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Thank you for your request to our REL Reference Desk regarding vertical alignment in curriculum and instructional planning in mathematics and science. Ask A REL is a collaborative reference desk service provided by the ten regional educational laboratories (REL) that, by design, functions much in the same way as a technical reference library. It provides references, referrals, and brief responses in the form of citations on research based education questions.

The information below represents the most rigorous research available. Researchers consider the type of methodology and give priority to research reports that employ well described and thorough methods. The resources were also selected based on the date of the publication with a preference for research from the last ten years. Additional criteria for inclusion include the source and funder of the resource.

**Question:** *What does research say about methods/strategies for vertical alignment in mathematics and science curriculum and instruction?*

### **Search Process**

**Key words and search strings used in the search:** *grade transitions AND vertical alignment AND curriculum; instructional planning AND grade transition; learning progressions AND vertical alignment.*

### **Search databases and websites:**

1. ERIC: <http://www.eric.ed.gov/>
2. JSTOR: <http://www.jstor.org/action/showAdvancedSearch>
3. Google Scholar: [www.google.com/scholar](http://www.google.com/scholar)
4. Institute of Education Sciences (IES) Resources: <http://ies.ed.gov>
5. What Works Clearinghouse: <http://ies.ed.gov/ncee/wwc/>

### **Results:**

*Based on the database searches described above, there were no results that reflected rigorous research as defined by the U.S. Department of Education-Institute of Education Sciences. Below are some resources to guide your search for information pertinent to your question.*

**Sample Citations Retrieved:** *(NOTE: Abstracts and executive summaries are copied directly from the reports when possible to ensure accuracy):*

Burton, Erin Peters & Frazier, Wendy Michelle (2012). Voices from the Front Lines: Exemplary Science Teachers on Education Reform. *School Science and Mathematics*, 112(3), 179-190. doi: 10.1111/j.1949-8594.2011.00131.x

**Abstract/Summary:** The purpose of this study is to gain insight into the experiences that nationally award-winning, exemplary science teachers have had over their career and examine

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the alignment of their responses with calls for K-12 science education reform from a selection of prominent commissioned government reports since 1980. From an assessment of the alignment of exemplary teachers, calls for reform have had a limited effect and highlight the weakness of using national reports as a wide-scale, nationalized approach to science education reform. Findings are focused on seven different areas of teacher development: classroom issues, teaching scientific inquiry, use of technology, preservice experiences, professional development of in-service teachers, vertical articulation, and science education reform over time. Among other issues, the teachers indicated one of the biggest barriers to inquiry teaching is the pressure to conform to high-stakes testing and the lack of examples of inquiry teaching during teacher education experiences.

Gojak, Linda. (2012) A Vertical Approach to Math Instruction. *Principal*, Nov/Dec, 12-15.

**Abstract/Summary:** In the current era of mathematics standards, whether they are Common Core State Standards or other state standards, effective vertical mathematics teams offer an opportunity for teachers to grow professionally through shared experiences, for leadership to grow among the faculty, and for the school to change its perspective on the teaching and learning of mathematics. At their core, vertical mathematics teams regularly bring groups of teachers across grade levels together to discuss content, pedagogy, and practice in a structured and supportive environment. Establishing vertical math teams creates professional development opportunities for teachers while also improving student achievement. Effective vertical teams provide a structured professional development experience that encompasses the intersection of analyzing and understanding curriculum and content with the practice of teaching focused on student thinking. The author presents strategies that contribute to successful vertical mathematics teams. The primary goal is for teachers' mathematical understandings to lead to student growth.

Ostler, Elliot & Flesch, Michael (2012). Using Dynamic Solution Exercises to Achieve Vertical Course Alignment. *MathAMATYC Educator*, 3(3),10-16.

**Abstract/Summary:** This paper justifies the need for, and offers some suggestions on, the selection and implementation of mathematical problems known as dynamic solution exercises (DSEs). The intent of this article is to help provide insight into how mathematics teachers can go about making "vertical articulation" a cooperative and tangible part of the mathematics curriculum. A sample dynamic solution exercise is provided based on research at Metropolitan Community College in Omaha, Nebraska. Some strategies for selecting and building a DSE instructional environment are included.

Vertical Alignment: Ensuring Opportunity to Learn in a Standards-Based System. Issue Brief. Center for Comprehensive School Reform and Improvement. Retrieved from:  
<http://www.centerforcsri.org/files/CenterIssueBriefAug09.pdf>

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**Abstract/Summary:** In response to requirements in the No Child Left Behind Act (NCLB), state policymakers have made concerted efforts to align state standards with state accountability assessments. When strongly aligned and articulated, state standards and assessments can provide a clear and coherent set of expectations for students and educators. How do districts ensure that what is taught and tested in classrooms aligns with the state standards and assessment? One approach is through vertical alignment of the district's written curriculum with state standards and assessments. Vertical alignment articulates the logical, consistent order for teaching the standards-based content in a subject area from one grade level or course to the next. There are different approaches to undertaking vertical curriculum alignment in a district. Regardless of the approach taken, districts will most likely face similar implementation issues. This brief explores some of the issues that districts may face when implementing vertical alignment of the written curriculum across grade levels. It is organized as follows: (1) Brief overview of vertical curriculum alignment; (2) Common issues that successful districts have addressed when implementing vertical alignment as part of districtwide curriculum development; and (3) Vignettes that highlight selected aspects of vertical alignment activities.

Schielack, Janie & Seeley, Cathy L. (2010). Transitions from Elementary to Middle School Math. *Teaching Children Mathematics*, 16(6), 358-362.

**Abstract/Summary:** In the move from elementary to middle school mathematics, students encounter major changes in instructional materials and approaches, work expectations, school structure, and general level of difficulty in material. Research shows that, in general, students suffer significant declines in academic achievement in the transition from elementary school to middle or junior high school. In particular, students' attitudes toward--and achievement in--mathematics appear to be negatively affected in this transition. A crucial component of addressing the transition from elementary to middle school math is the vertical alignment of the mathematics curriculum. Aligning major ideas across grades 3-8 efficiently addresses the curricular aspects of students transitioning from elementary to middle school mathematics. Students will find it easier to transition between elementary and middle school math if they have supportive teachers, counselors, and parents who communicate across grade levels to align curricula and bridge differences between instructional materials and environments.

Voogt, Joke & Roblin, Natalie Pareja (2012). A Comparative Analysis of International Frameworks for 21st Century Competences: Implications for National Curriculum Policies. *Journal of Curriculum Studies*, 44(3), 299-321.  
doi: 10.1080/00220272.2012.668938

**Abstract/Summary:** National curricula need to change drastically to comply with the competences needed for the 21st century. In this paper eight frameworks describing 21st century competences were analysed. A comprehensive search for information about 21st century competences was conducted across the official websites of the selected frameworks, resulting in

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32 documents that were analysed in detail. Travers and Westbury's framework of curriculum representations was used to determine horizontal and vertical consistency between the frameworks. The frameworks were compared on their underlying rationales and goals, their definition of 21st century competences, and the recommended strategies for the implementation and assessment of these skills in educational practice. In addition three international studies were examined to analyse how various countries (EU member states, OECD countries) and schools (SITES studies) deal (or not) with 21st century competences. The findings indicate a large extent of alignment between the frameworks about what 21st century competences are and why they are important (horizontal consistency), but intentions and practice seemed still far apart, indicating lack of vertical consistency. The implications of the implementation of 21st century competences in national curriculum policies are discussed and recommendations are provided. (Contains 4 tables.)

### **Referrals**

#### **Organizations:**

- National Council of Teachers of Mathematics: <http://www.nctm.org/>
- National Science Teachers Association: <http://www.nsta.org/>
- Association for Supervision and Curriculum Development: <http://www.ascd.org/>

#### **Federally Funded Resources:**

- Institute of Education Sciences (IES), public search engine available at: <http://ies.ed.gov/pubsearch/>
- What Works Clearinghouse: <http://ies.ed.gov/ncee/wwc>

#### ***Disclaimer:***

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