Raising State Assessment Scores through Digital Review

The Results of a 6 Year Study to Determine Whether Team-Based Digital Assessment Practice Can Significantly Raise State Test Scores

2017 Results

Stephen J. Smith

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G7 RESEARCH

Executive Summary

Many schools set proficiency improvement goals of 2-3% per year on state tests. In other words, their best hope is to move 2-3% of their students from failing to meet minimum state requirements to passing them. Effectively, they are attempting to move students from below a minimum bar of competency to "above the bar".

Very few schools achieve these 2-3% goals that they set for themselves. If they do it is often only for a particular year and then the next year the gains may be lost. It would be remarkable if there was an educational intervention that could provide these types of gains and do it in a sustained way year after year.

JogNog has improved state science scores in Massachusetts by an average of 2.9 percentage points each year for the last six years.

This corresponds to approximately **3 additional students out of every 100 passing** the state test in schools that used JogNog compared to schools that did not.

6 Years of Consistent Impact from JogNog Learning System

2012 Increase in Proficient % Over State	4.1 % points
2013 Increase in Proficient % Over State	3.5 % points
2014 Increase in Proficient % Over State	1.6 % points
2015 Increase in Proficient % Over State	1.3 % points
2016 Increase in Proficient % Over State	4.1 % points
2017 Increase in Proficient % Over State	2.8 % points
Average over 6 years	2.9% points

2017 Stats	
State Change in Proficiency from 2016 (41%) to 2017 (40%)	-1 % points
Change in Proficiency for New Schools Completing the Program	1.8 % Points
Increase in Proficient % Over State	**2.8% points**
Total # Schools	500+
Total # Schools Completing the Program	76
Total # New Schools Completing the Program	9

Why it is Difficult for Schools to Improve without JogNog

The challenges to this level of improvement are:

1. Students are burned out on "test prep" and testing in general
2. Students are generally unmotivated to do well on the test (there is little personal benefit for them)
3. Students have forgotten what they were taught in previous grades or earlier in the current school year
4. Teachers' schedules are so full that they often cannot cover many of the required standards
5. Students in general are unfamiliar with the pressures of taking 'high-stakes' digital tests

A Competitive Team-Based Learning System Shows Impact

In this paper we describe research on using a competitive team-based learning system to motivate students for learning and doing well on state standardized tests. The solution investigated has the following features to address the above challenges:

1. Students are presented review questions in a challenging and competitive way that is **fun and low-stress**
2. Students are reminded of the value of doing well on the state test through specific quiz review questions
3. All content from previous years and earlier in the school year is reviewed in an automated, personalized way
4. Even if teachers are unable to cover particular standards in class the learning solution can still be effective in having the students learn more content
5. The review **includes real test questions** from the state test presented via digital devices so that the students become familiar with the content which, in turn, lowers student stress levels

The learning system used in this research was JogNog and it was deployed as part of a larger program called the JogNog Tower Challenge. For this research the program was shown to be causal in improving proficiency rates that often exceed the school goals for improvement.

Background

For the past six years the JogNog Tower Challenge (JTC) has been an important part of learning and skills building in many schools across the United States. The JTC is a competition among schools to see how many quizzes its students can successfully complete and achieve mastery on the corresponding learning standards. Each quiz generally consists of from 30 to 100 challenging review questions on all subjects including Science, Math, ELA and History, for grades two through twelve.

The JogNog Tower Challenge helps teachers and principals to better prepare their students for state testing. The goal of state testing is to identify and help students that do not possess the basic knowledge required for their grade level. The goal for schools and teachers is to identify strategies to challenge these students to move from 'below the bar' to 'above the bar'. One of the best ways to do this is to make sure that students don't forget what they have already learned.

The JogNog Tower Challenge is a team-based competitive learning contest that provides students with a fun and exciting way to review and remember what they have learned in class and apply it to state tests. JogNog stands for "Joggin your Noggin" and it is aptly named as JogNog is particularly helpful in helping students to remember and review knowledge that they had previously been exposed to.

The JogNog Tower Challenge runs from September to June each school year. Schools that join the JogNog Tower Challenge have access to over 80,000 review questions that map to the curriculum.

Methodology for Measuring the Impact of the JogNog Tower Challenge

To measure the impact of the JogNog Tower Challenge we looked at the state test scores for 8th grade science in Massachusetts (MCAS). We looked at schools that had significantly participated in the challenge (schools with low participation would not have had enough exposure to JogNog to be expected to move the needle). We then looked at the change in proficiency from the previous year when JogNog was not used to the year that JogNog was used. Specifically we calculated the average change in science proficiency percentages for schools where:

1. 70% or more of the 8th graders participated by correctly answering an average of at least 100 questions per student
2. The school had not use JogNog the previous year

The change in the percentage of students in the Advanced or Proficient categories for that schools was then compared to the change across the state (some years the test is harder than in other years so JogNog does not take credit if the overall state scores went up over a particular year).

Impact of JogNog is Likely Much Greater than These Results Indicate

The impact of JogNog reported here, while substantial, is likely to be a significant underestimate of the value of the program for the following reasons:

1. Because of privacy considerations, we could not measure individual students but only at a school level. Thus we could not exclude students who did not participate at a significant level. Their inclusion would push the improvement reported towards average state levels.
2. Because we did not know which grade each student was in, we invariably included some schools where 5th, 6th, and 7th graders were using JogNog rather than 8th graders. Since the eighth graders actually took the state MCAS test, the inclusion of students not in eighth grade means that we may have included schools that did not actually have at least 70% participation of eighth graders. This would cause under-reporting of the impact of JogNog and implies that the actual impact of JogNog could be considerably greater than reported here. This could be easily fixed in future research if we had access to individual student test scores. Then we could look at impact on each student rather than coarsely measuring it just at the school level.

Addendum: The Schools that Completed the 2017 JogNog Tower Challenge

These are the schools where sufficient students mastered enough questions and were new to the program.

School Name	City	Correctly Answered Questions	Correctly Answered Questions per Student	>70% of Eighth Graders Using JogNog	2016 MCAS Science % Proficient and Advanced	2017 MCAS Science % Proficient and Advanced	YTY Change in % Proficient and Advanced
Littleton Middle	Littleton	64,201	521	X	63	71	8.0
Walter S Parker Middle	Reading	124,891	905	X	61	62	1.0
Sandwich STEM Academy	Sandwich	77,663	324	X	46	46	0.0
Ferryway School	Malden	46,388	242	X	37	40	3.0
Beebe School	Malden	71,776	414	X	37	39	2.0
Veritas Preparatory Charter School	Springfield	8,504	146	X	40	38	-2.0
Frederick W. Hartnett Middle	Blackstone	201,479	1,144	X	38	33	-5.0
Bourne Middle	Bourne	63,753	164	X	32	34	2.0
Ralph C Mahar Regional School	Orange	68,782	414	X	24	31	7.0
	Averages	**80,826**	**475**		**42**	**44**	**1.8**

MCAS data from http://profiles.doe.mass.edu/statereport/mcas.aspx

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The Results of a Longitudinal Experiment
to Determine if Competitive Computer-Based Practice
Can Significantly Raise State Test Scores

A Detailed Investigation of Causation for 2013

Kris Carlson

Joshua D. Savage

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G7 RESEARCH

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The JogNog Tower Challenge is a team-based competitive learning contest that provides students with a fun and exciting way to review and remember what they have learned in class and apply it to state tests. JogNog stands for "Joggin your noggin" and it is aptly named as JogNog is particularly helpful in getting students to remember and review many things that they had previously learned.

The JogNog Tower Challenge is free to schools and runs from October to May each school year. Schools that join the JogNog Tower Challenge have access to nearly 100,000 review questions that map to the curriculum

standards that teachers need to cover in class. JogNog can also be used for summative and formative assessment and learning from a computer, smartphone, Chromebook, or tablet.

Results

The graph below shows the average proficiency over four years compared to the state. The year that JogNog was used shows a significant increase in proficiency beyond anything that was tried before.

Proficiency of 15 Schools On State Science Assessment Before and After Using JogNog
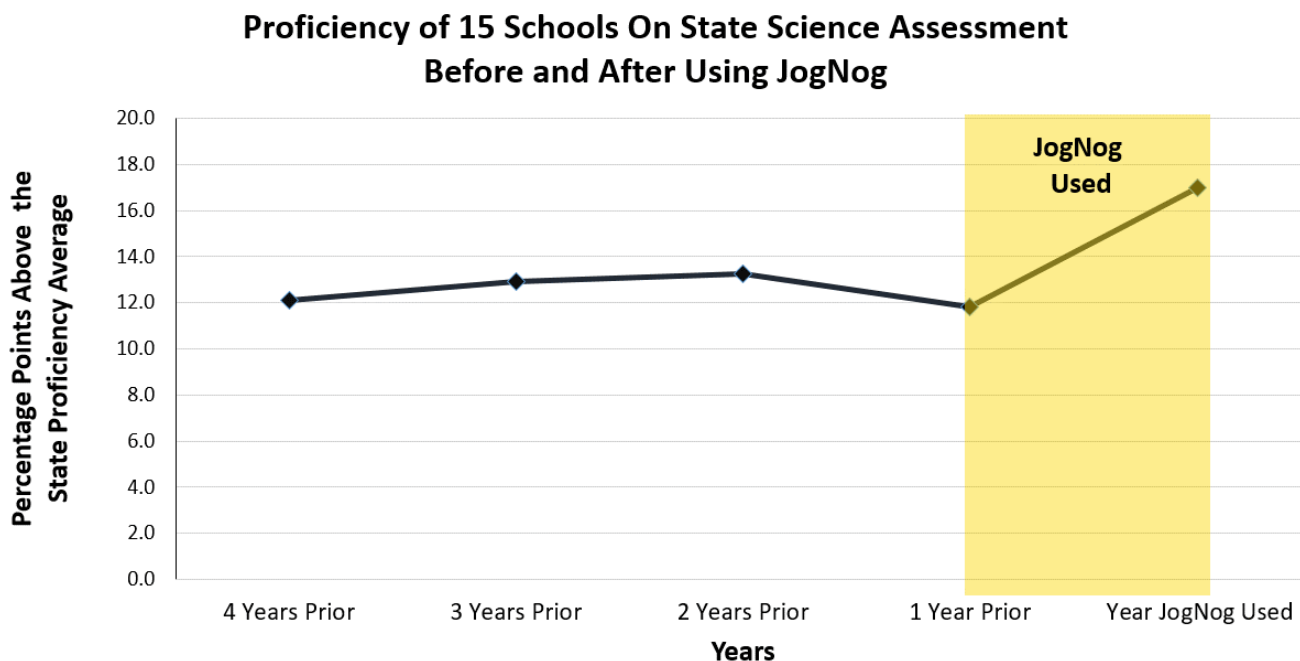
The other way to look at this data is to see the efficacy of various other programs that the schools tried in the previous years before trying JogNog. The chart below shows the increases (and decreases) in proficiency from different programs tried by the schools. Some interventions had negative impact and no other intervention had more than a 1% impact. The JogNog intervention had a 4% impact. Four times greater than any other program the schools had tried in the previous three years.

Year-Over-Year Change in % Proficient / Advanced for 12 Schools
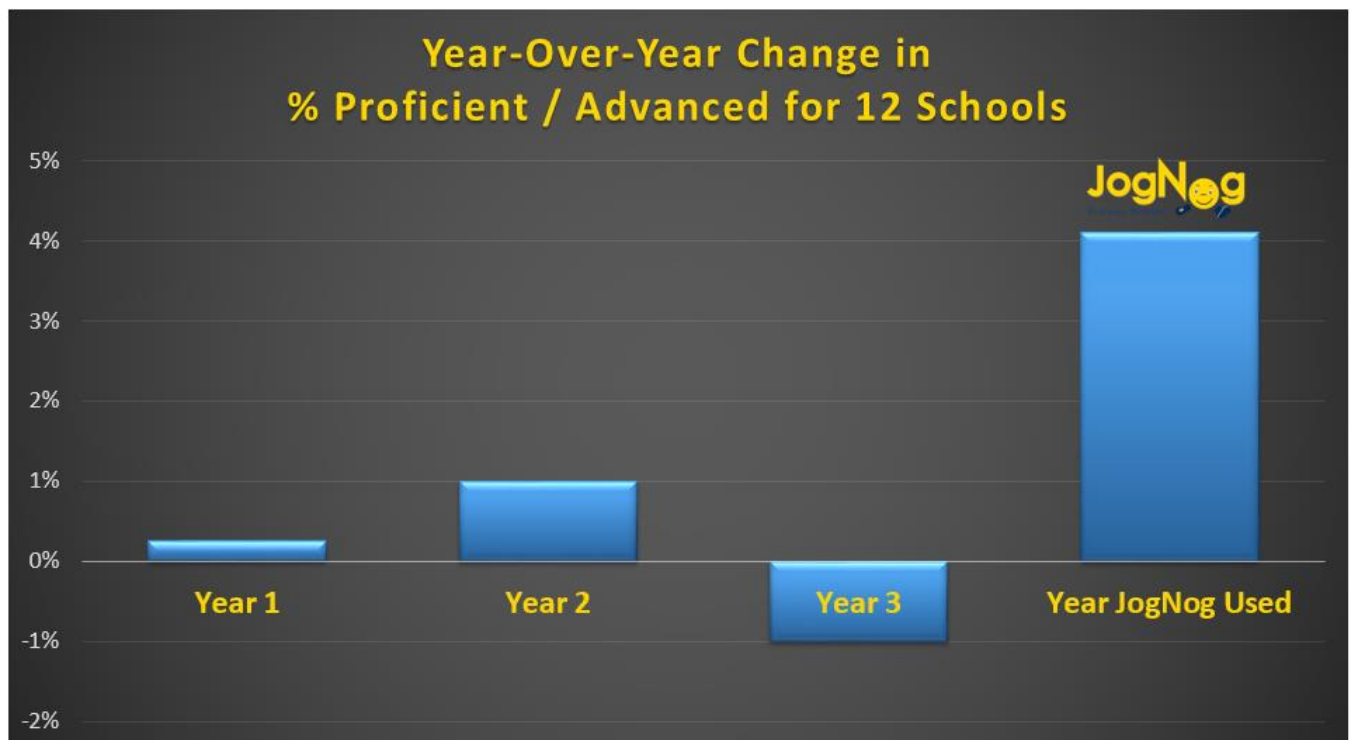
The JogNog Tower Challenge is free to teachers and students. For more information please go here: **www.JogNog.com/Challenge**

State Standardized Test Scores Improved in Massachusetts

The JogNog Science Challenge™ (JSC) is a program that helps teachers improve their students' scores on the Massachusetts standardized science test (the science MCAS). The program consists of a friendly competition among schools to learn science concepts and correctly answer as many relevant science questions as possible using the JogNog® educational app. This allows teachers to offload "drill & kill" rote learning and review of important facts and concepts to JogNog, freeing up class time for teachers to focus on higher-order thinking skills. Teachers typically free up 1-2 hours of class time each week using JogNog, and MCAS scores increased significantly.

The goals of the JSC are to help keep Massachusetts in its position as the top science and technology state in the country and to provide a proven program for other states to follow so that they can strengthen their science education. The JSC results are measured using the state standardized tests results (the MCAS) for each school.

JogNog Schools Maintained Performance While the State Dropped in 2013

Each year the state average test scores can vary depending on small differences in the difficulty of the MCAS and the student population. In 2013 the state average 8th Grade Science MCAS score dropped by 4 percentage points in Proficient and Advanced, but the schools that completed the JSC dropped by only 0.5 percentage points (JSC schools performed 3.5 percentage points better than the state).

In the previous year (2012), the state average rose by 4 percentage points but the schools completing JSC 2012 rose by over 8.1 percentage points. This meant that schools completing JSC 2012 improved by 4.1 percentage points more than the state. The results were similar in magnitude to the 2013 results and indicate a consistent improvement in schools that complete the JSC.
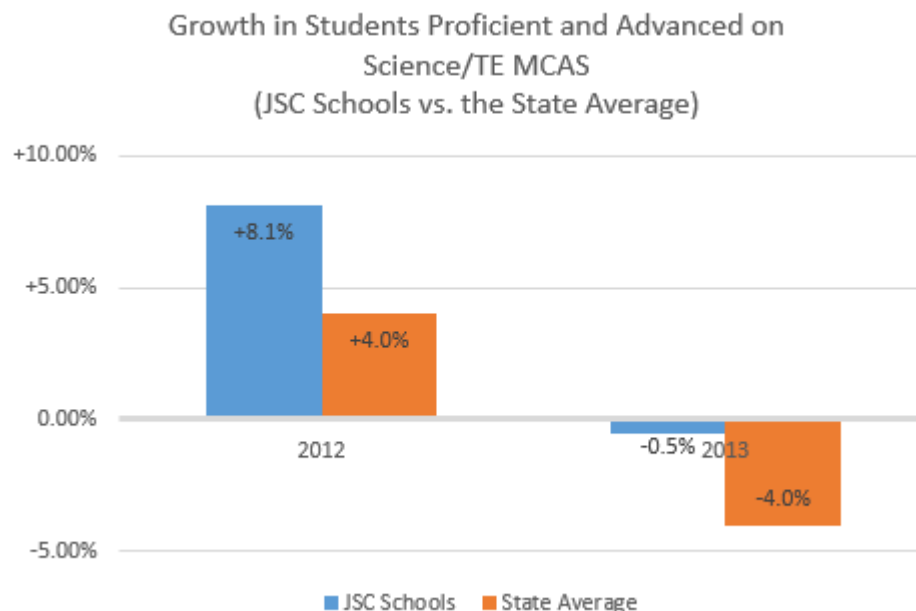

Figure 1a: *In 2012, schools that completed the JogNog Science Challenge increased the number of students in the Proficient and Advanced MCAS category by 4.1 percentage points over the statewide average. In 2013, these*

results were replicated when participating schools raised their number of Proficient and Advanced MCAS by 3.5 percentage points over the statewide average change.
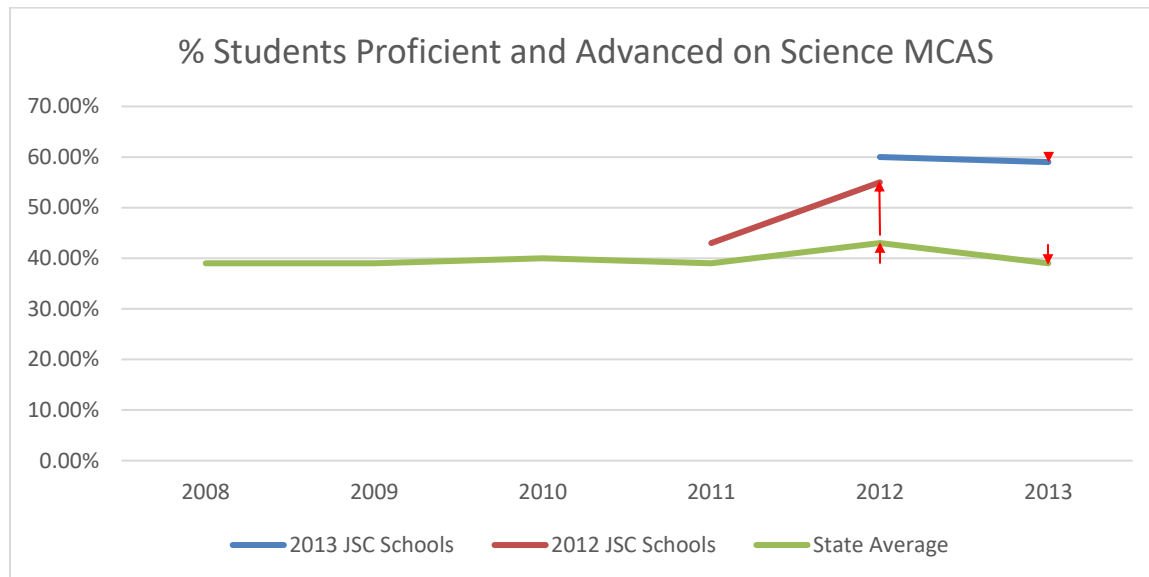

Figure 1b: *This graph shows the average number of students scoring Proficient and Advanced on the Science MCAS by year for schools completing the JogNog Science Challenge in 2013, in 2012, and for all schools in the state. Schools completing JSC 2012 saw significantly greater improvement than the state average increase in 2012 and those completing JSC 2013 decreased dramatically less than the state average decrease for the science MCAS test. Consistent performance over two years and nine participating schools is considered to be a significant impact.*

Many schools completed some of the JogNog Science Challenge but only nine fulfilled the criteria required for successful completion. These criteria were set as a reasonable lower bound on the level of participation required in order to see the program impact at the level of the school-wide MCAS results. The criteria that define "successful completion" of the JogNog Science Challenge by a school are:

1. At least 70% of all 8th grade students participate.
2. Each participating student answers at least 150 science questions.

The program was provided by JogNog at no cost to Massachusetts schools, and teachers typically used JogNog in the following way:

1. Invite students to create free accounts on JogNog
2. Invite students to join a JogNog class with the relevant science quiz games in it
3. Use online assessment to monitor students' mastery level (see Appendix D: JogNog Grade Book™)
4. Identify standards where students are weak (see Appendix E: JogNog Missed Questions™ Report)
5. Assign JogNog quiz games as homework to teach basic concepts and free up class time
6. Practice test-taking techniques by answering published questions from actual MCAS tests
7. Engage students in inter-class and inter-school competitions to drive student motivation

MCAS Score Increase Is Driven by JogNog Usage

To determine the value of the JSC to teachers and principals, a clear and understandable measure of success was needed. Following national and state policy, the percentage of students who score in the Proficient or Advanced categories of the MCAS 8th Grade Science test was adopted as a valid, unbiased measure.

The following were the key results of the JSC program:

1. While the state average 8th Grade Science MCAS Proficient and Advanced percentage dropped by 4 percentage points across the state, JSC participants held nearly steady with only a half percentage point decrease, thus exceeding the state performance by 3.5 percentage points.
2. A strong positive correlation between use of JogNog and increased Proficient and Advanced was shown for the 2013 8th Grade Science MCAS.
3. Schools with exceptionally strong participation generally produced exceptional 8th Grade Science MCAS score increases.

Schools that Completed the JogNog Science Challenge Performed 3.5 Percentage Points Better than the State
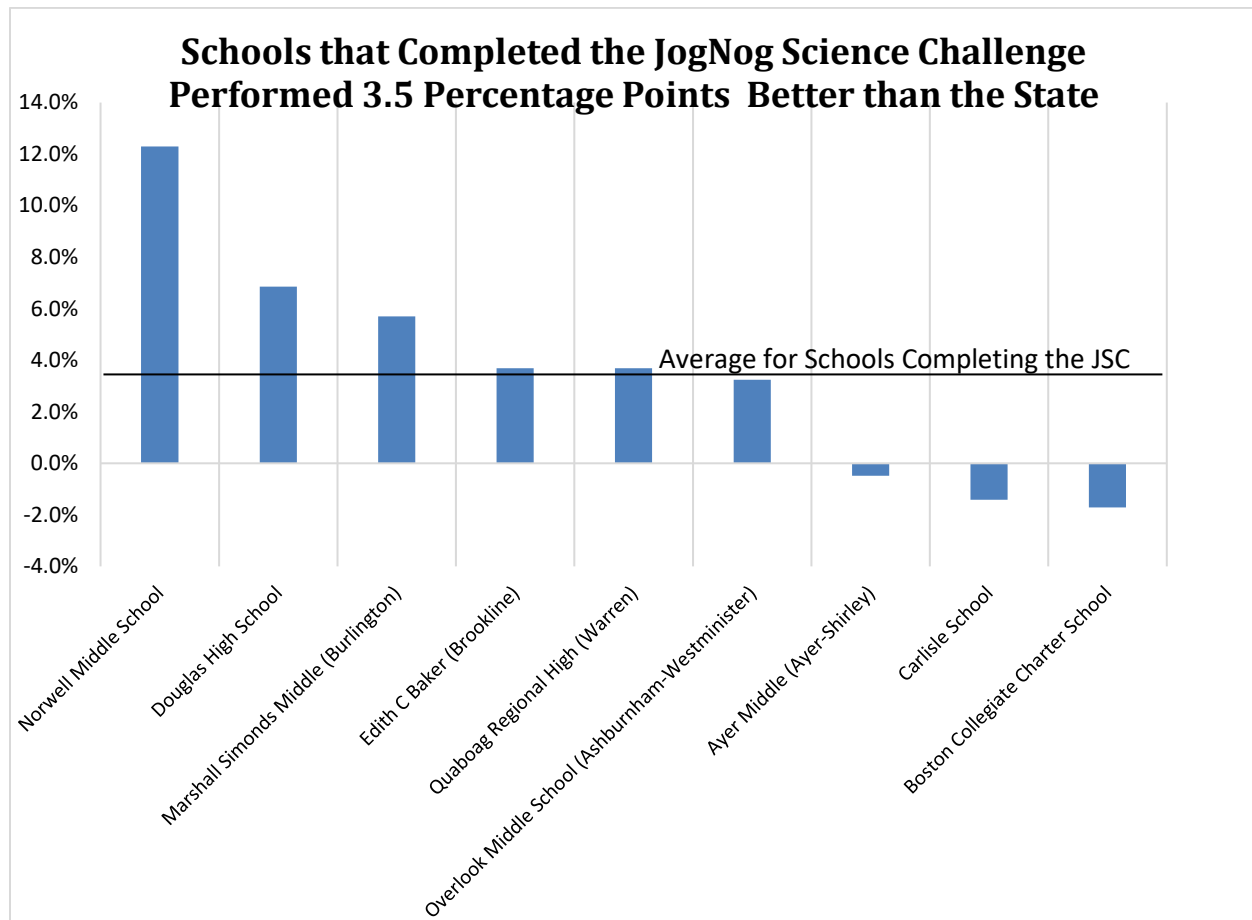
Figure 2: This chart shows the change in the percentage of students scoring Proficient and Advanced relative to the state average (state was -4% in 2013) for each school that completed the JogNog Science Challenge in 2013. As these results suggest, the participating schools have widely varying resources at their disposal for preparing for the MCAS. Many factors affect a school's ability to prepare students for the MCAS, including budgets, teaching schedules, and the effectiveness of other additional preparatory programs used by the school. The schools' individual performance can be more clearly seen by the individual 3-year graphs shown in Figure 3. Given the strong correlation between JSC participation and increased scores (Figure 4), however, a confident prediction can be made that the schools that showed strong MCAS performance would have had lesser results without the help of JogNog, and that schools that fell compared to the state would have fallen even farther had they not participated in the JSC.
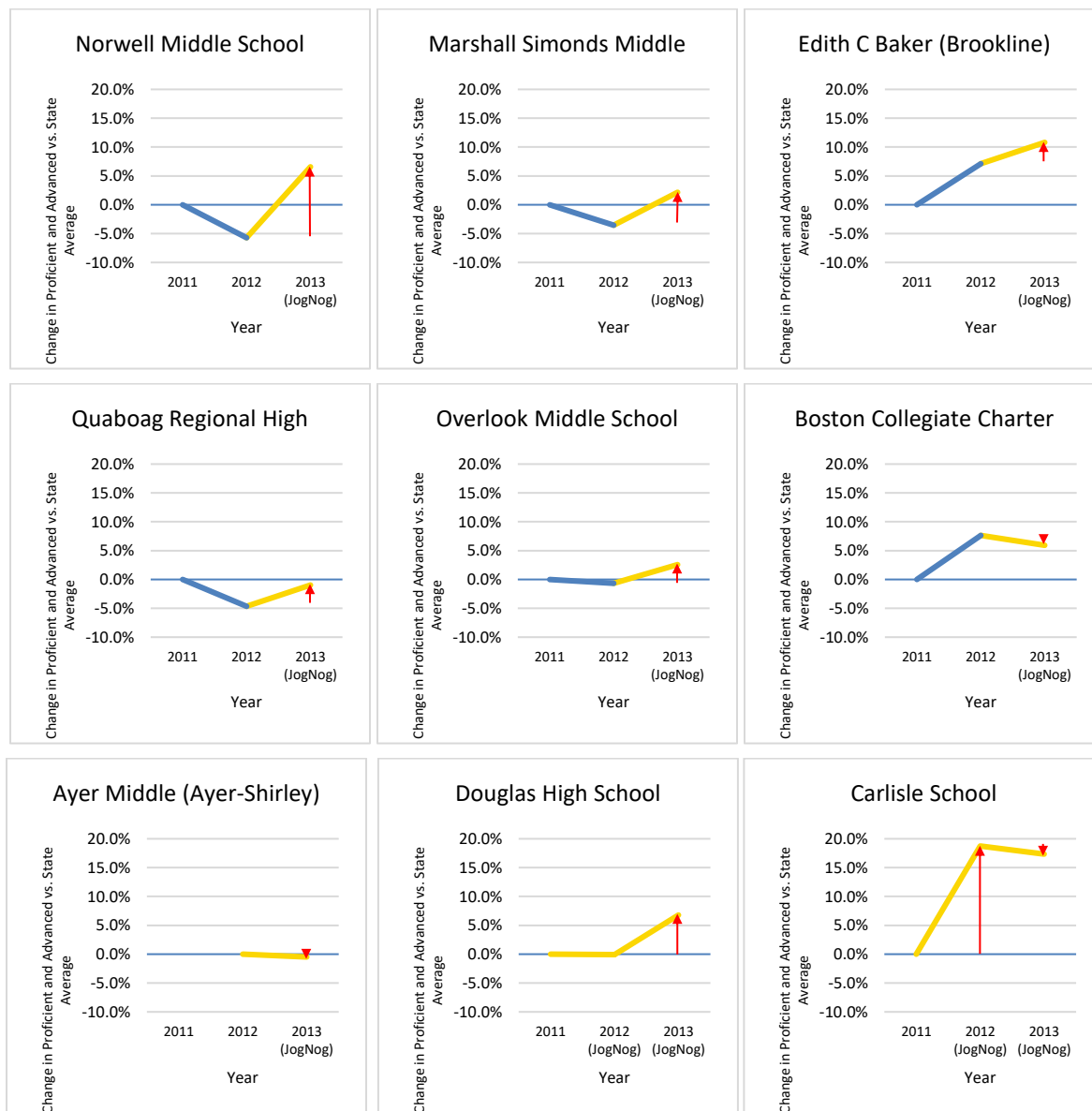
Nine Schools Completed JSC 2013

Figure 3: This matrix of nine graphs displays the change in each school's percentage of students scoring Proficient and Advanced since 2011 after subtracting the state's average year over year change. Note that in 2012 the state average increased 4 percentage points and in 2013 it decreased by 4 percentage points. Years marked with "JogNog" are years in which the schools involved completed the MCAS Science Challenge; yellow lines indicate spans of time in which schools used JogNog to prepare for the MCAS. The change between data points when participating in the JSC is also visually represented by red arrows approximating the amount of growth or decrease. (Ayer Middle only shows results for 2012 and 2013 because the school was merged into a new district, Ayer-Shirley, in 2012.)

More Questions Answered = More Improvement

By looking at all the schools that entered the JSC, including both those that completed the challenge and those that did not complete the challenge, a high statistical correlation was found between degree of participation and improved performance on the Science MCAS. Specifically, the average number of questions that students at each school answered in the JSC (correctly or incorrectly) is strongly correlated with each school's improved MCAS performance, as measured by the change in the percentage of students scoring Proficient and Advanced compared to the state average.
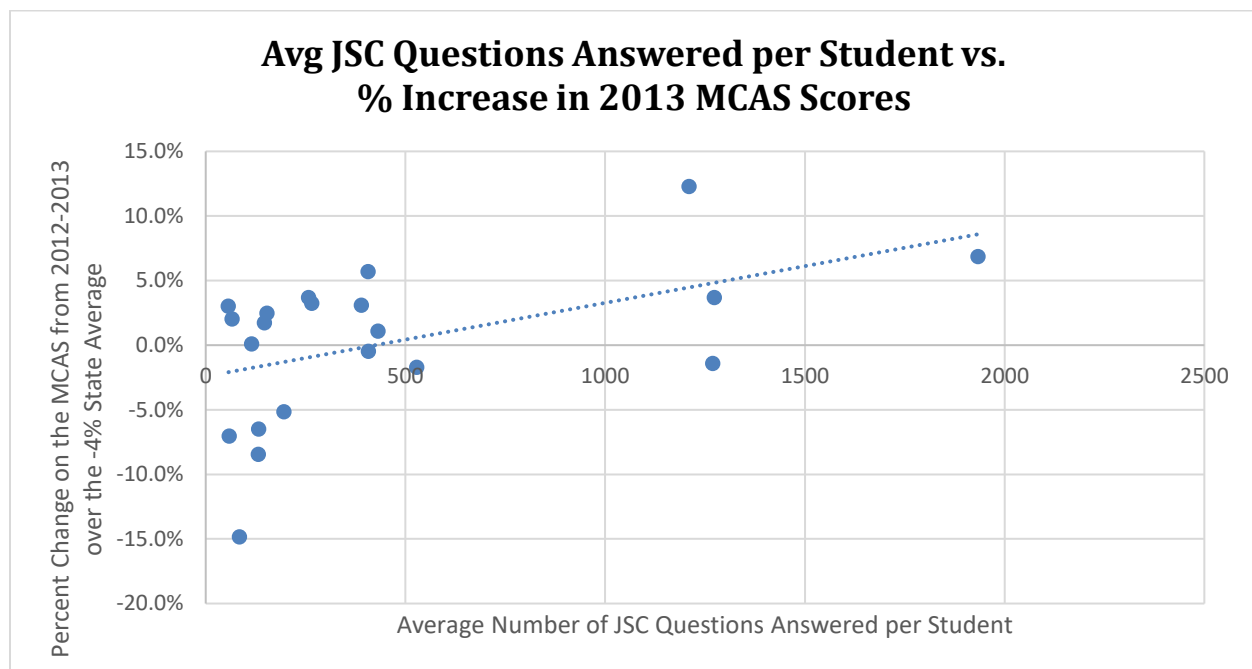
Figure 4: *Each point on the graph represents a school that entered the JSC. Some schools participated fully and completed the challenge but even the schools that did not complete the challenge showed improvement from partial completion. Note that viewing and answering a larger number of questions in the JSC is strongly correlated with a positive change in MCAS performance vs. the state average (p = 0.0003, single-tailed paired T-test).*

Schools Entering the JSC Represented All Proficiency Quartiles
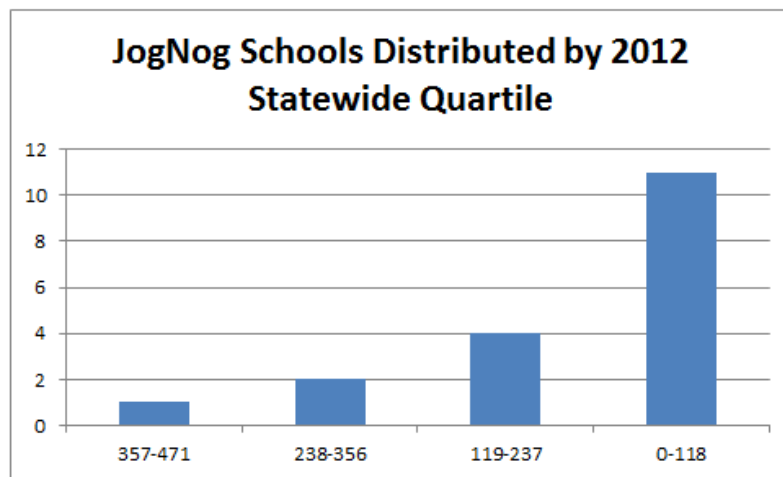
Figure 5: This graph displays the number of schools participating in the JSC that fell into each quartile of the 471 schools in Massachusetts in 2012 – 2013 when organized by rank. One participating school ranked among lowest in the state, while 11 of the schools came from the top 118 schools in the state. Although weighted toward the higher performing schools in Massachusetts, the JSC included schools from each quartile, allowing us to examine its effect on both high and low performing schools.

Multi-Year Participants Showed Consistent Improvement

Several schools used JogNog for one cohort of students within the 8th grade, permitting a comparison of results between the two cohorts. Douglas High School had strong participation in both 2012 and 2013, but much stronger participation in 2013. The chart below shows Douglas High School 8th Grade Science MCAS scores from 2007 through 2013. Inset numbers are the number of science questions answered correctly by students on average, for 2012 and 2013, when Douglas High School participated in JSC.
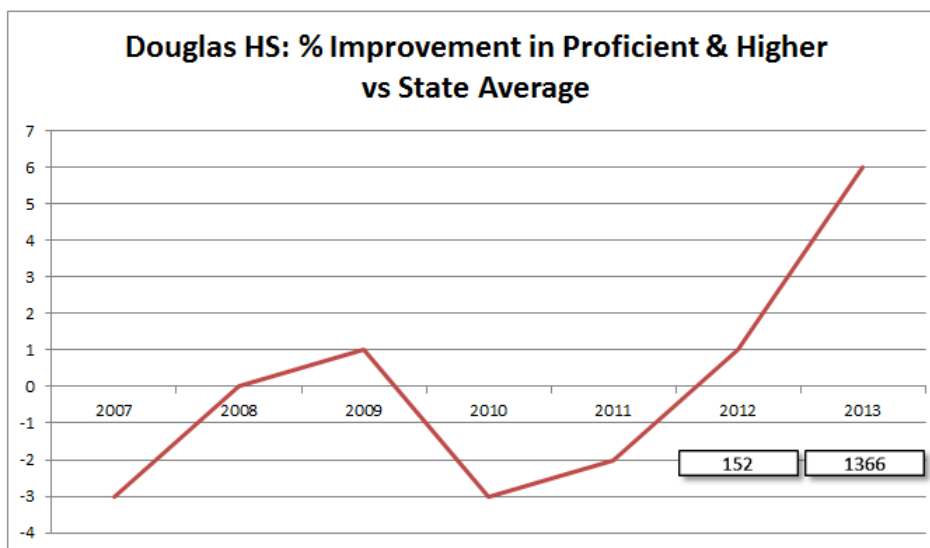
Figure 6: This graph displays a more comprehensive longitudinal record of Douglas High School's performance on the MCAS in terms of improvement in the percentage of students scoring Proficient and Advanced each year vs. the state average for that year. Note that Douglas High School participated in the JSC in 2012 and 2013.

A Simple Prescription for Increasing MCAS Scores

The results from the JogNog Science Challenge from the last two years provide evidence of a simple prescription that can be used to increase 8th Grade Science MCAS scores and State Standardized Assessment scores for STEM in general:

1. Students should answer at least 200 high-quality science review questions correctly (an increase over the recommendation from 2013).
2. Teachers should off-load rote "drill & kill" memorization of basic concepts to an educational app such as JogNog, to free up class time for more creative activity, problem-solving, hands-on laboratory and project work, and for teaching higher-order thinking skills.
3. Teachers should use online assessment (for example JogNog's Grade Book) to free up class time and allow more frequent, less invasive assessment.
4. Teachers should use online assessment (for example JogNog's Missed Questions report) to identify concepts and questions with which students are struggling, and modify lesson plans to remediate those issues.

If this prescription is followed, it is predicted that schools completing the JogNog Science Challenge in 2014 will meet or exceed the same 3.5-4.1 percentage point increases that have been observed for the past two years.

Appendix A

Schools Completing the Challenge: Proficient & Advanced Percentages

Name of School Completing the JSC*	2012 % of Students Proficient & Advanced	2013 % of Students Proficient & Advanced	2012-2013 change in % of Students Proficient and Advanced	2012-2013 Change vs. Statewide change of -4%
Norwell Middle School	68.1%	76.4%	8.3%	12.3%
Douglas High School	39.1%	42.0%	2.9%	6.9%
Marshall Simonds Middle (Burlington)	56.1%	57.8%	1.7%	5.7%
Edith C Baker (Brookline)	65.2%	64.9%	-0.3%	3.7%
Quaboag Regional High (Warren)	47.4%	47.1%	-0.3%	3.7%
Overlook Middle School (Ashburnham-Westminster)	56.7%	55.9%	-0.8%	3.2%
Ayer Middle (Ayer-Shirley)	47.1%	42.6%	-4.5%	-0.5%
Carlisle School	89.4%	84.0%	-5.4%	-1.4%
Boston Collegiate Charter School	68.5%	62.8%	-5.7%	-1.7%
Average for Schools Participating in the JSC	**59.7%**	**59.3%**	**-0.5%**	**3.5%**
State Total	**43%**	**39%**	**-4%**	**(N/A)**

For the criteria defining successful completion, please see page 1.

Appendix B

All Schools that Entered the JSC

This table shows the average number of answers per participating student in the JSC and the change in percent Proficient and Advanced compared to the overall change in the state average. This includes all schools that participated including those that did not fully complete the JogNog Science Challenge.

School Name	Average JSC Answers Per Student	2012-2013 Change vs. State Average of -4%
Norwell Middle School*	1,210	12.3%
Douglas High School*	1,934	6.9%
Marshall Simonds Middle (Burlington)*	407	5.7%
Edith C Baker (Brookline)*	258	3.7%
Quaboag Regional High (Warren)*	1,274	3.7%
Overlook Middle School (Ashburnham-Westminster)*	266	3.2%
Ayer Middle (Ayer-Shirley)*	408	-0.5%
Carlisle School*	1,270	-1.4%
Boston Collegiate Charter School*	529	-1.7%
Lynnfield Middle School	57	3.0%
Washington Irving Middle (Roslindale)	390	3.1%
Jonas Clarke Middle (Lexington)	154	2.5%
McCall Middle (Winchester)	66	2.0%
Ferryway (Malden)	147	1.7%
Madeline English School (Everett)	432	1.1%
Nessacus Regional Middle School (Central Berkshires)	115	0.1%
Frederick W. Hartnett Middle School (Blackstone-Millville)	196	-5.2%
Glenbrook Middle (Longmeadow)	133	-6.5%
Ashland Middle	59	-7.0%
Raymond J Grey JH (Acton-Boxborough)	132	-8.4%
Concord Middle	85	-14.8%

Schools that completed the JogNog Science Challenge

This chart compares the JogNog schools' performance on the 8th Grade Science MCAS in 2013, their first year in the JSC program, with the prior year. For each year, each school's change in the percentage of Proficient and Advanced students, minus the state average change, is shown.

Appendix C

Discussion: JogNog Used to Improve Test Scores in Specific Strands

Many teachers use JogNog to focus students on specific strands. For instance, to prepare for the 8th Grade Science MCAS, teachers may feel students need to review what they learned in 6th or 7th grade, such as earth and space science, or life science. In schools that lack a full tech/engineering curriculum, teachers use JogNog's array of tech/engineering quiz games to cover all state standards.

In 2012, several schools showed a strong correlation with JogNog usage in a specific strand and score increase in that strand. In 2013, schools could not share their usage data in a particular strand, but the scores for JogNog versus non-JogNog schools by strand was made available.

Multiple Choice Questions	Open-Response Questions
Life Science: +6.3%	Life Science: +0.34
Physical Science: +8.0%	Physical Science: +0.29
Earth and Space Science: +7.3%	Earth and Space Science +0.36
Technology and Engineering: +5.2%	Technology/Engineering: +0.24
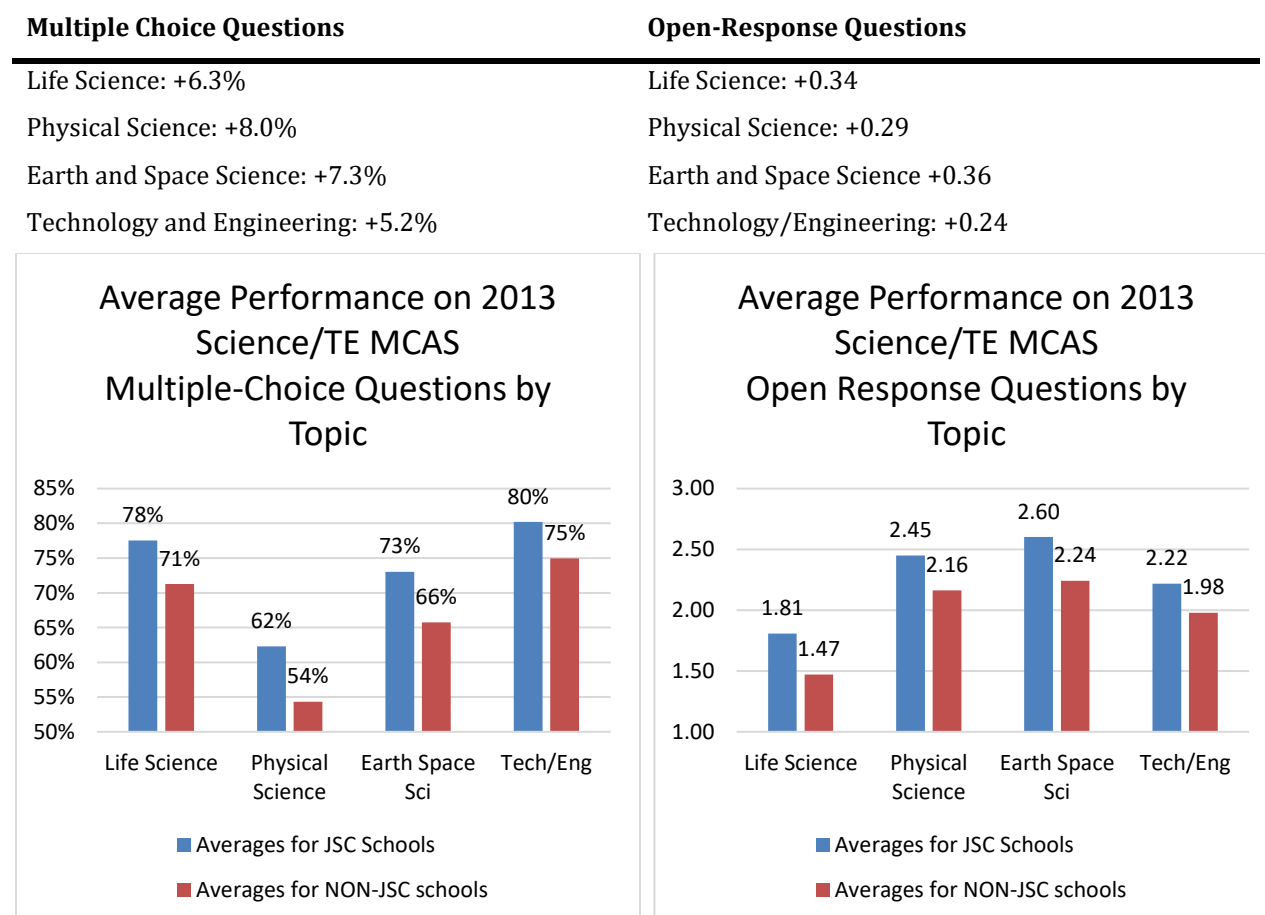
Figure 7: *This pair of graphs shows the averages of the scores for schools that participated in the JSC in 2013 as compared with those of schools that did not participate. "JSC Schools" includes all participating schools, not just the nine the completed the JSC. Multiple-Choice scores are an average of the % of students who gave a correct answer on each individual question, while Open Response scores are the averages of the scores on each corresponding Open Response question. This pair of graphs shows only performance in 2013, but change from 2012 to 2013 can be seen in Figure 8.*

School Name	2012-2013 Life Science Change	2012-2013 Physical Science Change	2012-2013 Earth-Space Science Change	2012-2013 Technology/ Engineering Change
Norwell Middle School	+8%	-6%	+12%	+5%
Douglas High School	+10%	-7%	+3%	+10%
Marshall Simonds Middle (Burlington)	+3%	-3%	+1%	+4%
Edith C Baker (Brookline)	+1%	-4%	+7%	+9%
Quaboag Regional High (Warren)	+6%	-5%	+14%	+9%
Overlook Middle School	+4%	-6%	+2%	+7%
Ayer Middle (Ayer-Shirley)	-1%	-9%	+6%	0%
Carlisle School	+4%	-9%	-1%	-3%
Boston Collegiate Charter School	-1%	-10%	+12%	+2%
Average for Schools Participating in the JSC	+4%	-7%	+6%	+5%
State Total	+3%	-4%	+3%	+3%

The method used for calculating change per-strand was as follows: Percentage scores per strand were taken by finding a school's average score on a strand and then dividing it by the maximum possible score for that year. Each multiple choice question is worth one point, and therefore the percentage of correct answers in a school equals the average score for that question. The sum of the Average Multiple Choice scores for each question (out of a variable maximum of 9 or 10 points) was added to the average Open Response score (a number from 0 to 4) to get the score for a strand (out of a maximum of 13 or 14 points). The score was then divided by the maximum score to get a percentage score for that year.

$$Strand\ Percentage\ Score$$
$$= \frac{(Sum\ total\ of\ the\ \%\ Correct\ on\ Each\ Multiple\ Choice\ Question) + (Average\ Open\ Response\ Score)}{Number\ of\ Multiple\ Choice\ Questions + The\ Maximum\ Score\ for\ the\ Open\ Response\ Question[= 4]}$$
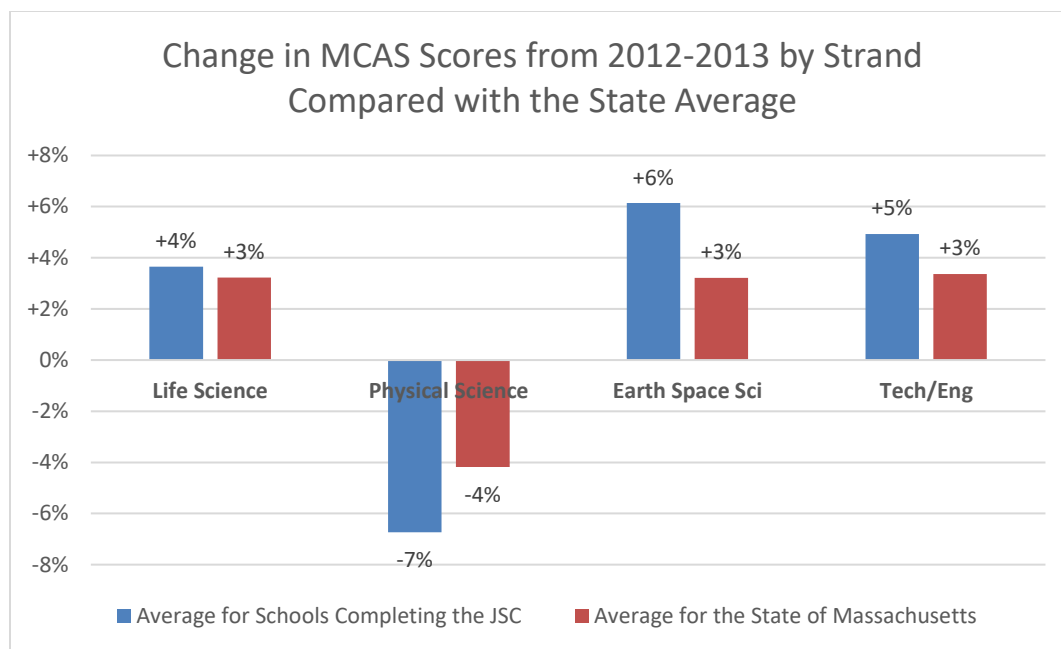
Figure 8: *This graph represents the change in scores on each strand from 2012 to 2013 for the nine schools that completed the JSC as compared to the statewide change in scores. Note that this graph is based upon raw score, NOT the percentage of students scoring Proficient and Advanced, which is an adjusted value based on aggregate score and could not be calculated per strand.*

What is the explanation for underperformance in the Physical Science strand?

First of all, with only 9 or 10 MCAS questions per strand, variation in the average percentage answered correctly can have a strong influence on the strand summary result. Second, some very low percentages of correct answers on two Physical Science questions in 2013 were found: only 40% of students in the state answered question 25 correctly, while only 30% of students answered question 34 correctly (only a slightly better rate than the 25% that one would expect if students were choosing one of the four multiple-choice options at random).

BOTH of these questions were Physical Science questions. By contrast, only one question in 2012 had less than a 50% success rate (question 27, also a Physical Science question, had a 44% success rate). Statistically, if, in a given year, one or two MCAS questions within a strand were exceptionally hard for all students to answer, the result would impact the top performing schools more heavily than lower-performing schools.

For example, if School A normally sees 85% of its students answer a multiple-choice question correctly and School B sees only 50% of its students answer a multiple choice question correctly, if the next year, both schools saw only 30% of their students answer the corresponding question correctly, the drop would be more significant for School A than it would for School B. Since 11 of the 18 schools participating in the JSC came from the highest quartile in the state, it is likely that a pair of unusually difficult questions would heavily impact the scores of the JSC schools for that particular strand.

Nevertheless, in consequence of the research, and particularly in light of the fact that the three questions missed most often across the state in the last two MCAS tests were all Physical Science questions, the JogNog quiz questions that teach the standards covered by those particular questions are being analyzed. Perhaps by adding more questions or adjusting the content of the existing questions to better reflect the difficulty of some MCAS questions, the JSC participants' scores on questions that traditionally have stumped students across the state will be improved.

Appendix D

JogNog Grade Book™ Assessment Tool

Top: Grade Book Legend.

Left: Students' First Score on the assigned quiz games. The First Score is permanently recorded as a pre-assessment of subject matter.

Right: Students' Most Recent Score on the assigned quiz games. The Most Recent Score provides a running post-assessment of students' mastery of subject matter.

Appendix E

JogNog Missed Questions™ Report

The Missed Questions Report is pre-sorted to show the most-often missed questions by students, thereby providing insight to teachers about concepts and specific questions with which students are struggling.

Questions Report

Class: American Science Challenge
Teacher: Kristen Carlson
Members: 514
Date: 10/28/2013

Show questions from this quiz: All Towers   This student: All Users

This report shows the questions that members of the Class answered incorrectly the most often.

Question	%
The ionosphere is located in which of the atmospheric layers? | CORRECT: thermosphere | mesospher...	42 %
Interchangeable parts are designed to be ___. | CORRECT: used freely in any associated product | ...	42 %
What does the slope of an object accelerating uniformly look like on an acceleration vs. time gra...	43 %
The worker listening to a telegraph at a telegraph station is an example of ___. | CORRECT: a dec...	43 %
Which organelles contain a double membrane? | CORRECT: chloroplasts | vacuoles | cell walls | rib...	44 %
What is the probability that a homozygous recessive and a homozygous dominant will create a homoz...	44 %
What type of heat transfer does NOT explain why a marshmallow browns when roasted over a campfire...	44 %
If the slope of a line on a distance-time graph is -2, the speed of the object being plotted is _...	44 %
Which of these is a TRUE statement? | CORRECT: The components of a compound are not easily separa...	45 %
What is one way of producing mass amounts of a DNA chain? | CORRECT: Polymerase Chain Reaction | ...	45 %
Which of the following is a reasonable estimate for the mass of a frog? | CORRECT: 300 grams | 3 ...	45 %
What is a feeding level? | CORRECT: the location of an organism along a food chain | the amount o...	45 %

Appendix F

A More Sophisticated Model of Improvement

A logarithmic model may provide a better fit to these data than the linear model previously provided. A linear model assumes that performance can continue to improve without limit but in reality there is a ceiling to the maximum possible performance achievable on the MCAS. In the analysis below, a logarithmic model is explored that better fits the data and matches the asymptotic nature of improved performance in the limit of increasing answers per student.
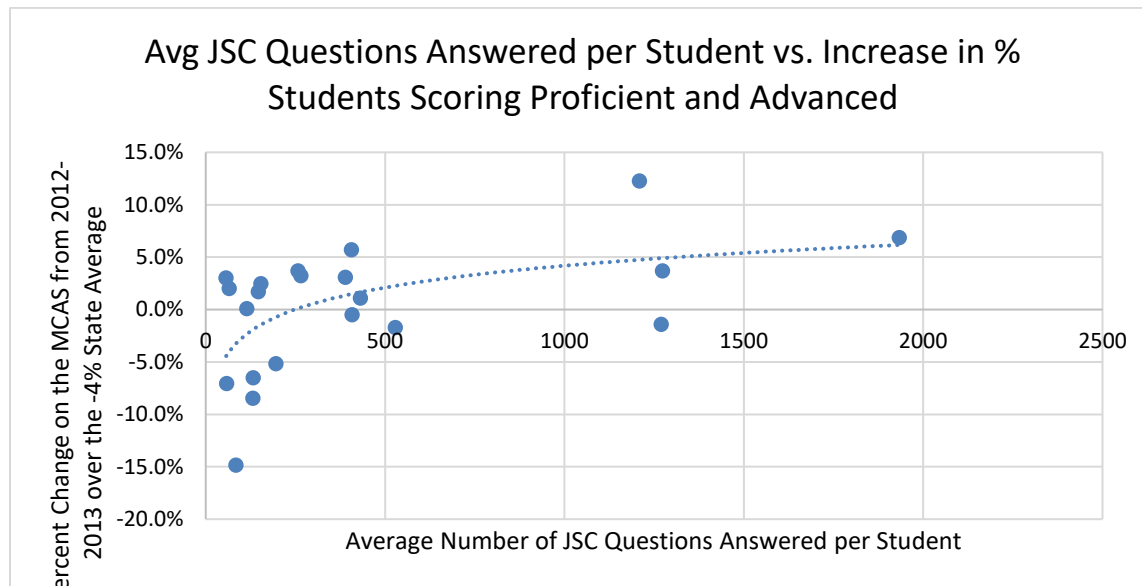

Figure 4: Each point on the graph represents a school that participated in the JSC to at least some degree and plots the amount of engagement (questions answered) against improved MCAS scores. Note that viewing and answering a larger number of questions in the JSC is strongly correlated with a positive change in MCAS performance vs. the state average (p = 0.0003, single-tailed paired T-test). Logarithmic Regression Line: $f(x) = 0.0301\ln(x) - 0.1659$ $R^2 = 0.2859$

The logarithmic regression shows a relatively modest coefficient of determination, but if it holds true, then one could expect answering questions in the JSC to be correlated with the following improvements over the state average in terms of the number of students scoring Proficient and Advanced in a school:

Number of JSC Questns Answd	Increase in P + A over State Average	Number of JSC Questns Answd	Increase in P + A over State Average	Number of JSC Questns Answd	Increase in P + A over State Average	Number of JSC Questns Answd	Increase in P + A over State Average	Number of JSC Questns Answd	Increase in P + A over State Average
250	0.0%	550	2.4%	850	3.7%	1300	5.0%	1900	6.1%
300	0.6%	600	2.7%	900	3.9%	1400	5.2%	2000	6.3%
350	1.0%	650	2.9%	950	4.0%	1500	5.4%	2250	6.6%
400	1.4%	700	3.1%	1000	4.2%	1600	5.6%	2500	7.0%
450	1.8%	750	3.3%	1100	4.5%	1700	5.8%	2750	7.2%
500	2.1%	800	3.5%	1200	4.8%	1800	6.0%	3000	7.5%

Appendix G

JogNog Science Challenge Quiz Games

JogNog science quizzes are aligned to the Massachusetts Curriculum Frameworks. Math and ELA are aligned to the Common Core State Standards. The JSC included these science quizzes, plus review quizzes, quizzes with released MCAS content from previous years, specific Pre- and Post-Assessment quizzes, and a quiz on test-taking strategies and motivational questions called "Ace That Test".

JogNog Science Challenge - Pre/Post-Assessment

JSC Ace That Test
JSC Pre-Assessment - Earth and Space Science
JSC Pre-Assessment - Life Science
JSC Pre-Assessment - Physical Science
JSC Pre-Assessment - Technology and Engineering

6,7,8th Grade - Life Science Overview

!FREE! Review - 6,7,8th Grade - LS Overview
Bones and Muscles
Cell Processes and Energy
Cell Structure and Function
Changes Over Time
Circulation and Respiration
Earth's History
Genetics and Heredity
Modern Genetics
Structure and Function of Invertebrates
Structure and Function of Plants
Structure and Function of Vertebrates
The Endocrine System and Reproduction
The Nervous System
Using Light
Viruses, Bacteria, Protists and Fungi
What is Life Science?

6,7,8th Grade - MCAS Prep

8th Grade MCAS Science - 2011
8th Grade MCAS Science - 2012
8th Grade MCAS Science I
8th Grade MCAS Science II

6,7,8th Grade - Science - Earth and Space Science

!FREE! Review - 6,7,8th Grade - Science - ESS
Earth - Mapping
Earth's Surface Natural Changes
Earth's Crustal Plates
Earth's Evolution
Earth's Heat Transfer Mechanisms
Earth's Movement
Eclipses
Galaxies
Gravity
Heat Transfer Relationships
Layers of the Earth
Moon Phases
Moons
Planets
Sun
Tides

6,7,8th Grade - Science - Life Science

!FREE! Review - 6,7,8th Grade - Science - LS 1
!FREE! Review - 6,7,8th Grade - Science – LS 2
Biological Evolution
Breakdown Process
Cell Functions
Changes in Ecosystems
Chromosomes
Evolution and Anatomy
Evolution and Environment
Evolution and Genetic Variation
Evolution and Geology
Extinction
Heredity
Human Circulation
Human Digestion
Human Excretion
Human Immune System
Human Movement, Control, Coordination
Human Reproduction
Human Respiration
Organelles in Plant and Animal Cells
Organisms and Ecosystems
Organisms in Kingdoms
Organization of Multicellular Organisms
Photosynthesis
Producers, Consumers, and Decomposers
Sexual and Asexual Reproduction
Single-Celled Organisms
The Food Web

6,7,8th Grade - Science - Physical Science

!FREE! Review - 6,7,8th Grade - Science - PS
Atoms and Molecules
Conservation of Mass
Elements and Compounds
Heat Energy
Heat Energy and Movement
Heat Energy and Particle Motion
Melting and Boiling Point
Mixtures and Pure Substances
Motion - Distance vs Time
Motion of Objects
Physical and Chemical Changes
Potential and Kinetic Energy
The Periodic Table
The Periodic Table - Names and Symbols
Volume and Mass - Tools of Measurement
Volume, Mass, and Density
Weight and Mass

6,7,8th Grade - Science Technology/Engineering

!FREE! Review - 6,7,8th Grade - Science - TE 1
!FREE! Review - 6,7,8th Grade - Science - TE 2
Adaptive and Assistive Devices - Bioengineering
Bioengineered Products - Food
Bioengineered Products - Fuel
Bioengineered Products - Pest Management
Bridges - Loads and Structural Shapes
Communication Symbols and Icons
Communication Technologies and Systems
Components of Communication
Engineering Design Features of Prototypes
Engineering Design Prototypes
Engineering Design Tools for Prototypes
Engineering Universal Systems Models
Forces and Bridges
Manufacturing - Custom vs Mass Production
Manufacturing Basic Processes
Manufacturing Technologies
Parts of a Structure
Showcasing Engineering Designs
The Engineering Design Process
The Manufacturing Organization
Tools for Constructing Prototypes
Tools of Communication Technology Design
Transportation - Forces that Affect Technology
Transportation - Universal Systems Model
Transportation Subsystems
Transportation Systems
Types of Bridges
Types of Tools
Using Appropriate Materials

6,7,8th Grade Review Science Games

Engineering and Technology Review 1
Engineering and Technology Review 2
Environmental Science 10
Environmental Science 11
Science - Earth and Space
Science - Engineering and Technology 1
Science - Life 1
Science - Life 2
Science - Physical 1
Science - Physical 2

JogNog Science Challenge - Science Vocabulary

Science Vocabulary - Bridges
Science Vocabulary – Forces

Appendix H

Abbreviated Table of 2013 8th Grade Science MCAS Data

School Name	2012 % of Students Proficient & Advanced	2013 % of Students Proficient & Advanced	2012-2013 Δ% Students Proficient & Advanced	2012-2013 Change vs State Average of -4%	Total JSC Correct Answers	Avg JSC Correct Answers Per Student	Total JSC Answers	Avg JSC Answers Per Student	JSC Students	Total Students in 8th Grade	Percent of the 8th Grade Class Participating in the JSC
Norwell Middle School	68%	76%	8%	12.3%	219063	940	282031	1210	233	232	100%
Douglas High School	39%	42%	3%	6.9%	146252	1366	206950	1934	107	147	73%
Marshall Simonds Middle (Burlington)	56%	58%	2%	5.7%	128052	299	174066	407	427	291	100%
Edith C Baker (Brookline)	65%	65%	0%	3.7%	15953	194	21188	258	82	61	100%
Quaboag Regional High (Warren)	47%	47%	0%	3.7%	102412	882	147853	1274	116	108	100%
Overlook Middle School (Ashburnham-Westminster)	57%	56%	-1%	3.2%	69433	181	102002	266	383	207	100%
Ayer Middle (Ayer-Shirley)	47%	43%	-4%	-0.5%	34172	275	50687	408	124	123	100%
Carlisle School	89%	84%	-5%	-1.4%	101221	1012	127064	1270	100	97	100%
Boston Collegiate Charter School	68%	63%	-6%	-1.7%	32945	366	47683	529	90	96	94%
Average for Schools Completing the JSC	60%	59%	0%	3.5%	94389	613	128836	840	185	151	96%
Lynnfield Middle School	59%	58%	-1%	3%	5069	31	9243	57	161	184	88%
Washington Irving Middle (Roslindale)	5%	4%	-1%	3%	22479	261	33601	390	35	173	20%
Jonas Clarke Middle (Lexington)	76%	75%	-2%	2%	10642	116	14098	154	91	264	34%
McCall Middle (Winchester)	81%	79%	-2%	2%	6707	47	9340	66	141	318	44%
Ferryway (Malden)	48%	46%	-2%	2%	3166	113	4143	147	28	85	33%
Madeline English School (Everett)	25%	22%	-3%	1%	12092	326	16019	432	37	91	41%
Nessacus Regional Middle School (Central Berkshires)	41%	37%	-4%	0%	5094	80	7267	115	63	167	38%
Frederick W. Hartnett Middle School (Blackstone-Millville)	44%	34%	-9%	-5%	10182	143	13980	196	71	172	41%
Glenbrook Middle (Longmeadow)	59%	49%	-10%	-6%	8969	94	12650	133	95	107	89%
Ashland Middle	51%	40%	-11%	-7%	2206	45	2891	59	49	191	26%
Raymond J Grey JH (Acton-Boxborough)	77%	64%	-12%	-8%	10596	101	13729	132	104	475	22%
Concord Middle	82%	64%	-19%	-15%	14019	62	19066	85	223	221	100%
Average for ALL Schools Entering the JSC	56%	53%	-4%	0%	45749	330	62645	453	131	181	69%
Median for ALL Schools Entering the JSC	57%	56%	-2%	2%	14019	181	19066	258	100	172	88%
State Total	43%	39%	-4%								