CABE 2020 EDITION

# Multilingual Educator

## CABE 2020
### A PERFECT VISION FOR MULTICULTURALISM AND MULTILITERACY

Celebrating 45TH 1975-2020 ANNIVERSARY

CALIFORNIA ASSOCIATION FOR BILINGUAL EDUCATION

APRIL 2020

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# MESSAGE FROM THE EDITOR

*Laurie Nesrala-Miles*

**Welcome to the CABE 2020 conference edition of Multilingual Educator!** As CABE celebrates its 45th anniversary, the theme, *A Perfect Vision for Multiculturalism and Multiliteracy*, could not be more timely or appropriate. The cultural and linguistic diversity of California and the nation is becoming more kaleidoscope-like each year, a multi-hued pattern of complex fractals with all cultures and languages contributing to the awe-inspiring beauty and intricacy of the whole, while maintaining the authenticity and autonomy of their own unique shapes and shades of color.

As the socio-political climate grows more contentious, the issues more confusing, and the rhetoric more divisive, we must remain focused on our CABE Vision of "Biliteracy, Multicultural Competency & Educational Equity for All." We cannot afford to allow our vision to soften, become muddled, or succumb to near-sightedness or astigmatism. Now is the time to be actively vigilant in our advocacy, shining an even brighter spotlight on the issues and causes that will either move our mission forward or threaten to stall its progress. As we bring our collective goals into sharper focus, it behooves us to remember the words of Joel A. Barker: "Vision without action is merely a dream. Action without vision just passes the time. Vision with action can change the world." Preserving 20-20 vision is imperative to realizing our dreams, but it is worthless if we fail to take the audacious steps required to compel that vision into action.

In this issue, you will find articles about parents, educators, and other members of the CABE community, who not only dare to dream of educational equity through multiculturalism and multiliteracy, but who also harness the passion and momentum of those dreams into actions that transport their vision into reality. These articles address a broad range of subjects from multilingualism, dual language programs, and English learners to language acceptance, translanguaging, and parent leader voices. Many address topics embedded in dual language contexts, such as Math, Science, Urban Ecology, and Special Education, as well as teacher education and professional learning.

We hope this issue leaves you inspired, energized, and informed—with a clear, laser-like focus on the action steps needed to make multiculturalism and multiliteracy a ubiquitous reality for our students and their families.

***Laurie Nesrala-Miles, Editor***

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# Assessing and Teaching Biliteracy in Mathematics: A Professional Development Model




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**In this article, we present a professional development model for assessing and teaching mathematics to bilingual students.** Our focus on mathematics achievement is guided by our commitment to equitable instructional practices for students developing bilingualism and biliteracy in California's schools. We co-developed an iterative formative assessment process to assist educators in understanding and addressing the relationship between mathematics teaching and learning, as well as culturally and linguistically responsive pedagogy. We recognize that the relationship between bilingual students' academic achievement and professional development for teachers requires ideological clarity on the social and political dangers of interventionist deficit approaches that promote English monolingualism and cultural assimilation (Alfaro & Hernández 2016; Flores, Strikwerda, & Ordaz 2019). Student achievement measures, such as standardized test scores, cannot be disassociated from the sociopolitical stances of privilege and exclusion that influence practices and policies for bilingual students (Gutiérrez 2013). As teacher educators, we consider equity in mathematics education research a professional responsibility (Aguirre, Herbel-Eisenmann, Celedón-Patichis, Civil, Wilkerson, Stephan, Pape, & Clements 2017). The present study illustrates the use of a formative assessment process to help support teachers, schools, districts, and communities in bolstering the mathematics achievement of bilingual students.

***Mathematical Proficiency.*** California's standards for mathematical practice are based on the five interdependent strands of mathematical proficiency: (a) conceptual understanding—comprehension of mathematical concepts, operation, and relations, (b) procedural fluency—skill in carrying out procedures accurately, flexibly, and efficiently, (c) strategic competence—ability to formulate, represent, and solve mathematical problems, (d) adaptive reasoning—capacity for logical thought, reflection, explanation, and justification, and (e) productive disposition—habitual inclination to see mathematics as sensible, worthwhile, and coupled with a belief in diligence and one's own efficacy (National Research Council 2001).

***The Mathematical Register.*** The register associated with mathematics includes discipline-specific words, expressions, and meanings (Halliday 1978). We contend that explicit instructional attention to the mathematical register is required

for Emergent Bilinguals (also referred to as English Learners) to develop academic language fluency and biliteracy in California's schools (Martiniello 2009). We utilize the phrase Emergent Bilinguals to affirm students' "potential in developing their bilingualism" (Garcia 2009, 322). Students developing their bilingualism may require scaffolding to understand academic vocabulary and grammatical patterns necessary for accessing the mathematical register (Schleppegrell 2007) and promoting mathematical discourse, which relates to the interplay of language, symbols, and visual representations (O'Hallaran 2005). When teachers use and reinforce the importance of mathematics-specific vocabulary in classroom discussions, Emergent Bilinguals developing English fluency and literacy achieve higher results on assessments than students in a comparison group (Snow, Lawrence, & White 2009). Moreover, the importance of assessing and teaching bilingual students in multiple languages allows educators to disaggregate evidence of language acquisition fluency from the mathematical register. Furthermore, the mathematical register includes notation conventions that are distinctive across languages, such as the representations of fractions in a decimal with a comma (e.g., one fifth can be represented in decimal form as 0,20) and ordinal numbers with a superscript of 0 being mistaken as a representation of degrees (e.g., the ordinal fourth in Spanish is represented as $4^0$ which a reader may interpret as four degrees) (Solano-Flores 2011).

***Formative Assessment and Professional Development.*** The purpose of formative assessment is to provide teachers with meaningful student information to guide instruction (Ruiz-Primo, Furtak, Ayala, Yin, & Shavelson 2010). The relationship between assessment, instructional practices, and bilingualism provides opportunities for educators to examine the extent of bilingual students' mathematical understanding and analyze how the process of developing bilingualism and biliteracy influences their mathematics learning (Duran 2008; Téllez & Mosqueda 2015). Understanding that mathematical knowledge and skills of bilingual students is distributed across languages, Avalos and Secada (2019) developed a professional development program to improve urban bilingual students' mathematical understanding and develop their mathematical register across languages via collaborative problem-solving discussions that focused on language, symbols, and visual representations. We believe professional development regarding the relationship between formative assessment and instructional practices is an antecedent access point to bilingual students' mathematics achievement.

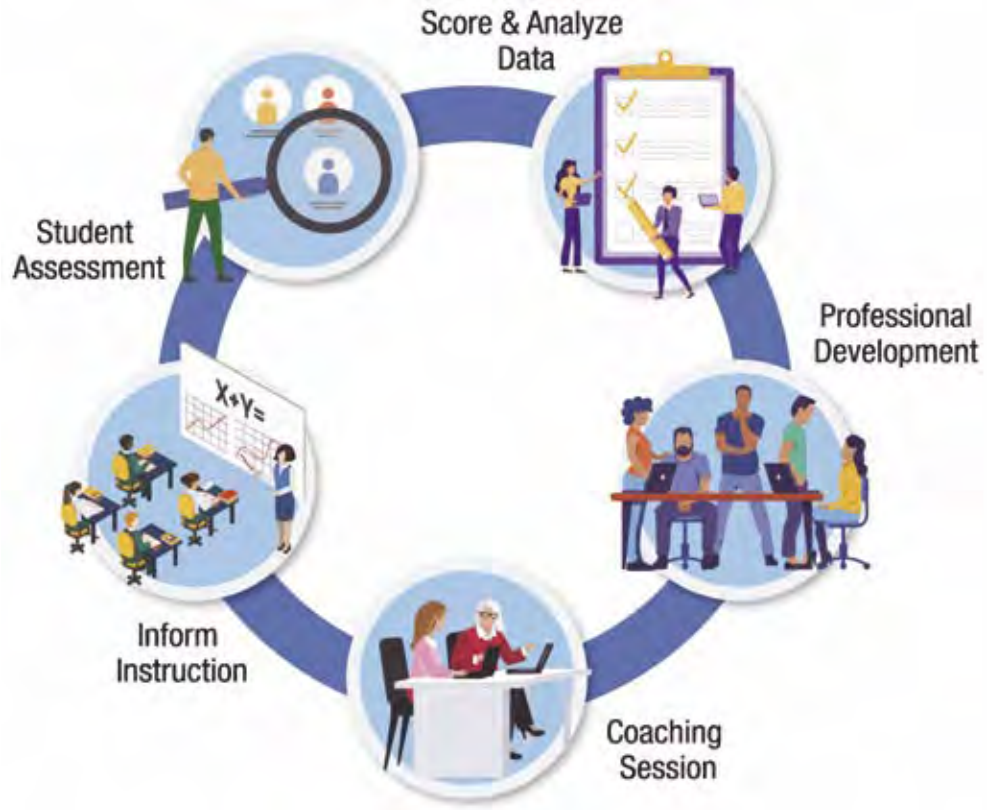
Guided by the literature on mathematical proficiency, the mathematical register, and formative assessment, we designed, implemented and analyzed a professional development model for mathematics teachers of Emergent Bilingual students informed by student assessment results. Considering that most research attention on mathematical proficiency has prioritized oral language functions and neglected written texts (Ryve 2011), our professional development model was attentive to both the importance of structuring accountable talk during mathematics instruction (Chapin, O'Connor, & Anderson 2009), as well as the potential for meaningful information from open-ended formative assessment writing prompts in mathematics. For example, students were asked, "In the box above, represent the following information in equation form—Divide a number by 5 and add 4 to the result. The answer is 9. Solve the equation. In the space below, explain to someone the steps you took to solve the equation." Throughout all stages of professional development, we referenced the strands of mathematical proficiency as guiding principles (National Research Council 2001).

## Equity-Based Action: Professional Development Informed by Student Assessment Results

We developed and implemented a professional development process informed by student assessment results where teachers learned about assessment and used assessment to examine student learning and inform their practice. This work was done with eight middle school mathematics teachers at an urban charter school in California's Bay Area. (We use United States Office of Management and Budget metropolitan statistical area classifications to qualify schools as urban.) The school served high percentages of students eligible for participation in the National School Lunch program (95%) and designated as English Learners (96%). Mathematics teachers' experience ranged between 5 and 25 years and three teachers self-reported as bilinguals. Our professional development approach consisted of: (a) three workshops to support mathematics teachers in the integration of language, literacy, and mathematics, (b) the co-creation of formative assessment tools (e.g., writing prompts and scoring rubrics), and (c) individualized coaching that included co-designing lessons, classroom observations, and post-instruction reflective conversations.
*(See Figure 1 on pg. 38.)*

The content of all three workshops included recent research findings, collective viewing and discussion of video examples of mathematics instruction that integrated

Figure 1




language development practices, and co-developing and refining formative assessment writing prompts, rubrics, and administration guidelines (e.g., reading aloud the prompt to students). All workshops included opportunities for teachers to score formative assessment samples, discuss patterns in student responses, and share instructional suggestions for promoting students' concurrent development in mathematical proficiency and disciplinary biliteracy. We encouraged teachers to promote student responses in the language they felt could best express their thinking.

After the first workshop, teachers administered a mathematical writing prompt about a savings account line graph with the y-axis representing dollar quantity and the x-axis representing number of months. We collected and scored all assessments using rubrics in both English and Spanish and provided each teacher with aggregated results for all students (n=99). We also met individually with each teacher and used aggregated assessment results and bilingual rubrics to co-design a future lesson, which we observed and discussed post-implementation. We used information from both the aggregated assessment results as well as our notes from the nine individualized coaching experiences to design the content of the second workshop.

During the second workshop, teachers collaborated on refining the formative assessment as a wireless phone plan line graph with the y-axis representing dollar quantity and the x-axis representing the length of calls in minutes *(Figure 2)*. We asked teachers to implement the revised formative assessment after the second workshop. Additionally, we once again collected and scored all assessments (n=118) and provided teachers with aggregated results for all students and met individually with each teacher to co-plan, observe, and discuss a lesson post-implementation. We reviewed both aggregated results of the second assessment and notes from our individualized coaching experiences to design the content of our third workshop.

During the third workshop, teachers collaborated on creating a formative assessment about representing, solving, and justifying an equation and we asked teachers for suggested modifications to the rubrics. After the third workshop, teachers implemented the formative assessment they created and we asked teachers to score their students' responses. Finally, we met with each teacher for a third individualized coaching experience that included pre-observation planning, recording teacher statements and actions during instruction, and post-observation dialogue.

The rubric we created to measure students' mathematical proficiency, disciplinary literacy, and English-language fluency simultaneously was in English. Cognizant of power differentials of language in schools, the assessment administration guidelines directed students to respond in Spanish or English. Most students composed their responses in English, but some

students responded exclusively in Spanish, and we created a Spanish-language version of the rubric.

**The bilingual rubric assesses students across four domains:**

(a) conceptual understanding—*entendimiento conceptual*
(b) procedural fluency—*fluidez de procedimientos*
(c) mathematics vocabulary—*vocabulario matemático*
(d) writing conventions—*convenciones de escritura*

**We scored all assessment dimensions on the following scale:**

(a) above grade-level
(b) at grade-level
(c) below grade-level
(d) does not address grade-level expectations

The conceptual understanding domain measured the logic and organization students used to solve the mathematics problem as well as their understanding of the mathematical concept. The procedural fluency domain measured students' ability to carry out mathematical procedures. The mathematics vocabulary domain measured students' use and quantity of disciplinary-specific and process-oriented vocabulary. The writing conventions domain measured students' use of punctuation, spelling, grammar, and transitional words. *(See Table 3 at the end of this online version of the magazine.)*

## Concurrent Measures of Mathematics, Biliteracy, and Bilingualism

Aggregated formative assessment results revealed mean score gains from first to third assessment on conceptual understanding and writing conventions. Mean score gains from first to third assessment on procedural fluency and mathematics vocabulary were not evident. On average, two trends existed: (a) students exhibited grade-level results on conceptual understanding, but demonstrated below grade-level results on writing conventions and (b) students exhibited grade-level results on writing conventions, but demonstrated below grade-level results on conceptual understanding. Rubrics provided a tool for teachers to analyze the interrelated, but distinctive, domains of learning mathematics, as well as developing biliteracy and bilingualism. Informed by assessment results, we provided teachers individualized instructional suggestions, as well as customized professional development workshops.

Moreover, we shared research findings about community cultural wealth and a repository of readings about Latinx mathematicians and scientists with teachers who reported students' motivation in mathematics as an area of interest. For teachers that were interested in developing their students' mathematical vocabulary and reasoning, we provided a workshop with research findings on academic literacy and a repository of daily journal exercises that would promote explanations of students' sense-making in mathematics. Teachers reported the opportunity to disaggregate students' mathematical learning by conceptual understanding and procedural fluency as useful for planning instruction. Finally, we provided a workshop with suggested daily language acquisition exercises and mathematical discourse routines to develop students' oral and compositional language throughout mathematics instruction. For example, we presented teachers a framework for teaching mathematical problem-solving and identifying language convention errors concurrently. *(See Figure 4 at the end of this online version of the magazine.)*

## Conclusions and Recommendations: Bilingualism and Biliteracy in Mathematics

Our aim in this article was to contribute insights regarding how to leverage assessment and professional development to prioritize equity in the mathematics learning of Emergent Bilinguals. Specifically, we suggest professional development collaborations to include continuous opportunities for teachers to be purposefully included in the development of formative assessment processes. Second, we recommend that bilingual education / Dual Language teachers use multiple assessment measures that prioritize 21st century indicators of learning: communication, collaboration, critical thinking, and creativity/problem-solving (Binkley, Erstad, Herman, Raizen, Ripley, Miller-Ricci, & Rumble 2012; Maldonado, Georges, Puglisi, & Hernandez 2018). Third, we encourage educators to create intentional opportunities for Emergent Bilinguals to demonstrate their learning across languages. By expanding formative assessment and instructional practices of mathematical proficiency in multiple languages, teachers invite bilingual students to maximize their linguistic and mathematical repertoire (Garcia 2009), support transfer between languages (Briceño & Maniates 2016), and structure pedagogical conditions that support equitable California policies, such as the State Seal of Biliteracy and the English Learner Roadmap.

*Table 3, Figures 2-4, and References are available in the online version: https://www.gocabe.org/index.php/communications/multilingual-educator/*