Core Connections, Courses 1-3

This document describes the course design, effectiveness and professional development of *Core Connections, Courses 1-3* which are aligned to the CCSS for grades 6-8.

The CPM Research Base and Course Design

The teacher-authors of CPM Educational Program (CPM) began with the belief that the primary goal of teaching mathematics should be ***long-term retention of knowledge***. If learning does not persist past the end of the chapter or the end of the year, in what sense has the student learned anything useful? So the question became, what are the most effective ways to foster long-term learning? Ultimately, the course design was built around three fundamental principles informed by both theory and practice. Two research papers (http://cpm.org/research-base) summarize all available literature about the three principles. Both papers should be reviewed by those interested in why CPM has developed the lesson pedagogy as it has.

1. Students learn ideas more deeply when they interact in study teams with classmates to discuss ideas while guided by a knowledgeable teacher (cooperative learning).

2. Students learn ideas deeply and make connections between mathematical topics when they learn by attacking a wide array of non-routine problems—ideally from the real world--clustered around core ideas (problem-based learning).

3. Students learn ideas and retain them longer when they are required to engage and re-engage with the ideas for months or even years (mixed, spaced practice).

These principles, derived from research, provided a philosophy of how children learn and how teaching should occur in an ideal classroom. The major change from mainstream curricula was to shift the focus of the student activity from being ***told a method*** or approach to being ***asked to solve problems*** designed to develop the method. The problems are attacked both individually and as a student study team with ideas freely exchanged as students grapple with new ideas or extensions of old ideas with the teacher as the ultimate resource. The mathematics is the same—students learn how to factor polynomials, for example—but they emerge from the CPM program with a deeper understanding of the topic and a better appreciation of where it fits into the whole structure of mathematics. Clearly some skills need to be mastered and become automatic, but simply memorizing what to do in a specific situation without an understanding of the reasons why the method works too often leads to quick forgetting and no real long-term learning. Concepts are organized so that the core ideas can be thoroughly acquired while relevant applications in related areas can be understood in terms of these core concepts.

This is why some of these core ideas extend over more than one year, the idea of proportion being one example. Each chapter addresses one of these ideas in depth, developing and reinforcing the others as

necessary. The book provides structured guidance during class time for the students to explore questions in study teams where they can work together and exploit each other's insights to gain understanding. Each lesson is designed to help students reach a mathematical objective. During the lessons, the teacher is always circulating through the classroom to monitor and guide the discussions as necessary so that students do not lead each other astray. CPM's approach is not to have students reinvent wheels; it is about giving students the pieces and showing them a picture of a wheel so they can figure out how to put them together themselves.

Part of each night's homework is designed to reinforce the new ideas learned during class with the remaining questions selected to recall and practice concepts and skills that were developed in previous lessons and chapters. Homework is essential for the internalization and reinforcement of ideas. Solving problems that are like those studied weeks or months before not only helps maintain the previous knowledge, it helps integrate the old knowledge with the new.

CPM teaches students how to employ problem solving strategies, question, investigate, analyze critically, gather evidence, and communicate rigorous arguments to justify their thinking in every lesson. Thus, they have regular opportunities to learn how to communicate and cooperate with each other, both as individuals and partners in solving mathematical problems. Students can tackle mathematical ideas set in everyday contexts to help them make sense of otherwise abstract principles.

Evidence of Effectiveness

The student results reported at cpm.org/research-base summarize various kinds of studies conducted about CPM materials. The reports cover a wide variety of topics, reflecting the different audiences who are concerned about different measures of success. As a result of these studies and reports, cumulatively involving tens of thousands of students, the body of evidence shows that CPM is an effective mathematics program that teaches basic skills, problem solving strategies, and conceptual understanding. In short, it is a complete, balanced mathematics curriculum.

The studies conducted from 1992-1995 were designed to, first, verify that the CPM curriculum is at least as effective with teaching students basic skills and procedures as those available from major publishers and, second, that CPM students benefited from other elements of the curriculum, such as acquiring systematic problem solving strategies and communicating mathematical ideas.

The studies conducted from 1998-2002 were in response to California's adoption of content standards and state-mandated testing. Once again the studies confirmed that CPM students learn basic skills and procedures at least as well but usually somewhat better (and occasionally much better) than students who use other programs. The five-year report for California SAT9 results is based on CPM usage in about 20% of California's high schools.

The studies conducted from 2003-2008 are more diverse. Some are results for CPM schools on state tests for California, Colorado, Pennsylvania, and Washington. There are also studies that examine CPM student performance at both the high and low ends of the achievement spectrum. One study examines course-taking patterns in inner city schools. Another looks at the results of an exemplary implementation of CPM in a three-county area of California (Center High School), and is followed by three more years of test data comparisons for the school. The 2010-13 reports continue the results of state test scores for California, Colorado, Pennsylvania and Wisconsin.

When CPM was named an "Exemplary Mathematics Program" by the U.S. Department of Education in 1999, the report from the team that evaluated the research supporting CPM's submission said, "While there is no single study that proves the effectiveness of the program, the preponderance of evidence is convincing." With the addition of the studies from 1998-2013, there can be no doubt that CPM is one way to effectively teach mathematics. Students of all abilities learn the basic skills while they benefit from the added features of the program: understanding concepts, acquiring problem solving strategies, developing the ability to communicate ideas clearly and effectively, and learning to work with others.

The CPM Professional Development Program

CPM has offered professional development support for teachers using the curriculum since 1989. A typical model, provided without cost, during the implementation year is eight days of workshops plus classroom support conducted by experienced CPM mentors. The workshops follow a written set of agendas that have been created and revised by teams of CPM's most experienced mentor teachers. These agendas include an array of topics, most of which are focused on how teachers teach and how students learn. Part of each agenda is devoted to classroom management and how to use student study teams effectively, as well as how to differentiate lessons and use a variety of assessments. Teachers also learn where the course resources are located. Teachers spend time learning and reviewing the mathematics by going through the chapters, especially the key lessons, to prepare to teach the mathematics of the course. The workshops are experiential, that is, the CPM mentor spends part of the time modeling how a CPM teacher conducts class. Likewise, teachers experience working in teams to understand how the students will learn.

In most cases, teachers attend three to five days of workshops in the summer with the balance of the days during the school year. Often when the mentors conduct the follow-up workshops, they also make classroom visits to teachers to provide one-to-one feedback and support. CPM also offers two to four days of workshops during the second year of implementation to support teachers using CPM.

The workshop experience is in addition to the extensive notes for each lesson in the teacher edition and online resources. Each lesson begins with a detailed "Suggested Lesson Activity" that discusses the problems in the lesson, how they may develop, questions to use with students, and other support, including suggestions for lesson closure, universal access and mathematical background information when appropriate. The resource section of each teacher edition has sections devoted to in-depth discussions of universal access and literacy, using study teams (cooperative learning), closure strategies for each lesson, the chapters and the course, technology support (especially calculators), and assessment. The assessment handbook discusses multiple forms of assessment; each chapter starts with an outline of suggested assessments for it.