Post-test Improvement of Online Algebra Re-teaching with Catchup Math

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Abstract
This report presents the results of an independent study of student mathematics learning utilizing an adaptive online math intervention service. The service, called Catchup Math, can be explored at Catchupmath.com. The study tabulated the scores for over 20,000 student pre-test/post-test outcomes during the 2010-11 school year. Tables are presented showing test scores for students who initially failed pre-tests in a math subject area and then received differentiated (adaptive) online re-teaching until they passed a post-test. The study covers five different mathematics programs for Grade 6 Math through Algebra 2. The metrics quantify the improvement in test scores and the average number of days of usage of the online service to achieve the passing scores, and also show that 90% of the students were able to pass after concerted effort.

Introduction
Catchup Math (Catchupmath.com) is an online mathematics intervention service licensed by schools and colleges to provide review and remediation for students who need re-teaching of mathematics. In Catchup Math, students take short quizzes (pre-tests) and then, based on incorrect answers, are prescribed review topics. The review is immediately delivered online via written and video lessons, activities, math games, and required practice problems with tutorial explanations. When students fail a quiz, they are required to complete their prescribed review, and then are given a similar but different quiz. If a post-test is failed, a new prescription for review followed by post-test continues until a post-test is passed. Upon passing a section of the program, students are advanced to the next section of the program.

Five Catchup Math "Proficiency Programs" cover the material from Grades 6-7 Math, Pre-Algebra, Algebra 1, Geometry, and Algebra 2. Each Proficiency Program consists of six sections; each section covers roughly one-sixth of the curricular material from a typical course or textbook.

Tabulations
The tables below show pre-test and post-test scores for students who failed a pre-test and then eventually passed a post-test. Results are shown for all six sections of each of the five Catchup Math Proficiency Programs. Students who pass the pre-test on the first try are not tabulated, nor are students who failed a pre-test but had not passed their post-test as of the date of the tabulation.

The scores shown are a percentage of correct answers for the 10-question pre-tests and post-tests. Passing is considered to be 70% or higher.

The tables also show the average number of distinct days of usage (number of days the student logged in) between the day of the failed pre-test and the day of the passed post-test.

The rows in the tables below provide the following averages:
Average Fail: Score of first failed pre-test for the section.
Average Pass: Score of the subsequently passed post-test.
Improvement: Score differential from first failed pre-test to passed post-test.
Average Days: Number of distinct days the student logged into Catchup Math.

Table 1: Grades 6-7 Math Program Improvement

	Sec 1	Sec 2	Sec 3	Sec 4	Sec 5	Sec 6
Average Fail:	44.9	46.5	50.5	44.8	46.6	50.8
Average Pass:	80.4	79.2	80.3	80.7	81.2	79.6
Improvement:	35.6	32.7	29.9	35.9	34.6	28.8
Average Days:	4.9	5.4	4.5	3.7	4.3	3.7

Table 2: Pre-Algebra Program Improvement

	Sec 1	Sec 2	Sec 3	Sec 4	Sec 5	Sec 6
Average Fail:	49.1	49.5	49.4	37.2	51.4	44.2
Average Pass:	79.0	77.8	79.8	78.7	81.1	81.1
Improvement:	29.9	28.3	30.4	41.5	29.7	36.9
Average Days:	4.8	3.7	3.8	5.2	3.4	3.3

Table 3: Algebra 1 Program Improvement

	Sec 1	Sec 2	Sec 3	Sec 4	Sec 5	Sec 6
Average Fail:	47.4	44.2	43.6	43.2	41.3	44.4
Average Pass:	79.3	79.3	79.9	79.8	79.9	80.5
Improvement:	32.0	35.1	36.3	36.6	38.5	36.1
Average Days:	4.7	3.7	3.1	2.5	3.0	2.0

Table 4: Geometry Program Improvement

	Sec 1	Sec 2	Sec 3	Sec 4	Sec 5	Sec 6
Average Fail:	42.7	46.7	43.1	38.6	36.1	34.9
Average Pass:	81.1	79.8	80.0	81.0	80.8	80.6
Improvement:	38.3	33.1	36.9	42.3	44.7	45.7
Average Days:	2.9	3.1	2.6	3.2	2.4	1.8

Table 5: Algebra 2 Program Improvement

	Sec 1	Sec 2	Sec 3	Sec 4	Sec 5	Sec 6
Average Fail:	35.8	31.9	33.8	31.0	19.2	30.0
Average Pass:	82.8	84.8	86.8	88.5	86.9	87.7
Improvement:	47.0	52.9	53.0	57.5	67.7	57.7
Average Days:	3.8	4.6	4.7	6.6	2.1	1.9

Additional Metrics Not in Tables
The average number of distinct days of usage (i.e., with at least one login session) from failing to passing a section was 3.7 days. The average number of calendar days was 10.7.

The average number of review topics prescribed to students before they achieved a passing score was 8.1. This counts all lessons shown to a student (including repeated lessons) during their re-teaching cycle(s) before passing the section.

Commentary
Catchup Math is generally made available to remedial students. There is great variability in the skills, motivation, and learning modes of these students. Additional variables include the distractions or lack thereof in the computer labs where Catchup Math is used and the degree to which there was parallel (blended) teaching or tutoring.

In addition to the Proficiency Programs, Catchup Math also includes other categories of programs: textbook chapter-based programs, high school graduation exam preparation programs, custom programs and quizzes constructed by teachers, and a placement exam. The results were not tabulated for these programs.

When a student fails a pre-test or post-test, the next test given is on the same material but different than the prior test in the wording and/or numerical values within the problems.

The number of students who failed their first quiz and used Catchup Math on at least 15 distinct days without ever passing was only 10% of the combined number of students who had initially failed.

Conclusions
The results show that remedial students can pass quizzes that they originally failed by learning from programs such as Catchup Math. The tables show that students with failing scores averaging 40% were able to improve their scores by 38% to passing scores of 78%. Furthermore, the transition from failing to passing a section corresponding to one-sixth of a full math course was achieved in 10.7 calendar days with 3.7 distinct days of usage. The number of students who continued to use Catchup Math after first failing a quiz and were still unable to pass after concerted effort was quite low, indicating a very encouraging 90% success rate by the measures described above.

Footnote on Methodology and Independence
This report is an independent third party assessment of Catchup Math and more generally an assessment of the potential for online differentiated math re-teaching services. During the school year period of August 2010 through April 2011, over 20,000 pre-test and post-test score combinations for Catchup Math students nationwide were recorded. Hotmath, Inc. paid an independent contractor to prepare the queries for the data analysis and provided unfettered access to the complete, original recorded data. Dr. Chance was provided full access to the query software and the student data. Also, the query software was spot-checked manually for small runs of the software for limited students.

Dr. Chance has a Ph.D. in Cognitive Science from UC Santa Barbara (2000) and has been involved in both research and statistical and quantitative analysis of health care, foster care, and educational programs at the University of California San Francisco Medical Center and as Director of Research, Seneca Foundation, San Leandro, California. Dr. Chance may be contacted at sarahchance@hotmail.com.