Integrating Language and Mathematics: Principles and Tools for Elementary Teachers and Students

Questions for the Early Childhood Community

Big Ideas of Early Mathematics with English Learners:

- 1. What do teachers of young English leaners need to **know**?
- 2. What **actions** do teachers of young English leaners need to undertake when teaching mathematics?
- **3.** What **professional development** structures need to be put in place to support teachers of young English learners?

Key Ideas and Notes	Interpretations, Connections, Applications

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CCSS Mathematical Practice (What STUDENTS Do)	NCTM Mathematics Teaching Practices (What TEACHERS Do)	
1) Make sense of problems and persevere in solving them*	Establish mathematics goals to focus learning	
2) Reason abstractly and quantitatively	Implement tasks that promote reasoning and problem solving	
3) Construct viable arguments and critique the reasoning of others*	Use and connect mathematical representations*	
4) Model with mathematics*	Facilitate meaningful mathematical discourse*	
5) Use appropriate tools strategically	Pose purposeful questions*	
6) Attend to precision*	Build procedural fluency from conceptual understanding	
7) Look for and make use of structure	Support productive struggle in learning mathematics	
8) Look for and express regularity in repeated reasoning	Elicit and use evidence of student thinking	





EXECUTIVE SUMMARY

Early Childhood Mathematics: Promoting Good Beginnings

A joint position of the National Association for the Education of Young Children (NAEYC)

and the National Council of Teachers of Mathematics $(NCTM)^{1}$

Position

The National Council of Teachers of Mathematics and the National Association for the Education of Young Children affirm that high-quality, challenging, and accessible mathematics education for three-to-six-year-old children is a vital foundation for future mathematics learning. In every early childhood setting, children should experience effective, research-based curriculum and teaching practices. Such high-quality practice in turn requires policies, organizational supports, and adequate resources that enable teachers to do this challenging and important work.

Rationale

As a society, we are becoming more aware of the importance of early experience in learning to read and write. A similar awareness with respect to mathematics is critical. Early childhood mathematics has a growing knowledge base about learning and teaching as well as an expanding array of research-based curriculum resources. Teachers are eager to provide young children with good beginnings. Now professional preparation programs, education agencies, policymakers, and other partners must mobilize the commitment and resources to apply what we know, support teachers' work, and generate significant progress in early childhood mathematics.

Recommendations

In high-quality mathematics education for three-to-six-year-old children, teachers and other key professionals should

1) enhance children's natural interest in mathematics and their disposition to use it to make sense of their physical and social worlds;

2) build on children's varying experiences, including their family, linguistic, and cultural backgrounds; their individual approaches to learning; and their informal knowledge;

3) base mathematics curriculum and teaching practices on current knowledge of young children's cognitive, linguistic, physical, and social-emotional development;

4) use curriculum and teaching practices that strengthen children's problem-solving and reasoning processes as well as representing, communicating, and connecting mathematical ideas;

- 5) ensure that the curriculum is coherent and compatible with known relationships and sequences of important mathematical ideas;
- 6) provide for children's deep and sustained interaction with key mathematical ideas;
- 7) integrate mathematics with other activities and other activities with mathematics;
- 8) provide ample time, materials, and teacher support for children to engage in play, a context in which they explore and manipulate mathematical ideas with keen interest;

9) actively introduce mathematical concepts, methods, and language through a range of appropriate experiences and teaching strategies;

10) support children's learning by thoughtfully and continually assessing all children's mathematical knowledge, skills, and strategies.

To support high-quality mathematics education, institutions, program developers, and policymakers should

- create more effective early childhood teacher preparation and continuing professional development in mathematics;
- use collaborative processes to develop well-aligned systems of appropriate, high-quality standards, mathematics curriculum, and assessment;
- design institutional structures and policies that support teachers' mathematics learning, teamwork, and planning;
- provide resources necessary to overcome the barriers to young children's mathematical proficiency at the classroom, community, institutional, and system-wide levels.

¹ This position is elaborated in the full version of the joint statement at www.naeyc.org/resources/position_statements/positions_intro.htm.



WIDA Early Years Guiding Principles of Language Development

- 1. Dual language learners are learning more than one language at the same time and adjust the use of their languages to different sociocultural contexts. (Abell, 2007; Bialystok, 2001; Comeau, Genesee, & Mendelson, 2007; Edelsky & Jilbert, 1985; Genesee, Boivin, & Nicoladis, 1996; Genesee, Nicoladis, & Paradis, 1995; Green, Peña, & Bedore, 2012)
- 2. Dual language learners learn language and culture through their experiences at home, in the community, and in early care and education. (Bornstein, 2012; Castro, 2011; Cuéllar & Garcia, 2012; Gillanders, Castro, & Franco, 2014; Magruder, Hayslip, Espinosa, & Matera, 2013; Reyes & Azuara, 2008; Sawyer, Scheffner Hammer, Cycyk, Lopez, Blair, Sandilos & Komaroff, 2016; Scheele, Leseman, & Mayo, 2010; Smith, 2001; Tabors, 2008)
- 3. The languages and language varieties used by dual language learners and their families are valuable resources to be considered and incorporated into early care and education and into everyday routines and activities. (Buysse, Castro, & Peisner–Feinberg, 2010; Castro, Espinosa, & Paez, 2011; Collins, 2010; Farver, Lonigan, Eppe, 2009; Garcia, 2005; Gonzalez, Moll, & Amanti, 2005; Heng, 2011; Lugo-Neris, Jackson, & Goldstein, 2010; Michael-Luna, 2013; Michael-Luna, 2015; Naqvi, McKeough, Thorne, & Pfitscher, 2012; Reyes, Da Silva, & Feller, 2016; Rowe & Fain, 2013)
- 4. Dual language learners benefit from continuous home language development at all levels of English language development. (Montelongo, Hernandez, & Herter, 2011; Prieto, 2009; Restrepo, Castilla, Schwanenflugel, Neuharth Pritchett, Hamilton, & Arboleda, 2010; Rodriguez, 2001; Schwartz, 2014; Simon-Cereijido & Gutierrez-Clellen, 2014)
- 5. Dual language learners follow different paths for language development than monolingual learners. (Andruski, Casielles, & Geoff, 2014; Bialystok, 2007; Davidson, Raschke, & Pervez, 2010; De Houwer, Bornstein, & De Coster, 2006; Dickinson, McCabe, Clark-Chiarelli, & Wolf, 2014; Dodd, So, & Lam, 2008; Fabiano-Smith & Goldstein, 2010; Hammer, Miccio, & Wagstaff, 2003; Hirata-Edds, 2011; Maneva & Genesee, 2002; Nicoladis & Marchak, 2011; Nicoladis, Pika, & Marentette, 2009; Smithson, Paradis, & Nicoladis, 2014; Yelland, Pollard, & Mercuri, 1993)
- 6. Dual language learners follow unique paths of language development according to their exposure to and opportunities for using their multiple languages. (Barnett, Yarosz, Thomas, Jung, & Blanco, 2007; DeHouwer, 2009; Genesee, 2001; Genesee, 2010; Gibson, Peña, & Bedore, 2014; Hammer, Davison, Lawrence, & Miccio, 2009; Jones & Shue, 2013; King & Fogle, 2013; Nicoladis, 2002; Place & Hoff, 2011; Scheele, Leseman, & Mayo, 2010; Soltero-Gonzalez, 2008)
- 7. Dual language learners approach learning language in different ways, with each learner bringing a unique set of attitudes, habits, and preferences for language use. (Baroody & Diamond, 2013; Chesterfield, Chesterfield, & Chavez, 1982; Chesterfield, Hayes-Latimer, Barrows & Chavez, 1983; McDermott, Rikoon, & Fantuzzo, 2014; Piker, 2013; Rikoon, McDermott, & Fantuzzo, 2012)
- 8. Dual language learners, like other children, develop language through play-based activities that invite rich language interaction. (Bell, Greenfield, Bulotsky-Shearer, & Carter, 2016; Bodrova & Leong, 2007; Bulotsky-Shearer, Bell, Romero, & Carter, 2012; Cohen, Kramer-Vida, Frye, & Andreou, 2014; Huerta & Riojas-Cortez, 2014; Konishi, 2007; Piker, 2013; Riojas-Cortez, 2000; Riojas-Cortez, 2001)
- 9. Dual language learners are developing language and literacy at the same time that they are also developing physically, cognitively, socially, and emotionally. (Barac, Bialystok, Castro, & Sanchez, 2014; Bialystok, 2009; Bialystok & Martin, 2004; Halle, Whittaker, Zepeda, Rothenberg, Anderson, et al., 2014; Jordan-DeCarbo & Galliford, 2001; Lee, 1996; Oades-Sese & Li, 2011; Okanda, Moriguchi, & Itakura, 2010; Vygotzky, 1986; Winsler, Burchinal, Tien, Peisner-Feinber, Espinos, et. al., 2014; Winsler, Fernyhough, & Montero, 2009; Winsler, Kim, & Richard, 2014; Yang, Yag, & Lust, 2011; Yazejian & Peisner-Feinberg, 2009)
- 10. Dual language learners' development of social and developmentally appropriate academic language is a complex and long-term process. (Alanis, 2013; Gort & Pontier, 2013; Gort, Pointer, & Sembiante, 2012; Hakuta, Butler, Goto, & Witt, 2000; Lewis, Sandilos, Hammer, Sawyer, & Méndez, 2016; Palmer, Martinez, Mateus, & Henderson; 2014; Scheffner Hammer, Hoff, Uchikoshi, Gillanders, Castro, & Sandilos, 2014; Tsybina, Girolametto, Weitzman, & Greenberg, 2006; van Kleeck, 2014; Walsh, Sanchez, & Burnham, 2016)

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Language Development Supports For English Language Learners To Increase Comprehension and Communication Skills

Environment				
 Welcoming and stress-free Respectful of linguistic and cultural diversity Honors students' background knowledge Sets clear and high expectations Includes routines and norms Is thinking-focused vs. answer-seeking Offers multiple modalities to engage in content learning and to demonstrate understanding Includes explicit instruction of specific language targets Provides participation techniques to include all learners 	 Integrates learning centers and games in a meaningful way Provides opportunities to practice and refine receptive and productive skills in English as a new language Integrates meaning and purposeful tasks/activities that: Are accessible by all students through multiple entry points Are relevant to students' lives and cultural experiences Build on prior mathematical learning Demonstrate high cognitive demand Offer multiple strategies for solutions Allow for a language learning experience in addition to content 			
oncom Supports*	Interactive Supports* Verbel and Textuel Sup			

Sensory Supports*	Graphic Supports*	Interactive Supports*	Verbal and Textual Supports
 Real-life objects (realia) or concrete objects Physical models Manipulatives Pictures & photographs Visual representations or models such as diagrams or drawings Videos & films Newspapers or magazines Gestures Physical movements Music & songs 	 Graphs Charts Timelines Number lines Graphic organizers Graphing paper 	 In a whole group In a small group With a partner such as <i>Turn-and-Talk</i> In pairs as a group (first, two pairs work independently, then they form a group of four) In triads Cooperative learning structures such as <i>Think-Pair-Share</i> Interactive websites or software With a mentor or coach 	 Labeling Students' native language Modeling Repetitions Paraphrasing Summarizing Guiding questions Clarifying questions Clarifying questions Leveled questions such as <i>What?</i> <i>When? Where? How? Why?</i> Questioning prompts & cues Word Banks Sentence starters Sentence frames Discussion frames Talk moves, including <i>Wait Time</i>

*from Understanding the WIDA English Language Proficiency Standards. A Resource Guide. 2007 Edition.. Board of Regents of the University of Wisconsin System, on behalf of the WIDA Consortium—www.wida.us.



Considering NAEYC, NCTM, and WIDA, reflect on the following questions:

1. How might these **instructional tools** - that promote mathematics and language integration and foster literacy and discourse - look like in the early childhood classroom?

2. What specific **modifications** might be necessary to support young English learners in the early childhood classroom?

3. What early childhood **experiences** would prepare English learners for the type of integrated elementary instruction we have described?