ELLs with Disabilities Report 19

Reading, Mathematics, and Science Instructional Strategies for English Language Learners with Disabilities: Insights from Educators Nationwide

NATIONAL CENTER ON EDUCATIONAL OUTCOMES

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Council of Chief State School Officers (CCSSO)

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Manuel Barrera • Vitaliy Shyyan • Kristi K. Liu • Martha L. Thurlow

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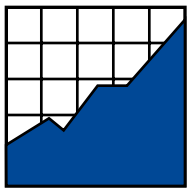

NATIONAL CENTER ON EDUCATIONAL OUTCOMES

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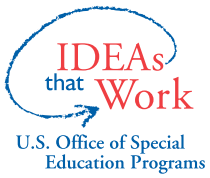


NCEO Core Staff

Martha L. Thurlow, Director
Deb A. Albus
Jason R. Altman
Manuel T. Barrera
Laurene L. Christensen
Christopher J. Johnstone
Jane L. Krentz
Sheryl S. Lazarus
Kristi K. Liu
Ross E. Moen
Michael L. Moore
Rachel F. Quenemoen
Christopher Rogers
Dorene L. Scott
Miong Vang
Yi-Chen Wu

National Center on Educational Outcomes
University of Minnesota • 207 Pattee Hall
150 Pillsbury Dr. SE • Minneapolis, MN 55455
Phone 612/624-8561 • Fax 612/624-0879
http://www.nceo.info

Overview

Introduction

The Elementary and Secondary Education Act of 2001—No Child Left Behind (NCLB)—has set a standard of accountability for the education of the broad range of learners in U.S. schools, including English language learners (ELLs) served under Individualized Education Programs (IEPs) in special education. The most modest estimates indicate that 9% of the total ELL population is served in special education programs (Zehler, Hopstock, Fleischman, Pendzick, & Stephenson, 2003).

Predictably, academic outcomes for this growing student population have not kept pace (Albus, Thurlow, Barrera, Guven, & Shyyan, 2004; Liu, Barrera, Thurlow, Guven, & Shyyan, 2005; Liu, Thurlow, Barrera, Guven, & Shyyan, 2005). State graduation standards typically are not designed with the additional supports that could guide educators in the use of instructional strategies for the range of diverse learners in schools (Albus, Thurlow, & Clapper, 2007). Current research on instructional practices for ELLs is scarce and often inferential from the practices employed for more general populations of learners (cf. Thurlow, Albus, Shyyan, Liu, & Barrera, 2004). As a result, educational practitioners are likely to generate instructional strategies based on their individual professional experiences, colleagues, and other sources of information including agencies providing technical assistance and professional development.

The difficulty here is that teachers may access a wide range of sources with varying degrees of accuracy and relevancy to support the instructional demands of students whose education is hampered by both a lack of fluency in English and disability-related learning problems. In a recent study, Thurlow and colleagues (Thurlow et al., 2004) examined the nature of the teaching methods used by practitioners in a Midwestern state serving ELLs with disabilities. They found that some of the strategies identified for use with ELLs with and without disabilities consisted mainly of more generic teaching principles such as "pre-, during-, and post-reading strategies" (Thurlow et al., 2004, p. 10). Moreover, there seemed to be little consensus about how a "strategy" is defined; hence, some identified strategies consisted of a combination of methods, approaches, and learning activities. In no case did educators seem to have access to methods specifically identified to address the needs of ELLs with disabilities. Of note was that a list of expert-determined methods and strategies identified from a review of research (cf. Gersten & Baker, 2000; Gersten, Baker, & Marks, 1998) on the instruction of ELLs with disabilities (e.g., direct teaching of vocabulary, curriculum-based probes, and graphic organizers) received significantly lower appraisals by classroom practitioners than their own broadly conceptualized versions of strategies. Moreover, the educators involved in the study were a voluntary sample from available schools and school districts at a time when there were few criteria or existing data for how to measure the efficacy of schools for demonstrating improved educational out-

comes among struggling learners such as ELLs with disabilities. Hence, the strategies, activities—teaching principles—identified in the Thurlow et al. (2004) study, while an important contribution to current knowledge of teacher practices, could only cautiously be described for use among other practitioners.

The primary lessons of our previous work, therefore, were the needs to (a) operationalize more directly the nature of the strategies that teachers employ in service to ELLs with disabilities, (b) provide a broader, preferably more random sample of educators of national scope, and (c) identify, if possible, educators who have, in some way, demonstrated effective practices with clearly discernible results in improving outcomes for ELLs with disabilities. From these experiences, it was clear that the present study should examine current teacher practices within successful school settings. This approach seems necessary given the observed difficulties of current models of "research to practice" where the validated research is minimally used by practitioners, at least directly (Boardman, Arguelles, Vaughn, Hughes, & Klingner, 2005; Landrum, Cook, Tankersley, & Fitzgerald, 2007; cf. National Science Foundation, 2002). In this way, it may be possible to better reconcile current research with established practices and provide a stronger conduit between researchers and practitioners.

In this new study, conducted in 2005–06, our standard for determining a successful school setting was to identify schools that had high concentrations of ELLs and that also had reported meeting "adequate yearly progress" under the guidelines of the No Child Left Behind Act (2001). The focus was to identify teacher-initiated instructional strategies currently preferred by practitioners who daily work with ELLs with disabilities. The findings generated in this study could potentially confirm strategies identified in our earlier work (Thurlow et al., 2004) through the perspective of educators who have had observed success in meeting grade-level academic standards and adequate yearly progress demonstrated through statewide academic assessments. Second, new strategies specific to these hypothesized successful settings could be identified, thereby providing a wider range of potential methods. Third, the compiled strategies might provide a way to examine congruities and incongruities between established research and the perceptions of successful practice by those who actually work with these students every day. Finally, the identified strategies might provide a way to operationalize what researchers in this field are finding through their systematic examinations.

This study focused on the instructional strategies employed at the middle and junior high school level. Teaching and learning at the middle school level have been found particularly challenging, perhaps because the curriculum places greater cognitive demands on emerging adolescents at a developmental stage when students, especially those who have already been struggling, can be at higher risk for academic failure (Mikow-Porto, Humphries, Egelson, O'Connell, & Teague, 2004). ELLs with disabilities could be at particular risk given the combination of learning challenges they may encounter during the middle school years.

Definitions of Terms

We began by defining key terms: "English language learners with disabilities" and "instructional strategy." We employed the following definitions:

English language learners with disabilities are students whose primary or native language is not English, who have difficulty in using English (i.e., reading, writing, speaking, and listening), and who have an Individualized Education Program (IEP). The IEP requires a description of the student's unique educational needs and contains a statement of his or her present level of performance and measurable educational goals and objectives.

An **instructional strategy** is a purposeful activity to engage learners in acquiring new behaviors or knowledge. Such a strategy should have clearly defined steps or a clear description of what the teacher does.

Our definition of instructional strategy was based on a review of scholarship and research in the areas of instructional design, instructional methodologies, and English as a second language (ESL) instruction. Given the observed lack of clarity regarding what a strategy constitutes, we thought it important to develop a thorough understanding of this term and arrive at a firm definition that would help readers and practitioners in the field comprehend the nature of our findings.

As with the strategy term, there is an ambiguity about the population of students under study given the problems of appropriate identification of English language learners who may also have disabilities (cf. Artiles & Ortiz, 2002; Barrera, 2006; Ortiz, 1997). Thus, because of the potential disagreements about whether ELLs with disabilities are appropriately identified, we thought it necessary to be more precise by describing the population in this study as those English language learners for whom an individualized education program (IEP) had been written for services within special education.

Method

Content Focus and Research Question

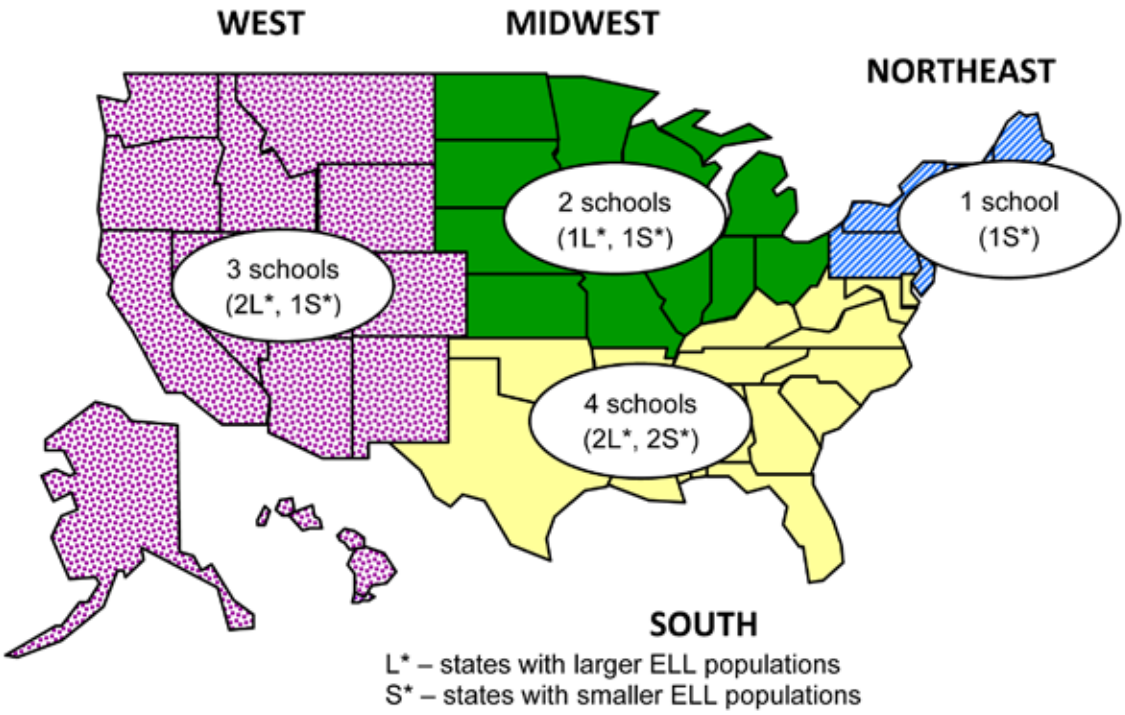
Reading, mathematics, and science are three content areas currently in focus for assessment of children under the provisions of the NCLB. Many states engage in continuous review and update of their reading, mathematics, and science grade-level and graduation standards. Hence, this study examined how teachers provide instruction in these three areas. The following research question served as our focus:

In schools throughout the U.S. that are making greater than average progress with English language learners, what instructional strategies do teachers recommend for improving the academic achievement of middle and junior high school English language learners with IEPs in standards-based reading, mathematics, and science instruction?

Sampling

To build a national sample, we used a stratified random selection in a multi-stage sampling process. At the beginning of the procedure, data from the National Clearinghouse for English Language Acquisition (accessed in 2004) were used to identify the 10 states with the highest and 10 states with the lowest ELL populations. Next, five states were randomly drawn from each pool to identify five states with the highest and five states with the lowest ELL populations where our research was to be conducted. The criterion for determining participation in this study was to identify schools in the target states that had demonstrated "Adequate Yearly Progress" (AYP) under the conditions set in the No Child Left Behind Act, across all learner groups, including students with disabilities and English language learners. We used 2003–2004 middle and junior high school (grades 6–9) data found on state department of education Web sites to select schools making Adequate Yearly Progress that served the largest possible population of ELLs. The size of the general ELL population was chosen as a criterion because schools often do not directly cite the size of the population of ELLs with disabilities. The principals of these schools were contacted first by phone and then with written invitations (usually via electronic mail) to participate in the study. Those schools agreeing to participate were visited by a research team. Our efforts resulted in sending research teams to three schools in the West Region, two schools in the Midwest Region, one school in the Northeast Region, and four schools in the South Region of the country. Figure 1 presents the geographic distribution of states where the study was conducted.

Figure 1. Locations of Study Sites



Research Team

The research team consisted of seven staff of the National Center on Educational Outcomes. Teams of three researchers traveled to the schools and conducted the MACB sessions with teachers. Three researchers had backgrounds in both research and technical assistance. They were well-versed in ways to incorporate diverse learners in state standards and accountability movements. Five members had experience as educators. Two of those five team members were also university-affiliated teacher educators with expertise in education policy and bilingual special education, respectively.

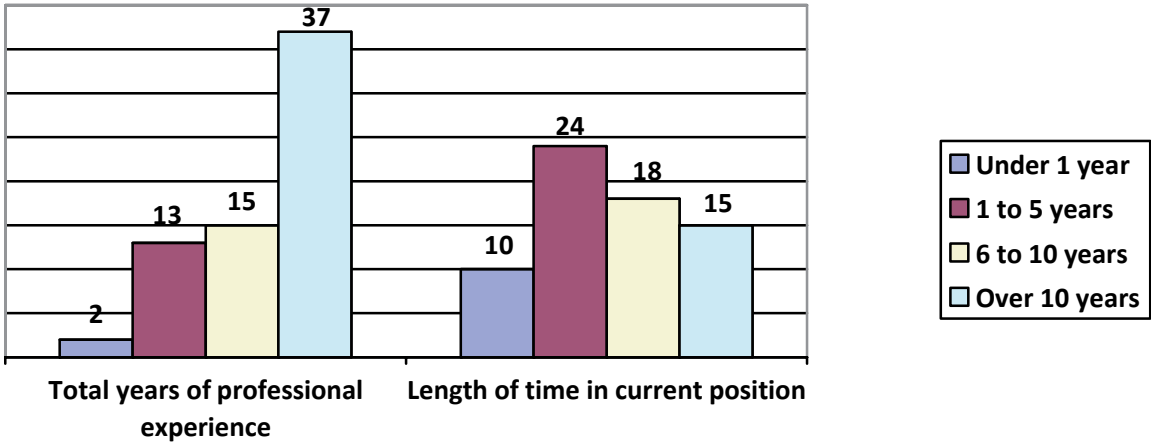
At the data collection sessions, one researcher had specific responsibility for leading the MACB process. A second researcher entered data into a spreadsheet, and a third took notes on the definitions of additional strategies nominated by teachers.

Professional Background and Experience

Each MACB session involved a group of teachers chosen with the guidance of the school principal or the principal's designee. An important component of the MACB process is to ensure that a wide spectrum of viewpoints on the issues examined is included (Vanderwood & Erickson, 1994a, 1994b). Thus, the primary criterion for choosing focus group members was that each had some responsibility in the instruction or related services for ELLs with disabilities. The study sample included 67 educators, primarily females (n = 58; 86.6%), from 10 highly-achieving schools in 10 states around the country. Thirty-five participants were educators from five states with high ELL student populations and 32 educators were from five states with low ELL student populations.

Figure 2 illustrates that study participants overall were largely experienced teachers. A majority of the 67 participants (n = 37) had more than 10 years of total teaching experience. An additional 15 teachers had between 6 and 10 years of professional experience. Fewer teachers were comparatively new to the profession, with 13 participants having 1 to 5 years experience and two participants being first-year teachers. Additionally, Figure 2 shows that slightly more than half of the participants (n = 34) had held their current position for 5 or fewer years (n = 24 at 1 to 5 years; n = 10 under 1 year). The remainder (n = 33) had been working in the current positions for 6 or more years (n = 18 at 6 to 10 years; n = 15 at over 10 years).

Figure 2. Professional Experience of Participants



As shown in Figure 3, the teachers comprised a broadly representative cross-section of general education (n = 24; 36%), special education (n = 10; 15%), and ESL/Bilingual Education specialists (n = 16; 24%). The remaining educators (n = 17; 25%) either had combined several positions or held administrative positions titles such as Special Education or ESL Directors.

Figure 3. Job Title of Participants

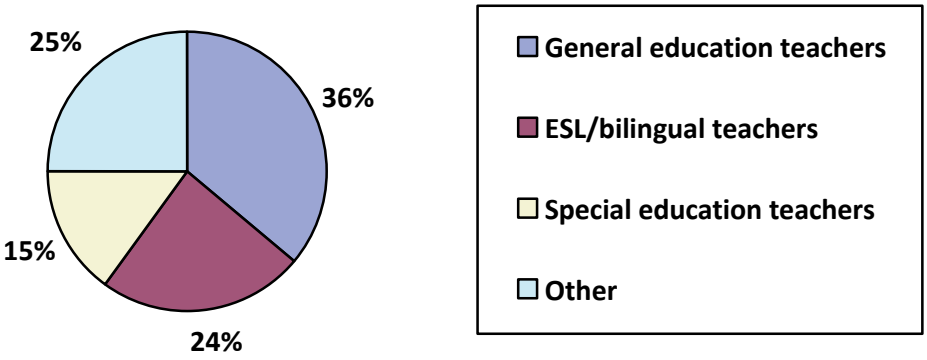


Table 1 summarizes information about content areas taught by our research participants. The largest subgroup of study participants taught middle school reading or mathematics (n = 24; 36%), followed by those who taught English Language Arts (n = 16; 24%). Smaller numbers of teachers taught Social Studies (n = 13; 19%), Science (n = 12; 18%), and Writing (n = 7; 10%). In some cases, participants taught more than one content area.

Table 1. Content Areas Taught by Educators

Content Area	Number	Percent
Reading	24	36
Mathematics	24	36
Science	12	18
Language Arts	16	24
ESL	13	19
Writing	7	10
Social Studies	13	19

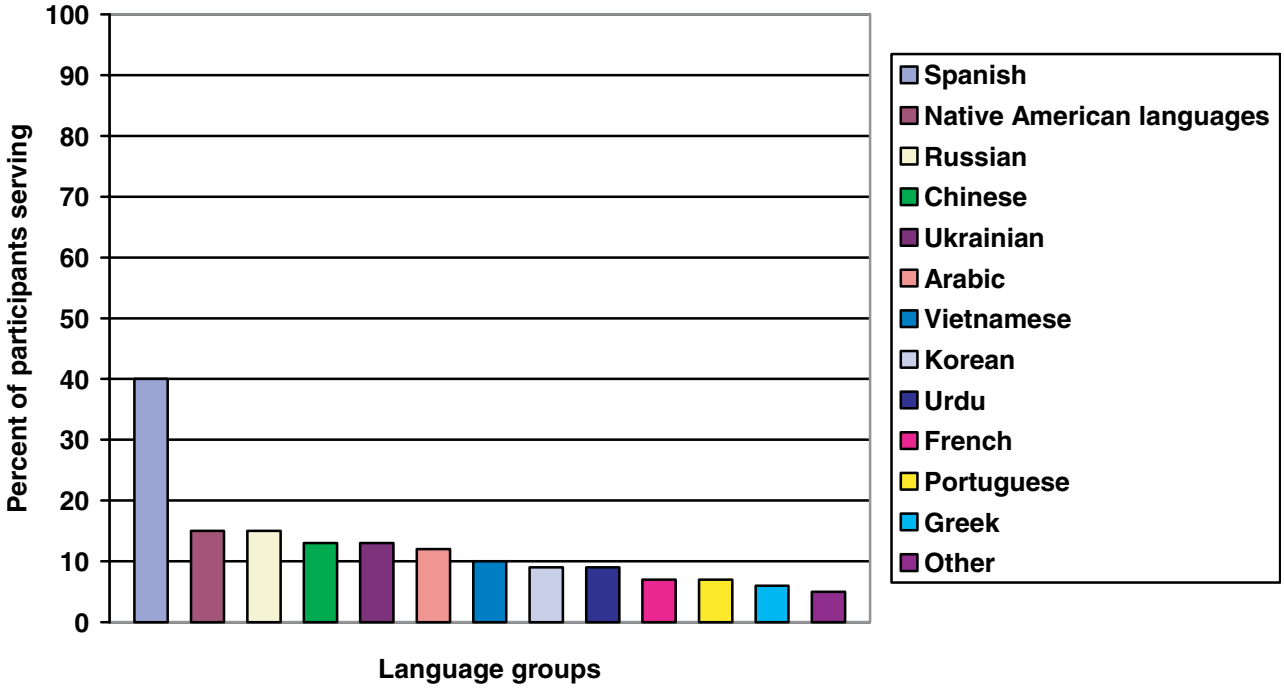
More than 1/3 of participants (34%) reported that they served ELLs, students with disabilities, ELLs with disabilities, and general education students in their classes. Fifteen percent of participants worked only with ELLs, and equal percentages (8%) served either ELLs, students with disabilities, and general education students, or just ELLs and general education students.

Language Backgrounds of ELLs Served

As highlighted by Figure 4, the largest group of study participants served ELLs whose native language was Spanish (n = 27; 40%). However, participants also reported working with students from the following language groups: Native American languages (n = 10; 15%), Russian (n = 10; 15%), Chinese (n = 9; 13%), Ukrainian (n = 9; 13%), Arabic (n = 8; 12%), Vietnamese (n = 7; 10%), Korean (n = 6; 9%), Urdu (n = 6; 9%), French (n = 5; 7%), Portuguese (n = 5; 7%),

and Greek (n = 4; 6%). Students from other primary language backgrounds (e.g., Assyrian, Bulgarian, Filipino, Hindi, Hmong, Nepali, Pakistani, or Somali) were reported in less than 5% of the cases.

Figure 4. Percent of Participants Serving ELLs of Various Language Backgrounds



Teacher Familiarity with State Standards

The demographic survey that teachers completed also generated information about teacher familiarity with grade-level content standards in their home state. While most teachers (79%) indicated at least some degree of familiarity with grade-level content standards for their state, a sizeable group (n = 13; 19%) were not at all familiar with the standards. One educator (2%) indicated that state standards were in the process of changing at the time of the research study.

Instruments and Procedures

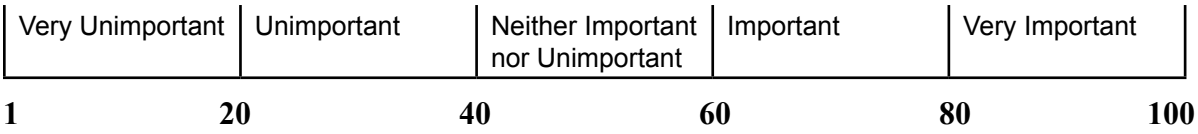
The Multi-Attribute Consensus Building (MACB) methodology (Vanderwood & Erickson, 1994a, 1994b) used in our previous one state study (Thurlow et al., 2004) was also used in this nationwide study. MACB is a quantitative, objective approach for determining a small group's consensus-derived opinion about the importance of each item in a list.

At the beginning of each session, teachers were provided an explanation of the study and asked to complete research consent releases as voluntary participants. Next, they were asked to com-

plete a brief demographic survey, which generated background information for data analysis purposes.

The MACB portion of the study contained three distinct parts. First, to provide an overall perspective from participants and as a way to introduce the MACB process, the data-gathering stage of the process opened with a weighting of the relative importance of three content areas in the instruction of English language learners with disabilities: reading, mathematics, and science. The MACB process includes a weighting procedure where participants weight their preferences for the importance of each item in a list on a scale from 1 to 100 (see Figure 5). For purposes of calculation within the weighting process, participants were instructed to weight at least one item at 100 on a hard copy of the research instrument (cf. Vanderwood & Erickson, 1994a; 1994b).

Figure 5. MACB Weighting Scale



After writing their responses on paper, participants called out their weightings to a researcher who entered them into a spreadsheet that was projected onto the wall. The spreadsheet tabulated an average weighting for each item so participants could see the items to which the group gave greater importance. These weightings were used to stimulate a facilitator-guided discussion for participants to clarify their decision making on the strategies. After this discussion, each participant had an opportunity to change weightings based on reflection in listening to each other.

As a second step, educators were invited to weight a small number of previously generated instructional strategies drawn from the Thurlow et al. (2004) study in order to get them thinking about specific instructional practices in the content classroom. We called these strategies "core strategies." The core strategies primarily consisted of the highest weighted strategies in reading, mathematics, and science instruction from the Thurlow et al. (2004) study. One exception was the inclusion of "curriculum-based probes" otherwise known as curriculum-based assessment or curriculum-based measurement. This strategy is highly recognized in the field of special education (Kavale & Forness, 1999; Reschley, 2006) and identified within the relatively sparse literature on instructional strategies supporting ELLs with disabilities (Gersten et al., 1999). Thus, it was a peculiarly anomalous finding in the Thurlow et al. (2004) study that this strategy received only moderate support from practitioners in that study. Given that the present study involved educators who had clearly demonstrated instructional success with a population that included ELLs with disabilities, we thought it important to include curriculum-based measurements and obtain a "second reading" of this strategy as we sought to confirm the viability of the

other core strategies. We note here that we used the term "probe" for both operational clarity among the range of practitioners involved in the study and to avoid the need for over-lengthy explanations regarding the differences between curriculum-based measurement and curriculum-based assessment.

Alongside the lists of core strategies was a glossary of core strategy definitions that were written to show how a strategy should be described based on the broad strategy definition employed for this study. Participants were asked to refer to this glossary as often as necessary in discussing and weighting strategies. To help teachers think about strategies that they would use in a grade-level standards-based content classroom, each participant was supplied with a full set of reading, mathematics, and science standards from their home state, to which they could refer as needed. Additionally, sample state standards were provided on content area pages of the study instrument.

Third, participants were then asked to generate additional strategies of their own for each content area and provide definitions for them. The participant-generated definitions were transcribed on chart paper so that they could easily be seen during the weighting process. Participants then weighted each of the additional strategies and an overall average weighting was calculated for each strategy to determine which ones educators thought were of greatest importance in standards-based instruction for ELLs with disabilities.

The sessions were designed to last no more than two hours from introductions to completion of strategy discussion and weighting. All sessions were digitally recorded and later analyzed for maintaining fidelity to the descriptions of strategies made by participants.

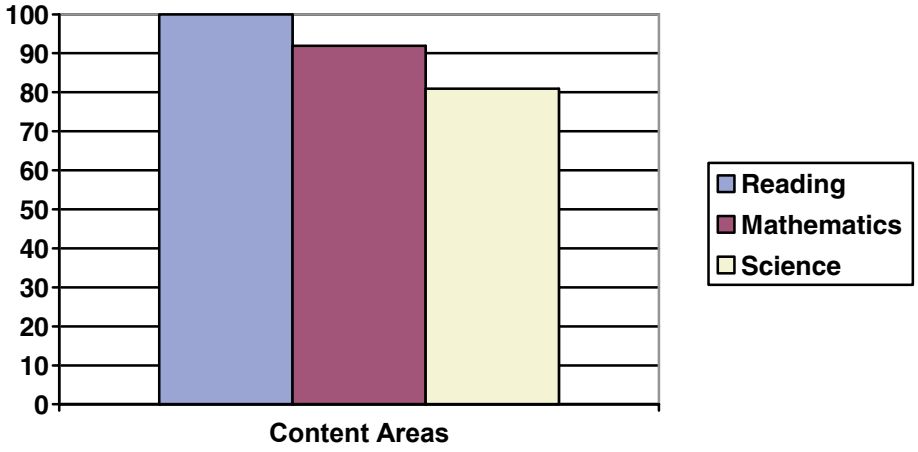
Results

Data are reported here in the order in which research participants encountered the study questions. Analysis of results is reported by demographic categories.

Content Area Importance

Consistent with the required MACB weighting procedure to assign at least one factor a weighting of 100, all research participants unanimously weighted reading as the highest priority. Mathematics was also weighted as very important but it received a lower average score of 91.9 with a standard deviation of 8.1. The science weightings averaged slightly lower than mathematics but still fell within the "very important" continuum at 80.9 with a standard deviation of 11.4. Figure 6 summarizes the content area importance results as weighted by all educators.

Figure 6. Importance of Content Areas



Teacher Weightings of Core Strategies

The core strategies from our previous study (Thurlow et al., 2004) and those generated in the present study are fully described in Appendices A–C. At the beginning of the content portion of the focus groups, we provided three core strategies for each content area chosen for their high weightings or, in the case of curriculum-based probes, for their relative importance in special education from the Thurlow et al. (2004) study. The initial three core strategies per content area served as a starting list to facilitate the strategy generation process and thereby supplement our previous analysis with the responses of these participants. In each of the following sections, only the titles of the named strategies are presented in the tables and narrative descriptions. Many, but not all, of the named strategies differed when participants were asked to describe the steps and procedures they used in implementing them.

Reading

Table 2 shows weightings for the core reading strategies. These and other reading strategies are defined in Appendix A. Most educators agreed on the importance of the "chunking and questioning aloud" and "relating reading to student experiences" strategies. In contrast, the "curriculum-based probe" strategy was weighted lower in its importance, within the "important" area of the scale (60–80) continuum. "Curriculum-based probe" ranged in its weightings from 5 to 100 and produced a relatively high standard deviation of 21.4.

Table 2. Core Reading Strategies

Instructional Strategy	Number of Weightings	Lowest Weighting	Highest Weighting	Standard Deviation	Mean
Chunking and questioning aloud	67	70.00	100.00	7.94	94.27
Relating reading to student experiences	67	70.00	100.00	6.99	95.70
Curriculum-based probe	67	5.00	100.00	21.37	75.84

Mathematics

Table 3 describes the weighting provided by session participants (n = 66; one teacher missed this part of the focus group session due to a pre-scheduled appointment). These strategies and others proposed for mathematics are defined in Appendix B. As noted, the "student-developed glossary" strategy was weighted as important while "daily re-looping of previously learned material" and "teacher think-alouds" strategies were weighted as very important.

Table 3. Core Mathematics Strategies

Instructional Strategy	Number of Weightings	Lowest Weighting	Highest Weighting	Standard Deviation	Mean
A student-developed glossary	66	65.00	100.00	9.15	89.71
Daily re-looping of previously learned material	66	80.00	100.00	5.27	96.33
Teacher think-alouds	66	50.00	100.00	8.94	93.48

Science

The core science strategies from our previous study included "using pictures to demonstrate steps," "pre-reading strategies," and "teacher modeling." Table 4 shows results of participant weightings. These science strategies are defined in Appendix C. All three strategies in Table 4 were weighted as very important by session participants (n = 66).

Table 4. Core Science Strategies

Instructional Strategy	Number of Weightings	Lowest Weighting	Highest Weighting	Standard Deviation	Mean
Using pictures to demonstrate steps	66	80.00	100.00	5.08	96.62
Using pre-reading strategies in science	66	80.00	100.00	4.79	95.33
Modeling/teacher demonstration	66	70.00	100.00	6.07	96.03

Additional Generated Strategies

The data tables for the newly generated strategies are further organized to show both frequency of choice by total number and percent of participants and by the number and percent of groups in small and large ELL population states. Only the most frequent newly generated strategies (5 for reading and science, 4 for math) are described here with the full list found in the Appendix. Determination of hierarchy for reporting was based on the total number of participants who weighted the strategies the highest among the total strategies named.

Reading

Table 5 summarizes the top five additional reading strategies generated by participants beyond the three core strategies provided at the outset of the sessions. These consisted of "using visuals" (generated in three large and two small population states reflecting 48% percent of the total group participants); "teacher pre-reading of text" (generated three times in one large and two small states reflecting 30% of the participants); "repeated student reading of text" (generated in one large state and one small state reflecting 27% of participants); "literature circles" (generated in two large ELL population states reflecting 24% of participants); and "checking background knowledge of students" (generated in one large state and one small state reflecting 19% of participants).

Table 5. Top Reading Strategies

Instructional Strategy	Large States*	Small States*	Participants		Percent of States
			N	Percent	
Using visuals	2	3	32	48%	50%
Teacher pre-reading of text	1	2	20	30%	30%
Repeated student reading of text	1	1	18	27%	20%
Literature circles	2	0	16	24%	20%
Checking background knowledge	1	1	13	19%	20%

*Large = states with large ELL populations; Small = states with small ELL populations.

Mathematics

The top four mathematics strategies newly generated by participants are summarized in Table 6. "Using manipulatives" was generated from eight groups across states with large and small ELL populations. "Relating mathematics to real life" was generated from seven groups representing states with large and small ELL populations. "Using visuals" was generated from four groups across states with large and small ELL populations. "Simplifying problems" was named by two groups representing states with small ELL populations only.

Table 6. Top Mathematics Strategies

Instructional Strategy	Large States*	Small States*	Participants		Percent of States
			N	Percent	
Using manipulatives	3	5	51	77%	80%
Relating mathematics to real life	4	3	45	68%	70%
Using visuals	2	2	20	30%	40%
Simplifying problems	0	2	12	18%	20%

*Large = states with large ELL populations; Small = states with small ELL populations.

Science

Table 7 shows the science strategies generated by the session participants. The top five strategies included "hands-on participation" from six groups representing three large and three small ELL population states and 50% of all participants; "graphic organizers" from four groups representing three large ELL population states and one small ELL population state reflecting 39% of participants; "student-made models" from four groups representing three large ELL population states and one small ELL population state reflecting 32% of participants; "vocabulary development" from three groups representing one large ELL population state and three small ELL population states reflecting 26% of participants; and "personal interest research" from one large and one small ELL population state reflecting 21% of participants. The remaining top weighted science strategies were added to the list one time in states with either larger or smaller ELL populations.

Table 7. Top Science Strategies

Instructional Strategy	Large States*	Small States*	Participants		Percent of States
			N	Percent	
Hands-on participation	3	3	33	50%	60%
Graphic organizers	3	1	26	39%	40%
Student-made models	3	1	21	32%	40%
Vocabulary development	1	2	17	26%	30%
Personal interest research	1	1	14	21%	20%

*Large = states with large ELL populations; Small = states with small ELL populations.

Results by Teacher Demographic Variables

Additional analyses were conducted on teacher preferences for core strategies and subject areas. These results showed patterns similar to those already reported. A notable detail is the perception about the use of curriculum-based probes. More experienced teachers tended to weight curriculum-based assessments much higher (average of 83—very important) than beginning teachers (average of 58—neither important nor unimportant). Special educators and other specialists or program coordinators tended to consider curriculum-based probes as highly important (average of 83—very important) whereas bilingual/ESL specialists tended to rate them much more moderately (average of 66—low range of important). General education content area teachers tended to weight curriculum-based probes closer to special educators, but demonstrably less so (average of 78—high range of important).

Discussion

This study was conducted to examine the instructional strategies that practitioners have found successful in promoting grade-level standards-based academic achievement among ELLs with disabilities. Findings in this study confirmed results from our previous work, provided additional breadth and depth in understanding the instructional practices of teachers having some measure of success with ELLs with disabilities, and raised more questions needing further research.

Teacher Perspectives on the Importance of Reading, Mathematics, and Science

It is important to note that the support for instructional strategies in service to ELLs with disabilities identified through this study occurred in the context of generally high teacher ratings for the content examined. Educators in this study tended to weight all three content areas of reading, mathematics, and science as "very important." Nevertheless, the weighting of science education seemed more variable in states with small ELL populations and among educators with over 10 years of experience. It may be that the importance of science is more distant for educators who were trained in an era when students with special needs did not typically receive science instruction. In addition, some states may still prioritize the teaching of reading and math. The importance of science education is expected to increase in coming years as a result of the proposal to include science achievement in accountability alongside reading and mathematics when NCLB is reauthorized (cf. Commission on No Child Left Behind, 2007). Future work in this area may reveal more consistent perceptions of science education among educators.

Review of Teacher Strategies

In examining the instructional strategies of teachers in the areas of reading, mathematics, and science education, we conducted two types of analysis: first, we sought to confirm the support for and feasibility of strategies previously identified in earlier research (Thurlow et al., 2004) and from research literature on expert-perceived effective instructional practice (Gersten, Baker, & Marks, 1998)—what we called "core strategies" in this study. Second, we identified locally-determined strategies from the MACB participants. These strategies helped us to determine how specifically these practitioners implemented instruction.

Teacher Ratings of Strategies

In general, our data showed that educators tended to be neutral or positive about every instructional strategy they weighted. Negative points were expressed only in a few instances and positive support was particularly prominent when educators discussed strategies that they frequently used or that were widely described in research literature, with some notable exceptions. In the cases of overly variable support or obvious disagreement, the discussion that was generated

proved insightful. Thus, in addition to numerical weightings, we also collected transcripts of participant discussions to gain better understanding of teachers' views. We report here some of this illustrative commentary.

Commentary on Subject Areas and Related Strategies

One reading strategy, "relating reading to student experiences," received significant support from educators across states and also generated commentary within the discussions about mathematics and science. By example, one teacher noted:

> We try to generate connections to their [students'] own lives. That's their favorite one, "Oh, I remember when, you know, this happened to me or my mom, or my friend." Also connecting to another book that we read or story in class….And then that should bring the text more to life for them. They see that there's a connection. They could understand it better; they're more connected to it.

In discussions about mathematics and science strategies, repetition and re-teaching ("daily re-looping of previously learned material," "drill and practice," "multiple and varied exposure to the same concept," "multiple ways of teaching," etc.) emerged as a theme in our study. During one group discussion, a math teacher shared the following: "I am available a lot for extra time to re-teach something in a different way that I might not use with all my kids but I would use it for someone who is struggling. But I have to have the time element to do that. But that is one of the strategies that I use is being available for extra time to re-teach…the key here is re-teaching to a smaller group or to an individual." In another session, a science teacher emphasized the importance of consistent teaching so that students are "as close as possible to the same picture in their head no matter what. No matter what their background knowledge is and you just keep going through that according to details…"

Another core mathematics strategy, "student-created glossary," received slightly lower weightings from educators representing states with smaller ELL populations. On the other hand, one educator from a larger ELL population state stressed the importance of the appropriate use of this strategy. She explained, "I think a lot of times we say, 'All right, have your notebook and have your stuff,' [but] as far as do they refer to it and do they really understand it? Sometimes I don't think like necessarily student-developed glossary is going to work. It's important if they actually are using it and keeping track of it and…understanding it and putting things in their own words, but a lot of times it just becomes a place to copy and the teacher checks and says, 'Ok, you have your glossary.'"

Commentary on Curriculum-based Assessment

Some instructional strategies received weightings with significant levels of variability. In particular, weighting for "curriculum-based probe" (reading strategy), ranged from 5 to 100. It was weighted as "very important" by special education teachers and "other" educators (administrators and specialists) and by educators with over 10 years of experience, but weighted much lower by ESL and classroom teachers. The following interaction between educators in one of the groups illustrates differing attitudes and opinions about the strategy.

One proponent of curriculum-based probes stated, "I think it's very important that you need to know where the child is at in order to keep going. You cannot keep going unless you know where the child is. So you have to constantly assess, even if it's informal, it works."

Another educator argued:

> I remember doing these as a child, kind of being tested like this in such a quick time frame. And then you know, it even says "reach frustration level." And I, I just….It frustrates me and it hurts me, and it makes me sad to just think that you have to test them to the point of frustration that such a time limit. Imagine being ELL and Special Ed at the same time trying to do this.

Finally, a third educator seemed to find consensus on the strategy:

> I've tested students like this and you know what? It's a different thing. It depends, I think, on the teachers, how they're presenting it and administering it because if you go and you reinforce to them "You did a great job this time. You read further than last time." Or "You did a great job reading." Ok. You know I'm testing all different grade levels so this keeps getting harder and harder and harder. Then they're not as frustrated as like "Come on, this is a stop watch. Like, go, go!" That's a different level of frustration.

Locally Identified Instructional Strategies

In addition to analysis of the core strategies, we asked MACB participants to name and describe instructional strategies that they typically have found successful with ELLs with disabilities. As previously described, these results illustrate the wide variation in the way commonly understood strategies are used within the field.

As in our previous study (Thurlow et al., 2004) and despite our efforts to engage study participants in operationalizing the strategies they named, we found that teachers in this study tended to include in their nominations practices that could be more broadly defined as either general

principles of good teaching or instructional approaches. When pressed, these practitioners tended to vary in the specific ways they implemented the practices they named.

It is, perhaps, more helpful to consider the strategies named in this study as strategy clusters that any particular teacher or group of teachers may employ differentially. In one example, the highest rated science strategy was named "hands-on participation." Although many participants used this term uniformly, their descriptions of what they believed constituted such student participation ranged from designing science experiments, use of science laboratory activities, to demonstrating science knowledge "in practice." From this experience, it seems important to look beyond the "titles" that teachers use in describing their practices and examine the multiple ways teachers have implemented a particular strategy. Thus, we believe our findings have implications for research to practice.

Implications for Research to Practice

Findings in this study reinforced and in some ways provided needed elaboration into understanding the difficulties of bridging research with practice. How teachers tended to describe their practices did not coincide well with what research professionals consider appropriate research-based practices. In this sense, our findings appear to confirm previous research-to-practice studies (e.g., Boardman et al., 2005; Landrum et al., 2007). For example, both Boardman and colleagues (2005) and Landrum and colleagues (2007) found that teachers tend to prefer practices supported by their peers more than strategies presented in "research" formats. Our findings show that teachers tend to describe their practices more specific to their individual situations using a diverse array of definitions. At the same time, many of the practices described here resonate with some validated research and contradict others. In one example, the use of physical objects, "manipulatives," in mathematics is a well-established practice (cf. Chomsky, 2003; Marzano, 1998). Much as is reported in research, teachers in our study described a wide array of specific methods in which they used manipulatives in their classrooms. However, none described the sequence of instruction moving from directly physical to more abstract representations often ascribed as most effective for the use of manipulatives (Blynt, 2006; Maccini & Gagnon, 2000). This pattern was a common one among teachers' descriptions of the strategies they used. Given the observed success of the teachers who participated in this study, our findings seem at least to give pause for reflection about the connection between practices identified by teachers with responsibility for teaching ELLs with disabilities and current practices in reporting empirically-supported educational practice.

Limitations of the Study

The limitations of this study include the potentially limited generalizability of locally identified strategies across states and individual focus groups, a rather small sample. Additionally, the incongruity between what participants reported as appropriate strategies and the way similar practices are described by researchers in the field may have reflected a lack of participants' familiarity with current research. This lack of familiarity may also be explained by the limited degree to which research described as empirically-supported is not often associated with the student population of interest in this study: ELLs with disabilities. Several observers have pointed to the faulty assumption that evidence-based practices are directly supportive to one population if they have been found useful in other populations (Kovaleski, 2007; Vanderwood & Nam, 2007). This particular problem has received some attention with regard to the utility of interventions for ELLs with disabilities even if interventions have been found validated for related populations such as individuals with disabilities (not ELLs) or ELLs (without disabilities) (Barrera, 2006; Klingner, 2007; Klingner, McRay-Sorrells, & Barrera, 2007). Results from this study, through the evidence showing implementation of a variety of strategies validated within broader populations of students but in different forms indicate the need for more in-depth and direct validation research for the instruction of ELLs with disabilities.

Finally, some educators were asked to weight instructional strategies outside of the content areas they were assigned to teach. Despite the possibility that many instructional strategies generated in the study may serve multiple content areas, the weightings may have been influenced by lack of familiarity with some of the strategies originally and subsequently named. Future studies should include an assessment of participant perceptions of their familiarity with the strategies discussed.

Future Directions

This nationwide study highlighted what educators with a record of success, defined as meeting Adequate Yearly Progress, consider useful instructional strategies for ELLs with disabilities. The variability and difficulty with which participants described specifically what they did when teaching these students coupled with the seeming variance between what is described as successful in published research and how teachers may implement their instruction indicates a need for further research to examine the use of strategies as teachers appear to implement them. Such research would require the following elements inferred by our findings. First, the focus of instruction should be directed toward improving grade-level standards-based academic achievement. These strategies should be identified in specific subject areas such as reading/language arts, mathematics, and integrated or subject-specific science curriculum. Second, there is a continuing need to operationalize instructional strategies identified for research in specific well-described terms for appropriate comparison and evaluation. Finally, because of the observed variability in

perspectives regarding the use of progress monitoring such as curriculum-based measurement, attention should be paid to the manner in which effectiveness of strategy implementation is verified through appropriate and validated assessments.

This latter point is particularly important in the case of work conducted with ELLs with disabilities given the variability in the available expertise among educators historically involved in their education (Gersten & Wanderwood, 1994; McArdle, Mele-McCarthy, & Leos, 2005). Specifically, ELLs with disabilities require both language learning-based approaches and individualized instructional support. Hence, it seems particularly important to verify how and how well specific strategies for these students are implemented and how well they work to provide viable standards-based outcomes. One important approach is to conduct single-subject research studies that examine both accurately identified and implemented strategies that are coupled with verifiable individual measures of academic progress. The National Center on Educational Outcomes has conducted an initial set of such studies (Barrera, Liu, Thurlow, & Chamberlain, 2006; Barrera, Liu, Thurlow, Shyyan, Yan, & Chamberlain, 2006) stemming from our previous MACB research (Thurlow et al., 2004). These studies and our findings here suggest that future research in this area should include multistate or national single case design studies that would test the effectiveness of the strategies specifically described by teachers in the field.

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Appendix A

Glossary of All Reading Strategies

Instructional strategy	Definition
Acting out a story	Having the students act out part of a story. Using physical movement (no reading or writing) to demonstrate and improve comprehension of the story. The strategy is useful for shier students who do not have to speak in front of a large class, only act.
Affective filter	Making the classroom setting more conducive, non-threatening, so that students feel more comfortable, less anxious, by building rapport, simplifying language, etc.
Back-to-back directions	Students stand back-to-back. One student gives directions to draw something and the other one draws it.
Back-to-back retelling/ paraphrasing	Students stand back-to-back. One student reads a paragraph and the other one writes what they hear.
Bilingual conversations	The teacher uses Language 1 and students answer in Language 2.
Bilingual vocabulary sheet	A sheet with three columns: a word in English, a picture of the word or the word used in a sentence, and the word in students' own language.
BME	Writing the beginning, middle, end of a story on a sheet of paper folded into three sections. Drawing pictures of the beginning (middle, and end) and summarizing.
Book box	Group presentation of a story in order. Each group takes a chapter of a book. They put three items related to the story in a box and explain how the items relate to the story.
Book in a box	Students cut out images or bring realia related to a book and put them in a box (e.g., illustrating five main points per chapter). Students work through each chapter to process the book.
Brainstorming	Building up consensus on reflections from a previous lesson.
Chart	Charts of cause and effect showing how two stories or parts of one story relate.
Checking background knowledge	Assessing students' background knowledge on the topic under study.
Choral reading	Reading together rhythmically to build fluency.
Chunking and questioning aloud	The process of reading a story aloud to a group of students and stopping after certain blocks of text to ask the students specific questions about their comprehension of the story and some key features of the text.
Clicks-clunks (words students are not sure about)	While reading with partners, students identify "clicks" (words that are already meaningful) and "clunks" (words students are not sure about).
Cloze sentences	The teacher takes a sentence from the text and leaves out key words for students to supply them. The strategy is recommended for early readers.

Instructional strategy	Definition
Combining reading and writing	Combining reading and writing with speaking and listening as a basis of the literacy approach.
CROPQV	Connections, relations/reactions, opinions, predictions, questions, visuals. Students divide a sheet in six parts and write down these components as they read. The materials are useful for discussion or review.
Curriculum-based probe	Having students read aloud three basal reader passages for 1 minute; teacher marks the place where the student stops and then asks comprehension questions and continues to give probes until students reach frustration level as defined by reading rate and median score.
Drawing out	Students drew their responses, thoughts, etc.
Fluency builders	Pronouncing vocabulary units faster and faster.
Frayer model – 4 sections	The core word is in the center of a box; around it: a synonym, an antonym, a picture, and the word used in a sentence (also known as webbing or branching out).
Graphic display of a story	Filling in cells in a box with drawings of main events.
Group jigsaw	Splitting up a text by paragraphs. Each group reads and presents a paragraph in order.
Guided reading	Checking students' background knowledge, selecting texts for individual and group reading aloud or silently, building vocabulary, checking for understanding constantly.
Hands-on participation	Designing math activities so that students are actively involved. Avoiding exclusive teacher demonstration. Hands-on participation is as important as verbal participation in the activity.
Journal	Students record quick writes, prompts, etc.
KWL	The "know, want to know, learned" routine; a form of self-monitoring where students are taught to list what they know already about a subject (at the beginning of class), what they want to know, and later what they learned (at the end of class). The strategy can be used individually and in groups.
L1-L2 back-to-back	Providing auditory or written content input to students in their native language alongside with English.
LINKS	Students use three-section note cards for self-study with the following three components: a picture, definition, and example or connection to real life.
Literature circle	Students discuss portions of books in a small group; sometimes roles are assigned for group interaction; the teacher breaks down reading tasks, after working individually on particular tasks, students come back together as a group.
Looping	Using the same vocabulary across different content areas to increase students' exposure to the material.
Miming	Demonstrating without talking and having students guess it; referring to students' prior knowledge and building on it.

Instructional strategy	Definition
Modeling questions	The teacher demonstrates how to ask questions based on the text and students follow the pattern. The strategy can be used before, during, and after reading.
Multiple approaches	Students find multiple ways to get to the answer.
Multiple reading	Reading the same text multiple times.
One-to-one	Individual conferencing between the teacher and student.
Partner rephrasing	Answering questions in pairs: one student answers, the other paraphrases, and then they write the answer down.
Peer modeling	Students demonstrate how to read the text, talk through strategies, and their peers use the method.
Phonemic awareness	Practicing sounds and letters in order to build phonemic awareness and remembering of sounds by the students.
Picture summaries/chunking text	The teacher chunks a text into manageable units (e.g., the chunk has a whole idea, the chunk has 10 or fewer vocabulary words) and then students draw pictures to summarize the chunks and make poster presentations.
Picture walk	Starting with covers, looking at illustrations, T.O.C. to predict content.
Pictures to demonstrate steps	Using a series of pictures to demonstrate the steps in a project or experiment so that students get a visual image of what they need to do.
Practicing reading skills	Repeated practice of the same reading skill across different texts – fiction, non-fiction.
Predictions	Students predict what will happen next based on a story. Exploring what-ifs, additional probing.
Pre-reading	Giving students pre-reading tasks.
Pre-reading survey of text	Looking at graphics, key words, titles, timelines and predicting what the text will be about.
Probable passage	The teacher then constructs a “probable passage” that uses 10-15 key words, makes fill-in-the-blanks passages and students fill in the blanks and compare the probable passage to the actual one.
Progress monitoring	Performing assessments (state, formative, quarterly writing records) and sharing results with students.
Pronunciation	Having students stop or slow down and concentrate on enunciating the word.
Providing wait-time	Allowing students additional time to complete their tasks.
Questioning the author	Asking the author questions about opinions, biases, etc.
RAFTS	Each student reads the same text from assigned or chosen perspectives. Groups with the same perspectives write a piece reflecting the reading.
Read/Slap/Remember	Reading a paragraph, slapping hands when done reading and asking for the main idea (What do you remember?).
Reading in pairs	Reading in scaffolded pairs, in which a better reader reads on the first day and a less achieving reader reads on the second day. The readers ask each other questions.

Instructional strategy	Definition
Relating reading to student experiences	Having students talk about connections in the reading to their own experiences; sharing in a large group or small group setting; using group experiences to better understand reading.
Re-looping	A process of always bringing in previously learned material to build on each day so that students have a base knowledge to start with and so that learned structures are constantly reinforced.
Repetition	Repeated use of instructional content materials utilizing various technological means.
Retelling	Detailed reciting of what was read in students' own words or repeating instructions back to the teacher.
Retelling with groups	Students retell reading materials in groups.
Second shot reading	In groups, students read with the teacher a challenging text, set goals (fluency), practice in groups and with the teacher, and reread the text individually with the teacher.
Skimming for main ideas/ key words	Students skim for key words and main ideas in the text.
Small group work	Reading in small groups to improve comprehension and fluency.
Student-created dictionary	Students keep track of key content and concept words and define them in a log or series of worksheets that they keep with their text to refer to.
Study notes	Teacher-prepared study notes with pre-highlighted key words.
Summarizing	Students give a summary of the text they read.
Teacher modeling	The teacher models the process of reading by reading the text, describing reading strategies (correcting own mistakes, looking up unfamiliar words, etc.). Students follow the example and are less self-conscious about correcting their own mistakes.
Teaching text backwards	Reading a question first and then reading the text to answer the question.
Tell-backs	Students retell and summarize what they have read.
Think, pair, share	Having students think about the reading content, pairing them up for reading (preferably, a higher- and a lower-achieving student), and calling randomly on a few students to summarize what they have read.
Think-alouds	Using explicit explanations of the steps of problem solving through the teacher modeling thought; for example, reading a story aloud and stopping at points to think aloud about reading strategies/ processes.
TPR	Total physical response – coordination of speech and action.
Using picture books	Using picture books to learn about text features (e.g., captions, headings, table of contents, maps, illustrations, etc.).
Using visuals	The teacher provides thematic two- or three-dimensional visuals to highlight meanings of new vocabulary items or give context to key ideas. Resources: other books, picture dictionary, newspapers, film clips, internet, realia, etc. Students can be involved in creating visuals and the visualizing-verbalizing process.

Instructional strategy	Definition
Vocabulary application	Learning words in the context and using them in a sentence.
Vocabulary building	Breaking words into parts (prefixes, suffixes). Guessing meaning of a word based on common roots and associating it with other words.
Vocabulary review	Reviewing the vocabulary beforehand and pointing out the reviewed units during reading.
Webbing	Finding many ways to get to the answer (word meaning), not just one way. (e.g., Thanksgiving: thankful, giving, sharing, holiday, before Christmas, etc.)
Who wants to be a millionaire	The teacher provides support to students by giving them strips of paper with three lifelines: “Ask a friend,” “Ask the teacher,” “Ask the class.”
Word bank	Student-created records of clusters of words with related meanings. Used for future writing tasks.
Word dissection	The teacher prepares cards with prefixes, roots, and suffixes and goes over their meaning first. Then students make different combinations of cards and talk about whether they make sense.
Word of the day	Practicing idioms, daily language, etc.
Word quilt	Students use a piece of paper with four sections: a word, its definition, the word used in a sentence, and a drawing that describes the word. Each student has a patch with their own word and they put their patches all together into a quilt.
Word scavenger hunt	The teacher prepares a list of daily vocabulary words based on book themes. Students look for words in all readings, mark them with post-its and share what they found in a large group.

Appendix B

Glossary of All Mathematics Strategies

Instructional strategy	Definition
Acting out a problem	Having the students act out a problem. Using physical movement (no reading or writing) to illustrate math, e.g., moving to the side of the classroom that is marked “positive” or “negative.”
Applying to money	Using monetary concepts to introduce math problems.
Ask three before me	Students ask questions of three other people before they ask the teacher. The strategy is used at the end of class (sometimes with the use of chips).
Breaking down the problem	Breaking down the problem solution process into specific steps.
Chunking and checking	Breaking down tasks into small sections, checking progress frequently, and building knowledge.
Conversion	Practicing conversion from metric to non-metric units and vice versa.
Daily re-looping of previously learned material	A process of always bringing in previously learned material to build on each day so that students have a base knowledge to start with and so that learned structures are constantly reinforced.
Designing projects	Getting students involved in designing math projects.
Domino deal 555	Students work on problems 5 minutes alone, 5 minutes with a partner, and 5 minutes with a teacher.
Drill and practice	Repeated practicing of simpler math problems before moving to more complex word ones.
Frayer Model	Using note cards with words, their definitions, pictures, and association. Students work at note cards on their own time.
Hands-on participation	Designing math activities so that students are actively involved. Avoiding exclusive teacher demonstration. Hands-on participation is as important as verbal participation in the activity.
Hands-on visualization	Use of manipulatives to create visuals for steps of math processes and concepts.
Integrate and apply	Applying math problems to other content.
Investigation	Students investigate the problem, come up with the solution, and realize that there is more than one way to solve the problem to get the same answer.
Journals/reflections	Having students write their reflections in a journal.
Math games	Playing math games, such as Rummy, Yahtzee, Bingo – games based on repetition.
Multiple comprehension checks	Multiple checks for understanding by asking questions in a one-on-one informal format.
Multiple mathematic responses	Students use numbers, symbols, words, pictures, graphs, and manipulatives to demonstrate their understanding of the material. This allows for response in strongest areas.
Multiple ways of teaching	Teaching the same content using different approaches, e.g. repetition.

Instructional strategy	Definition
Picture books	Using picture books to learn math concepts.
Providing wait-time	Allowing students additional time to complete their tasks.
Reducing the number of problems	Reducing the number of word problems to lessen the instructional load for students.
Relating mathematics to real life	Having students talk about connections in math to their own experiences; sharing in a large group or small group setting to understand mathematics better (e.g., real estate, tips, stocks, charts of zoos, etc.).
Re-teaching	Allotting extra time to re-teach material (in a different way) to a smaller group or an individual.
Share and compare	Students work on problems individually first, then share answers with a partner to compare and see if they agree. If they disagree, they decide who is right and why.
Simplifying language	Minimizing the amount of words and making the language in math minimal.
Simplifying problems	Substituting easier numbers when introducing a new function.
Student presentations	Having students make presentations of instructional materials.
Student-created models	Students create math models.
Student-developed glossary	Students keep track of key content and concept words and define them in a log or series of worksheets that they keep with their text to refer to. The glossary can also be bilingual.
Student-generated problems	Students generate problems to explain to other students.
Summarizing	“Take it out the door” – students do not leave the classroom until they answer the essential question for the day (done individually, in pairs, or larger groups).
Teacher modeling	The teacher describes the learning process and models math problems and students follow the example themselves.
Teacher think-alouds	Using explicit explanations of the steps of problem solving through teacher modeling metacognitive thought (e.g., demonstrating the thought process used in problem solving).
Think, pair, share	Asking students a question and giving them time to think silently about the answer, pairing them up to discuss responses (preferably, a higher- and a lower-achieving student), and calling randomly on a few students to summarize their discussion or give their answer.
Use both metric and non-metric dimensions	Using both metric and non-metric units.
Using a real-life based math problem	Connecting math problems to life-based situations.
Using a white board	Writing on an individual white board and then rewriting everything in the notebooks.
Using manipulatives	Students create manipulatives by labeling stripes of paper with math concepts (e.g., area, perimeter, volume, fractions, etc.) or folding them into two, four, etc. while incorporating visual notes of math content (also known as “foldables”).

Instructional strategy	Definition
Using visuals	Bringing two or three-dimensional visuals into the classroom to enhance teacher instruction.
Using visuals to generate vocabulary	Using visuals in class to generate new vocabulary items.
Word pictures	Students write words in shapes related to their definition (e.g., horizontal [written horizontally], vertical [written vertically]). The strategy is especially useful in geometry and stats.
Word walls	The teacher chooses words from a unit, writes them on cards, puts cards on a wall with definitions or examples, and refers to them often. Words can be color coded depending on a book or unit.
Work backward	Working on the problem backward, starting with the answer.
Writing story problems	Writing math stories by starting with numbers and building up a text around them.

Appendix C

Glossary of All Science Strategies

Instructional strategy	Definition
Alternative responses	Collecting alternative responses from students to check their understanding of the material.
Applications	Applying science at home (e.g., “kitchen science”).
Chunking	The process of reading a science text or problem aloud to a group of students and stopping after certain blocks of text to ask the students specific questions about their comprehension of the material.
Clarifying problem	Oral clarification of a problem using simplified language to make sure students understand what the problem is asking.
Control vocabulary	Giving students a list of most important terms to memorize.
Daily re-looping	A process of always bringing in previously learned material to build on each day so that students have a base knowledge to start with and so that learned structures are constantly reinforced.
Differentiated labs	Teaching multiple ways of solving lab problems.
Foldables	Students fold stripes of paper into two, four, etc. while incorporating key science concepts, terms, their definitions, and pictures (e.g., the solar system).
Graphic organizers	Visual displays to organize information into things like trees, flowcharts, webs, etc.; they help students to consolidate information into a meaningful whole and they are used to improve comprehension of stories, organization of writing, and understanding of difficult concepts in problems.
Grouping on learning styles	Grouping students according to “intelligences” or learning styles (e.g., arts).
Guided practice	The teacher and students work on a project together.
Habits of mind	Teacher demonstrates the process of problem solution and describes how the answer can be found.
Hands-on participation	Designing science activities so that students are actively involved in projects or experiments; hands-on participation is as important as verbal participation in science classes.
How to read a text	Pointing out and getting students to discover the different parts of the text that can be used in learning: captions, headings, etc.
Journals	Students record in a journal what they learned or strategies they learned, or questions they have; students can share their ideas in class, with partners, and with the teacher.
Labs	Students participate in science labs.
Matching cards to review key terms	Students get cards with key terms and definitions. They match them to review the learned material.
Mnemonic devices	Using association techniques to help students remember some aspect of science.
Model making	Creating paper models of science concepts.

Instructional strategy	Definition
Modeling/teacher demonstration	The teacher demonstrates how to do a lab or experiment before having the students try it on their own.
Multiple and varied exposure to the same concept	Exposing students to the same concept through multiple and varied means (e.g., the water cycle can be studied in reading, watching a video, and displaying the diagram).
Pairing up	Pairing up students for individualized work.
Personal interest research	Students conduct active research in science. This can be done in a native language.
Picture books	Using picture books in teaching science.
Quick assessment	No name test.
Relating science to real life	Relating science materials to students' real-life experiences.
Retelling (checking steps)	Students retell what they understand; checking students' comprehension of instructions.
Scaffolded lab reports	Having students fill in lab reports with more and more missing concepts/components.
Skimming text for key concepts	Reading paragraph by paragraph and paraphrasing the main idea. The teacher and students think aloud about what is important.
Smart board	Using an electronic device shaped as a board that can be plugged into a computer, written on, read aloud test, etc.
Student glossary	Students develop a glossary of science terms using their own words for definitions.
Student-designed experiments	Engaging students in design of science experiments.
Student-generated rules	Students generate safety rules.
Student-led projects	Students create science models (e.g., the solar system).
Student-made models	Students create three-dimensional models of a science concept (e.g., faults, rock classification).
Summarizing	Students give a summary of science materials.
Teacher modeling	Teacher demonstrates how to do a lab or experiment before having the students try it on their own.
TPR	Total physical response performed by students.
Tribond – three related things	Creating models of three things related with one another (e.g., electron, neutron, proton) and discussing the relationship.
Using data tables	Using tables and graphs to illustrate science content.
Using foldables	Students create folded paper visual representations of key concepts and terms.
Using pictures to demonstrate steps	Using a series of pictures to demonstrate the steps in a project or experiment so that students get a visual image of what they need to do.
Using pre-reading strategies in science	Giving overview of unit, previewing main ideas, connecting subject to the background knowledge of the students, etc.
Using visuals	Bringing two or three-dimensional visuals into the classroom to enhance teacher instruction in reading.

Instructional strategy	Definition
Video archives	Showing students videos on a topic under study by starting with an introductory activity and finishing with a movie quiz.
Video follow-up	Introducing video demonstrations of experiments that cannot be performed in class. Following up on the videos.
Visualize and verbalize	Students picture the science content and describe it to the teacher. The picture can be described by the teacher first.
Vocabulary development	Identifying and defining key vocabulary items.
Word sort	Matching the scientific term with its definition or picture (on flash cards).
Word walls	The teacher chooses words from a unit, writes them on cards, puts cards on a wall with definitions or examples, and refers to them often. Words can be color coded depending on a book or unit.
Working in a group	Working in a group with specific roles assigned to students.

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