Review of the *Everyday Mathematics* Curriculum

Gwenanne Salkind

George Mason University

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Dr. Patricia Moyer-Packenham

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*Everyday Mathematics* (EM) is a K-6 curriculum that was designed by the University of Chicago School Mathematics Project (UCSMP) with funding from the Amoco Foundation, the GTE Corporation, the Everyday Learning Corporation, and the National Science Foundation (NSF) (W. M. Carroll & Isaacs, 2003, p. 328). The program was developed over an eleven year period from 1985 – 1996. A team of authors developed the entire curriculum, K-6, which is in contrast to how most curricula are developed, simultaneously by a different team of authors at each grade level. The grade level curricula were developed sequentially, one at a time, beginning with kindergarten (W. Carroll, 1998; Isaacs, Carroll, & Bell, 2001). The slow development of the program allowed time for the authors to conduct field studies on each grade level, make revisions to the program, and build the program from one grade level to the next. This resulted in a cohesive, comprehensive curriculum.

The Research Base of *Everyday Mathematics*

The creation of EM was influenced by a wide research base (Isaacs et al., 2001). Research on young children’s mathematical knowledge led to the EM creators’ beliefs that children come to school with a great deal of mathematical knowledge. Children in kindergarten and first grade are better equipped to learn rigorous mathematical concepts than originally supposed. They also believed that when children learn algorithms without understanding it inhibits their further mathematical learning. Allowing children to invent their own algorithms would lead to greater mathematical understanding (Isaacs et al., 2001).

The EM creators prescribed to Vygotsky’s view that children learn in social contexts through dialogue with peers and adults (Isaacs et al., 2001). They were aware of studies that showed U.S. students lagging behind other nations in mathematical achievement. They knew that, in one higher achieving nation, Japanese teachers focused instruction on problem-solving,
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Exploration, and mathematical reasoning. Other research and national reports convinced the EM creators that problem-solving and reasoning were important skills that citizens would need in the twenty-first century (Isaacs et al., 2001).

Research on mathematical modeling influenced the EM authors’ thinking about tools and representations. They believed that exploration of multiple representations led to increased problem solving ability (Isaacs et al., 2001). Tools such as mathematical manipulatives and calculators could facilitate mathematical thinking. Research on instructional pacing suggested that a brisk pace and spaced practice in a variety of contexts was important. EM authors also believed that there should be a balance between conceptual understanding and procedural skill (Isaacs et al., 2001). The authors’ beliefs and assumptions about teaching and learning, their understanding of a wide range of research, and their personal experiences led to the development of a set of principles for Everyday Mathematics curriculum development (see Isaacs et al., 2001, p. 5 and Senk & Thompson, 2003, p. 80).

Key Features of Everyday Mathematics

Everyday Mathematics instruction includes the ten mathematical content and process standards set out by the National Council of Teachers of Mathematics (NCTM) (2000): number and operations, algebra, geometry, measurement, data analysis and probability, problem solving, reasoning and proof, communication, connections, and representation. The program is implemented in a spiraling manner, revisiting topics throughout the school year and in subsequent school years. Each time a topic is repeated, it is revisited at a slightly higher level and in a different context (Fuson, Carroll, & Drueck, 2000; University of Chicago School Mathematics Project, 2002a). The program is implemented through individual, small group, and whole class activities. Activities include hands-on explorations, student discussions, and interdisciplinary projects. Students use tools such as white boards, measuring devices,
manipulative materials, and calculators. Problem solving, mental computation, and invented algorithms are major foci of the EM program. Students invent and justify solution strategies for problems that are set in real-life contexts.

Research on *Everyday Mathematics*

*Everyday Mathematics* is one of few curricula on which an extensive amount of research has been conducted. Research studies include studies done by the creators, outside researchers, and school districts that are using the curriculum. Formative, longitudinal, and summative studies have been conducted. I looked at two research studies, two research summaries, and two content analyses for this review.

*A Study of Second and Third Graders Using Everyday Mathematics*

Fuson, Carroll, and Drueck (2000) compared second and third graders using EM curriculum to U.S. and Japanese students by drawing assessment items from existing studies. The same EM students were followed in second and third grade. Second graders were assessed on number sense and general mathematics achievement. Third graders were assessed on a variety of mathematics topics including whole number concepts, computation, geometry, and measurement. Results suggest that EM students can learn more than U.S. students using a traditional curriculum. EM students scored the same or higher than U.S. students on number sense items and about even with Japanese students. EM students were at average levels when compared to U.S. students on multi-digit addition and subtraction computation, but outscored U.S. students on place value, reasoning, geometry, data, and problem-solving. Overall, Japanese students scored better than EM students.

*A Study of Fourth Graders Mathematics Achievement in Massachusetts*

Fourth grade EM students outperformed fourth grade students using other curricula in the state of Massachusetts (Riordan & Noyce, 2001). EM students scored higher in four mathematics
strands (number sense; patterns, relations, and functions; geometry and measurement; and statistics and probability) and three problem types (multiple choice, short answer, and open response). One limitation of the study was that EM and comparison schools’ student populations were predominantly white middle-class.

Two Research Summaries of Everyday Mathematics

Carroll and Isaacs (2003) reviewed a number of studies that focused on achievement results of students who used the EM curriculum. The studies they reviewed included studies conducted by the UCSMP Elementary Component, studies at Northwestern University by Dr. Karen Fuson, and studies conducted by individual schools and districts that used the EM program. The overall results of their research review indicated that EM students performed as well as students using traditional texts on basic facts and paper-and-pencil computation (W. M. Carroll & Isaacs, 2003). EM students used a greater variety of computational strategies, however, and they were especially versatile with mental computation. EM students outperformed comparison students on mathematics topics that are traditionally left out of the curriculum such as geometry, measurement, and data analysis. EM students also scored higher on tests of problem-solving, reasoning, and mathematical communication. The reviewers hypothesized that Everyday Mathematics’ practice of having students invent algorithms and share multiple solution strategies with peers may have contributed to students’ greater fluency with problem-solving and flexibility with mental computation (W. M. Carroll & Isaacs, 2003).

Similar findings were reported in a research summary by the UCSMP (2005). Additionally, “children who use EM tend to learn more mathematics and like it better than children who use other programs” (p. 1). The authors pointed out that there is an extensive amount of research on the EM program. “The agreement about the curriculum across so many
research studies is, itself, perhaps the strongest evidence that EM is effective” (University of Chicago School Mathematics Project, 2005, p. 1).

*An Analysis of Everyday Mathematics in Light of the TIMSS*

The Third International Mathematics and Science Study (TIMSS) compared fourth-, eighth-, and twelfth-grade students around the world. “The United States was the only country with fourth graders above the international average and eighth graders below” (W. Carroll, 1998, p. 1). TIMSS researchers suggested five probable reasons for U.S. students’ poor performance: (a) Textbooks in the U.S. are not as challenging as those in other nations; (b) U.S. lessons focus on rote procedures; (c) topics such as geometry, measurement, and algebra are underrepresented in the U.S. curriculum; (d) the U.S. curriculum lacks a focus at each grade level; and (e) U.S. teachers are less likely to implement reform ideas than teachers in other countries. William Carroll (1998) analyzed the *Everyday Mathematics* curriculum against these five probable reasons. He suggested that the EM program could mitigate the reasons for poor performance.

EM has a brisk pace and topics are taught with greater depth and breadth than traditional U.S. curricula. EM instruction focuses on problem solving and conceptual understanding. “Geometry and measurement are investigated in greater depth at each grade level in *Everyday Mathematics*” (W. Carroll, 1998, p. 6). EM has a focus on number sense in the primary grades and algebra and geometry in upper elementary. Classroom teachers were involved in the development of EM. Therefore, the program considers the working lives of teachers as well as the difficulties involved in implementing change. Carroll (1998) maintains that *Everyday Mathematics* is a unique curriculum that addresses the concerns presented by the TIMSS researchers and prepares students for algebra in seventh grade.
Mathematically Correct is an advocacy group founded in Southern California in 1995. They advocate for the improvement of mathematics education in U.S. schools. Mathematically Correct reviewed mathematics programs at grades two, five, and seven. EM was one of the programs reviewed at grades two and five. The reviewers chose specific content topics at each grade level and surveyed the textbooks to see how those topics were treated (Clopton, McKeown, McKeown, & Clopton, 1999). The topics ranged from mathematics that would be new to the grade level to mathematics that would require mastery. Expectations and grade level standards were developed based upon the Mathematically Correct Standards and the San Diego Mathematics Standards.

The authors of the review found the EM second grade program to be “mediocre.” They found that some content topics were covered in depth while others received weak coverage. They were unhappy with the lack of direct instruction of the content. They did not agree with the practice of soliciting computational strategies from the students. They thought traditional algorithms should be taught. The reviewers criticized the overuse of calculators and the number of computational problems students were asked to do. (There were too few problems.) They were also concerned that the method of instruction involving student discussion on student generated strategies required the teachers to be knowledgeable and skillful.

The Fifth Grade EM program received overall low ratings for mathematical depth, quality of presentation, and quality of student work (Clopton et al., 1999). The reviewers were concerned that decimal multiplication and division were not presented in the text and that mastery of multiplication and division of whole numbers was given limited coverage. Reviewers expected to see many more practice problems than were provided in the textbook.
Content Analysis of *Everyday Mathematics*

**Content Analysis Criteria**

I created the following criteria as a guide to evaluating any mathematics curricula. The criteria were developed by applying ideas from *Choosing a Standards-Based Mathematics Curriculum* (Goldsmith, Mark, & Kantrov, 2000), *On Evaluating Curricular Effectiveness* (National Research Council, 2004), and *Principles and Standards for School Mathematics* (National Council of Teachers of Mathematics, 2000).

*Mathematical content*. The content is aligned with the NCTM standards (National Council of Teachers of Mathematics, 2000). The content addresses the Virginia Standards of Learning (Virginia Department of Education, 2001, 2002). The content is comprehensive and accurate.

*Organization and structure*. The content is sequenced in a logical and coherent structure. There is a balance between conceptual understanding and procedural skill.

*Student experiences*. Students are expected to construct their own understanding of mathematics. Students are engaged in problem solving, reasoning, and mathematical discourse. Students make connections among mathematical ideas and to real-life contexts. Students use representations to communicate mathematical ideas. Student use of manipulatives and technology advance their mathematical understanding. Student materials are user friendly.

*Teacher support*. The instructional materials support teachers in facilitating student learning. The instructional materials support teachers in their own development of mathematical content knowledge and pedagogy. The teachers’ guides are user friendly.

*Parent communication*. The curriculum provides resources for communicating with parents. The materials for parents are clear and easy to read. There are suggestions for ways that parents can support their child’s learning at home.
Assessment. The curriculum provides multiple kinds of assessments. The assessments are a routine part of classroom activity. The assessments are aligned to the instruction. Formative and summative assessments are provided. There are opportunities for students to engage in self-assessment.

Equity. The curriculum meets the needs of all students. The materials are free from cultural and racial bias. Suggestions are provided that would allow teachers to differentiate instruction for students at different levels of mastery and with different learning styles.

Content Analysis Findings

I analyzed the Everyday Mathematics curriculum materials at grades two, three, four, and five for this review. The evaluation criteria in each category were applied to the EM program. The following is a discussion of each criterion listed above.

Mathematical content. My analysis of EM lessons found content from all five NCTM content strands: number and operation, algebra, geometry, measurement, and data analysis and probability. The NCTM standards are highlighted at the beginning of each unit with a table that shows where each standard is in the EM curriculum. The level of instruction seems in line with the NCTM standards at each grade level.

I used the Fairfax County Public Schools (FCPS) Mathematics Pacing Guides (Fairfax County Public Schools, 2003) to help me determine the extent to which the Virginia Standards of Learning (SOL) are addressed in the EM curriculum. Overall, the SOL objectives seem to be represented in the EM curriculum, although many are introduced at earlier grade levels. For example, diameter and circumference of a circle are introduced in EM grade three and SOL at grade five. Identifying place value in decimals to the thousandth place is introduced in EM at grade three and SOL at grade four. Positive and negative integers are introduced in EM at grade
four and SOL at grade six. Prime and composite numbers are introduced in EM at grade five and SOL at grade six.

The mathematical content in EM appears to be accurate. I did not find any mathematical errors in my analysis.

**Organization and structure.** The EM content is organized into units. Each unit has nine to thirteen lessons. There is a mathematical focus to each unit. The activities in the lessons support the learning goals that are outlined at the beginning of each unit. There is a clear sequence to instruction. While EM uses a spiraling structure to teach mathematics, this spiral does not interrupt the sequence of the program. Concepts are continually revisited in different contexts. This is mostly accomplished through Math Boxes (a daily review sheet) and the Ongoing Learning and Practice part of each lesson.

Lessons are organized into three parts: (a) Teaching the Lesson, (b) Ongoing Learning and Practice, and (c) Options for Individualizing. Each lesson begins with a Math Message in which students individually think about a concept that will be discussed in the lesson. The Math Message Follow-Up begins the formal instruction part of the lesson. A Math Message at grade three asks students to use counters to represent 24 trombone players in a parade (University of Chicago School Mathematics Project, 2002d, p. 408). In the Math Message Follow-Up, students share how they arranged their counters. A lesson about multiplication arrays ensues.

The EM curriculum emphasizes conceptual understanding. Mastery of basic facts and procedural fluency are not neglected, however. Students practice facts through fact triangles and games. Standard algorithms are introduced after students understand the concept of the operation and have invented their own algorithms. EM introduces a focus algorithm for each operation. These are not the traditional algorithms but algorithms that are easy to understand and use. “These algorithms have been selected because they provide the greatest mathematical payoff for
the least cost in instructional time” (University of Chicago School Mathematics Project, 2002a, p. 99). Students are expected to master the focus algorithms: Partial Sums, Trades-First Subtraction, Partial Products, and Partial Quotients.

**Student experiences.** EM is focused on conceptual understanding. Activities are designed so that students construct mathematical knowledge through hand-on activities and investigations. In each lesson, students learn new content, review concepts, and practice skills. Concept review and skills practice frequently take the form of games.

The student materials are well-organized. The Student Reference Book provides explanations and examples of important mathematical ideas, directions for games, and charts and tables that are used with math lessons. Student Journals are consumable books in which students solve problems and record data.

Students engage in whole class, small group, partner, and individual activities. Student discourse is a main feature of every lesson. Students are encouraged to solve problems and share their solution strategies. Many problems are set in real-life contexts. One example from second grade EM asks students to take turns being customer and clerk at a fruit stand (University of Chicago School Mathematics Project, 2001b, p. 175).

EM also includes cross-curricular projects at each grade level. These projects were designed to incorporate other disciplines into mathematics instruction. Science, social studies, art, reading, and language arts are included. There are also yearlong cross-curricular projects at grades three – five. Grade three students record sunrise and sunset times each week. This data is used to calculate elapsed time and create line graphs. Grade four students take an imaginary world tour by looking at information about other countries in the student reference books. In grade five, students take an imaginary American tour which includes studying census data.
In EM lessons, mathematical models and representations are used to aid student understanding of important mathematical concepts. Students are encouraged to use manipulatives and drawings to represent their own mathematical thinking. An example in the fifth grade EM asks students to draw pictures and write number sentences to solve division stories (University of Chicago School Mathematics Project, 2002b, p. 238). An example of manipulative use in second grade EM asks students to create three-dimensional shapes with straws and twist ties (University of Chicago School Mathematics Project, 2001b, p. 328).

Calculators are used in EM as teaching tools. Students use calculators to look at patterns of counting, develop place value concepts, play mental mathematics games, and solve problems requiring computations that might be too difficult for students of their age level to perform. Part of student learning about calculators includes deciding when it is appropriate to solve a problem by estimating, calculating mentally, using paper and pencil, or using a calculator.

**Teacher support.** The curriculum materials provided with EM support teachers in facilitating student learning. A two volume, spiral-bound, teacher’s guide contains detailed lessons and planning tips. Each unit includes an overview, learning goals, assessment options, cross-curricular links, suggestions for meeting individual needs, a materials list, and pacing suggestions. The guide is user friendly. It is laid out in an organized manner and lesson procedures are clear.

Mathematical concepts and pedagogy are discussed at the beginning of each unit in the content highlights section. Additional discussions of mathematical content and pedagogy are included in the Teacher’s Reference Manual. Essays on mathematical topics such as number, counting, basic facts, algorithms, mental arithmetic, and measurement help teachers understand mathematical concepts that they may have forgotten or never learned.
Parent communication. EM provides Family Letters, Home Links (K-3), and Study Links (4-6) as ways for teachers to communicate with parents. A Family Letter is sent home at the beginning of each unit. The Family Letter explains the content that will be taught in the unit in language that is easy to understand. The Family Letter also includes ongoing activities students can do at home to support their learning in school.

Each EM lesson has a Home/Study Link which is assigned as homework. Home/Study Links include projects, activities, and review problems that connect with classroom instruction. Many Home/Study Links ask students to interact with family members. One second grade Home Link asks students to practice making change with someone at home (University of Chicago School Mathematics Project, 2001a, p. 725). Each lesson also includes a follow-up to the Home/Study Link. In a fourth grade Study Link, students were asked to complete a multiplication facts table (University of Chicago School Mathematics Project, 2002c, p. 150). The Study Link Follow-Up in the next lesson asked students to describe strategies or shortcuts they used to complete the table (University of Chicago School Mathematics Project, 2002c, p. 153).

Assessment. Informal and formal assessments are aligned to EM instruction. Ongoing assessments include suggestions for “kid watching” and portfolio ideas that are dispersed throughout the lessons. The last chapter in each unit includes formal assessments such as interviews and written tests. Oral assessments ask students to explain their mathematical thinking or do mental calculations. Class checklists and individual student profiles allow teachers to keep comprehensive records of student performance. Mid-year and End-of-Year written assessments are also included.

Portfolio writing and the Weekly Math Log provide opportunities for students’ self-assessment. For each piece of student work included in the portfolio, students are asked to tell
what the work shows about their learning, what they need to improve, and why the work is important. The Weekly Math Log asks students what they studied in math this week and how it relates to topics they have learned about in the past. An interest inventory is another form of self-assessment that is included in the program.

**Equity.** The EM materials are free from cultural and racial bias. Illustrations include children of different gender and ethnicity. Story problems use a variety of names from diverse cultures. The curriculum supports diverse learners. The spiraling structure allows struggling learners to revisit topics when they are better able to understand them. Optional activities are included in each lesson for reteaching, extra practice, and enrichment. Suggestions are made for adjusting activities up or down to meet diverse student needs. Ways to support students acquiring proficiency in English are also suggested. These suggestions help the teacher to provide instruction that gives access to challenging curriculum to all students.

**Strengths and Weaknesses of Everyday Mathematics**

**Strengths**

*Student experiences.* EM includes a variety of student experiences that are designed to meet the needs of a diverse population of students. The experiences allow students to make sense of mathematics at a deep conceptual level.

*Approach to computational fluency.* EM instruction allows students to fully understand an operation before introducing an algorithm, has students invent and explain their own computational procedures, lets students explore a variety of standard algorithms, and requires students to master focus algorithms. This method of instruction sets computational fluency within conceptual understanding. Students understand, learn, and remember computational procedures. These procedures are easy for students to use and will serve them through life.
Teacher support. The EM teacher’s guides and ancillary materials provide a high level of support for EM teachers. The Teacher’s Reference Manual is an especially useful resource because it reviews many mathematical concepts that teachers need to understand.

Assessment. The varied assessment tools and methods in the EM program provide teachers with much information about student learning. This information allows teachers to make instructional decisions and report student progress to parents.

Weaknesses

Pacing. The introduction of concepts earlier than the Virginia Standards of Learning may be a problem for some school districts. I believe that this is not a problem as long as teachers at the lower grade levels teach the concepts and students learn them. Students will meet the state standards earlier than anticipated. They will do well on state assessments with this knowledge.

Fragmentation of the lesson. Each EM lesson has many parts: Mental Math and Reflexes, Math Message, Study Link Follow-Up, Math Message Follow-Up, Teaching the Lesson, Math Boxes, Study Link, and Ongoing Learning and Practice which may include games. It is difficult for a teacher to juggle all these pieces. The lesson becomes disconnected and piece-meal. Time is also an issue. While some lessons may continue over many days, there are only so many days in a school year.

Student self-assessment. The self-assessment options for the EM program are limited. If teachers chose to use them for every unit, students would get bored with the repetition.

Yearlong projects. I believe that the cross-curricular yearlong projects are a weakness in the program. The projects incorporate science and social studies objectives that may or may not be part of the curriculum that teachers are required to teach. The projects are time intensive, and the mathematics in the lessons is not always easy to spot. The objective for a fourth grade World Tour lesson is “to find air distances” (University of Chicago School Mathematics Project, 2002c,
I do not believe this is worthwhile mathematics, especially not mathematics that is worth three-four days of instructional time as the teacher’s guide suggests. I think the time could be better spent focused on mathematical ideas rather than social studies or science ideas that are not in the curriculum.

Suggestions for Improvement

Assessment. While the assessment provided with the program is strong, I suggest that pre-assessments and self-assessments are created for each unit. Teachers could use pre-assessments to determine students’ knowledge of unit content before teaching the unit. This would help them make instructional decisions and differentiate instruction for individual or small groups of students. Open-ended reflection questions focused on the mathematical content in each unit could be created. These student self-assessments would allow students to reflect on their own learning.

Yearlong projects. I recommend that EM remove the yearlong projects or make them an optional part of the curriculum at the fourth and fifth grade levels. If the projects are kept in the program, the mathematical concepts taught in the lessons should be made explicit. The teacher’s guides should include a list of mathematical objectives for each World Tour or American Tour lesson.

Conclusion

Overall the Everyday Mathematics curriculum met my evaluation criteria. The mathematics content in EM is aligned to the NCTM standards and the Virginia SOL. The organization is logical and coherent. Student experiences include the five NCTM process standards. In fact, I consider student experiences to be a strength of the program. The program materials support teachers in providing instruction for diverse learners and in developing their own mathematical content knowledge.
Many research studies suggest that EM makes a difference in student achievement. EM students perform as well or better than students in a traditional curriculum on computational tasks. EM students typically outperform students using more traditional programs on assessments of problem solving and reasoning skills and in mathematics strands that traditionally receive less emphasis such as geometry, measurement, and data analysis.

While the Mathematically Correct reviews were not complementary, the philosophy of the reviewers on teaching and learning differ from my own. I found their reviews to be interesting, but not highly enlightening.

I would recommend that schools and districts consider the EM program when selecting curricula for their students. Students using Everyday Mathematics make sense of mathematics. They learn mathematics at a high level which equips them for future mathematical learning and a productive life.
References


http://everydaymath.uchicago.edu/educators/references/shtml


http://www.pen.k12.va.us/VDOE/Instruction/sol.html#mathematics