

Algebra as a Strand of School Mathematics for All Students

A Position of the National Council of Teachers of Mathematics

Question

What is algebra as a strand of a school mathematics curriculum for all students?

NCTM Position

All students should have access to algebra in a pre-K–12 mathematics curriculum, including opportunities to generalize, model, and analyze situations that are purely mathematical and ones that arise in real-world phenomena. Algebraic ideas need to evolve across grades as a way of thinking and valuing structure with integrated sets of concepts, procedures, and applications.

Algebra is not confined to a course or set of courses in the school curriculum; rather, it is a strand that unfolds across a pre-K–12 curriculum. Students experience the algebra strand as a way of thinking and valuing structure that develops across grades. At the elementary level, students develop fluency with numbers, explore structure in operations and their properties, and verbalize quantitative relationships (cf. Kieran 2007a; Schifter, Russell, and Bastable 2009). Middle grades students move from verbal descriptions of relationships to proficiency in generalizing numerical relationships and expressing them with symbolic representations and in the language of functions (cf. Kieran 2007b). High school students extend their ability to use and see structure in symbolic expressions as they create and reason with equations, inequalities, and systems (cf. Kieran 2007c).

Each topic within the algebra strand should be experienced as an integration of concepts, procedures, and applications. Concepts such as variable and equivalence and procedures such as solving equations and inequalities are equally important. Multiple strategies, including variations on common procedures and procedures using different representations, are needed to solve problems within mathematics and within other contexts. At all levels, students generalize, model, and analyze situations that are purely mathematical or ones that arise in real-world phenomena. They develop strategic use of a range of representations, tools, and technologies—including calculators, graphing utilities, spreadsheets, and computer algebra systems.

Before students transition into algebra content as a prominent part of their coursework, they need to develop a solid foundation in pre-kindergarten through middle school mathematics. For example, prior to extensive study of linear equations and slope, students should be able to write and interpret equivalent numerical expressions, recognize situations in which quantities are proportionally related, and write ratios to express relationships between those quantities.

Characterizing algebra as a strand of the school curriculum highlights the power and usefulness of algebraic thinking and skills—proficiencies that open academic doors and are evident in many professions and careers. Such an algebra strand in the school curriculum is critical and is accessible for all students.

References

- Kieran, Carolyn. What Do We Know about the Teaching and Learning of Algebra in the Elementary Grades? NCTM Brief, 2007a <http://www.nctm.org/news/content.aspx?id=12326>
- Kieran, Carolyn. What Do Students Struggle with When First Introduced to Algebra Symbols? NCTM Brief, 2007b. <http://www.nctm.org/news/content.aspx?id=12332>
- Kieran, Carolyn. “Learning and Teaching Algebra at the Middle School through College Levels.” In *Second Handbook of Research on Mathematics Teaching and Learning*, edited by Frank K. Lester, pp. 707–762. Charlotte, N.C.: Information Age; Reston, Va.: National Council of Teachers of Mathematics, 2007c.
- Schifter, Deborah, Susan Jo Russell, and Virginia Bastable. “Early Algebra to Reach the Range of Learners.” *Teaching Children Mathematics* 16 (November 2009), 230–237.

Resources

- Carraher, David, and Analucia Schliemann. “Early Algebra.” In *Second Handbook of Research on Mathematics Teaching and Learning*, edited by Frank K. Lester, pp. 669–705. Charlotte, N.C.: Information Age; Reston, Va.: National Council of Teachers of Mathematics, 2007.
- Carraher, David W., Analúcia D. Schliemann, Barbara M. Brizuela, and Darrell Earnest. “Arithmetic and Algebra in Early Mathematics Education.” *Journal for Research in Mathematics Education* 37 (March 2006), 87–115.
- Common Core State Standards Initiative (CCSSI). *Common Core State Standards for Mathematics. Common Core State Standards (College- and Career-Readiness Standards and K–12 Standards in English Language Arts and Math)*. Washington, D.C.: National Governors Association Center for Best Practices and the Council of Chief State School Officers, 2010. <http://www.corestandards.org>.
- Fennell, Francis: What Algebra? When? *National Council of Teachers of Mathematics*. NCTM Web 22 Apr.2012
- Greenes, Carole E., ed. *Algebra and Algebraic Thinking in School Mathematics, Seventieth Yearbook of the National Council of Teachers of Mathematics*. Reston, Va.: NCTM, 2008.
- Kaput, James, David Carraher, and Maria Blanton, eds. *Algebra in the Early Grades*. Mahwah, N.J.: Lawrence Erlbaum Associates: Information Age; Reston, Va.: National Council of Teachers of Mathematics, 2008