

REL Appalachia Ask A REL Response

Early Childhood, Math
April 2021

Question:

What does the research say about professional learning models and opportunities that equip teachers to promote early math skills, particularly early numeracy, for students in preK through grade 3?

Response:

Thank you for your request to our REL Reference Desk regarding evidence-based information about professional development to promote early math skills and numeracy. Ask A REL is a collaborative reference desk service provided by the 10 Regional Educational Laboratories (RELs) that, by design, functions much in the same way as a technical reference library. Ask A REL provides references, referrals, and brief responses in the form of citations in response to questions about available education research.

Following an established REL Appalachia research protocol, we searched for peer-reviewed articles and other research reports on professional learning models specific to early numeracy. The sources included ERIC and other federally funded databases and organizations, research institutions, academic research databases, and general Internet search engines. For more details, please see the methods section at the end of this document.

The research team did not evaluate the quality of the resources provided in this response; we offer them only for your reference. Also, the search included the most commonly used research databases and search engines to produce the references presented here, but the references are not necessarily comprehensive, and other relevant references and resources may exist. References are listed in alphabetical order, not necessarily in order of relevance.

References

McCray, J., & Chen, J. Q. (2013). Innovation in early math education: The whole teacher approach to professional development. In M. Martinez & A. Castro Superfine (Eds.), *Proceedings of the 35th annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education* (pp. 1012–1017). University of Illinois at Chicago. <https://eric.ed.gov/?id=ED584499>

From the abstract: “In this presentation, we introduce a conceptual framework for in-service professional development—the Whole Teacher approach, which attends simultaneously to the attitudes, knowledge, and practice of a teacher’s growth. Putting the framework in operation, we describe a project designed to improve teachers’ competence and increase children’s performance in early mathematics. Utilizing a quasi-experimental design, pre- and post-measures with intervention and comparison groups have been collected. The results

indicated that significant growth in children's mathematical performance favored to the intervention group. The discussion focuses on the significance of the Whole Teacher approach to teacher professional development."

Patterson, L., & Xu, Y. (2020). Enhancing teachers' competence in building students' numeracy in grades K–3. *Frontiers in Education*, 5(31), 1–6.

<https://www.frontiersin.org/articles/10.3389/feduc.2020.00031/full>

From the abstract: "Supporting growth in problem solving is key to capacity development for both teachers and students. When teachers engage in rich academic conversations that inquire deeply into content and pedagogy, they have an opportunity to cultivate student capacity to engage in rich academic discourse, problem solving and mathematical learning. In this study, we examined an intensive professional development training intervention in which teacher participants learned to use and understand the Teaching Learning Community (TLC) approach, design and connect standards-based lessons, and nurture a mindset of learning and thinking like a problem solver among students and teachers alike. We further examined whether there were any differences in students' MAP test scores over time among students whose teachers participated in the intervention and students whose teachers did not participate. Findings from the Analysis of Variance of students' MAP test scores indicated that students whose teachers participated in the intervention demonstrated more growth in mathematical proficiency, particularly in Grade 3. Thus, implementing an intervention like form of high-quality professional development, and an opportunity to collaborate with peers and experts can result in direct improvement to student achievement in math."

Sarama, J., Clements, D. H., Wolfe, C. B., & Spitler, M. E. (2016). Professional development in early mathematics: Effects of an intervention based on learning trajectories on teachers' practices. *Nordic Studies in Mathematics Education*, 21(4), 29–55.

https://www.researchgate.net/publication/311664932_Professional_development_in_early_mathematics_effects_of_an_intervention_based_on_learning_trajectories_on_teachers%27_practices

From the abstract: "We evaluated the effects of a research-based model for scaling up educational interventions on teachers' practices in preschool mathematics. The original participants were from 106 classrooms for 4-year-olds in two distal city districts serving low-resource communities, with 42 schools randomly assigned to one of three groups, of which the two treatment groups were the same throughout preschool (thus, there were 72 treatment classrooms). The intervention, a professional development program based on young children's mathematical learning trajectories, had a substantial positive effect on teachers' instructional practices, some of which mediated student outcomes. Teachers also demonstrated sustained levels of fidelity as long as six years after the end of the intervention. Notable is these teachers' encouragement and support for discussions of mathematics and their use of formative assessment. Finally, teachers taught the curriculum with increasing fidelity over the following six years without support from the project."

Zaslow, M. (2014). General features of effective professional development: Implications for preparing early educators to teach mathematics. In H. P. Ginsburg, M. Hyson, & T. A. Woods (Eds.), *Preparing early childhood educators to teach math* (pp. 97–115). Brookes Publishing. <http://archive.brookespublishing.com/documents/ginsburg-early-math-professional-development.pdf>

From the introduction: "The research on early childhood professional development is burgeoning, and it is beginning to yield conclusions about features of effective professional

development. This chapter asks the question: What from this growing body of work is important to draw on when seeking to prepare early educators to teach young children mathematics?... The chapter begins by providing background on two reviews of the research on early childhood professional development that serve as the primary resources for this chapter. The chapter discusses six features of effective early childhood professional development that emerge from these reviews. Next, the implications of these features for preparing teachers to instruct young children in math are noted. This discussion includes a cautionary note from the evidence on the status of early childhood professional development, especially inside institutions of higher education. The chapter concludes by asking how research on addressing the challenges specific to professional development in early mathematics can be generalized to strengthen early childhood professional development irrespective of the specific content.”

Additional Ask A REL Responses to Consult

Ask a REL Appalachia at SRI International. (2018). *What are the effects of sustained teacher professional development in elementary mathematics on teacher confidence and mathematics content knowledge?* <https://ies.ed.gov/ncee/edlabs/regions/appalachia/askarel/aar39.asp>

Ask a REL Appalachia at SRI International. (2019). *What is the impact of preservice and inservice math training for special education elementary school teachers on student and teacher outcomes?* <https://ies.ed.gov/ncee/edlabs/regions/appalachia/askarel/aar68.asp>

Additional Organizations to Consult

Development and Research in Early Math Education (DREME) Network:

<https://dreme.stanford.edu/>

From the website: “The DREME Network was created in 2014 to advance the field of early mathematics learning research and improve young children’s opportunities to develop math skills. The Network focuses on math learning from birth through age eight years, with an emphasis on the preschool years. Network members and affiliates collaborate to conduct basic and applied research, develop innovative tools that address high-priority early math topics, and inform and motivate other researchers, educators, policymakers, and the public.”

- Early math resources for teacher educators: <http://prek-math-te.stanford.edu/>

Early Math Counts: <https://earlymathcounts.org/>

From the website: “In 2012, the University of Illinois at Chicago College of Education launched the Math at Home (now Early Math Counts) website with a grant from the CME Group Foundation to give early childhood educators in Illinois the knowledge and skills they need to boost children’s mastery of early math. The CME Group Foundation provided additional funding in 2016 to support the development of Early Math Counts—a free, online professional development program for early childhood educators across the nation.”

- Early math resources: <https://earlymathcounts.org/resources/>

Erikson Institute, Early Math Collaborative: <https://earlymath.erikson.edu/>

From the website: “In 2007 Erikson Institute launched the Early Math Collaborative to increase the quality of early math education. We do this in three key ways:

1. Professional development of teachers, facilitators/trainers, and administrators.
2. Conducting research to generate new knowledge about approaches to teacher education, teacher development, and the most effective methods of mathematics instruction for young children.
3. Being a source of information on foundational mathematics—what it is, how it develops in children, and how best to teach it.”

Methods:

Keywords and Search Strings

The following keywords and search strings were used to search the reference databases and other sources:

- (“professional development” OR PD OR “professional learning” OR “learning model*” OR “in-service”) AND (teacher OR educator) AND (numeracy OR “early numeracy” OR “early math*”) AND (“early elementary” OR “early grade”)

Databases and Resources

We searched ERIC, a free online library of more than 1.6 million citations of education research sponsored by the Institute of Education Sciences (IES), for relevant resources. Additionally, we searched the academic database ProQuest, Google Scholar, and the commercial search engine Google.

Reference Search and Selection Criteria

In reviewing resources, Reference Desk researchers consider—among other things—these four factors:

- Date of the publication: Searches cover information available within the last 10 years, except in the case of nationally known seminal resources.
- Reference sources: IES, nationally funded, and certain other vetted sources known for strict attention to research protocols receive highest priority. Applicable resources must be publicly available online and in English.
- Methodology: The following methodological priorities/considerations guide the review and selection of the references: (a) study types—randomized controlled trials, quasi experiments, surveys, descriptive data analyses, literature reviews, policy briefs, etc., generally in this order; (b) target population, samples (representativeness of the target population, sample size, volunteered or randomly selected), study duration, etc.; (c) limitations, generalizability of the findings and conclusions, etc.
- Existing knowledge base: Vetted resources (e.g., peer-reviewed research journals) are the primary focus, but the research base is occasionally slim or nonexistent. In those cases, the best resources available may include, for example, reports, white papers, guides, reviews in non-peer-reviewed journals, newspaper articles, interviews with content specialists, and organization websites.

Resources included in this document were last accessed on April 6, 2021. URLs, descriptions, and content included here were current at that time.

This memorandum is one in a series of quick-turnaround responses to specific questions posed by education stakeholders in the Appalachia region (Kentucky, Tennessee, Virginia, and West Virginia), which is served by the Regional Educational Laboratory Appalachia (REL AP) at SRI International. This Ask A REL response was developed by REL AP under Contract ED-IES-17-C-0004 from the U.S. Department of Education, Institute of Education Sciences, administered by SRI International. The content does not necessarily reflect the views or policies of IES or the U.S. Department of Education, nor does mention of trade names, commercial products, or organizations imply endorsement by the U.S. government.