A. Which kind of question makes you think harder or is more challenging?

❑ Multiple-choice ❑ Open-ended ❑ No difference

Why?

B. Which kind of question best lets you show what you know about math?

❑ Multiple-choice ❑ Open-ended ❑ No difference

Why do you think so?

C. Which kind of question was easier for you to understand what to do?

❑ Multiple-choice ❑ Open-ended ❑ No difference

Why do you think so?

D. Which kind of question do you like better?

❑ Multiple-choice ❑ Open-ended ❑ No difference

Why?

E. What do you like best about open-ended questions?

F. What do you like least about open-ended questions?

G. When you answer open-ended questions, do you think any differently or do anything differently than when you answer multiple-choice questions?

❑ Yes ❑ No If yes, please explain.

H. Do you guess on tests? ❑ Yes ❑ No

If so, on which kind of question—multiple-choice or open-ended—do you guess more? ❑ Multiple-choice ❑ Open-ended

Why?

I. What would be your advice to another student who has to prepare for an assessment like this?

THANKS FOR YOUR HELP!