HMH fuse™

ALGEBRA 1

Results of a yearlong Algebra pilot in Riverside, CA

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Summary

Technology has the potential for greatly improving education when new tools are combined with robust digital curriculum and are properly utilized in and out of the classroom. As part of our continuing mission to improve student achievement by combining proven curriculum with cutting-edge technology, Houghton Mifflin Harcourt partnered with Riverside Unified School District in California during the 2010-2011 school year to pilot *HMH Fuse: Algebra I,* a new comprehensive educational program designed for the iPad.

Amelia Earhart Middle School in Riverside, CA was selected by the district to pilot the new program. As a school that has experience with forward-moving technology, the educators at Earhart devised a strategic plan to utilize *HMH Fuse: Algebra* with students randomly assigned to use the app in comparison with those using a textbook for an entire school year. The results of the implementation were impressive: students using the *HMH Fuse* app were more motivated, more attentive in class, and more engaged with Algebra content relative to students using textbooks. This change in student behavior also resulted in markedly improved student test scores at the end of the school year.

The results of this case study at Amelia Earhart Middle School revealed that instructional technology can have a substantial effect on student academic achievement when that technology is strategically implemented and pairs strong educational content with a robust technological platform, as was the case with the Riverside *HMH Fuse: Algebra I* pilot.

Rise of Technology in Schools

Students in the 21st Century live in a world in which they are immersed in digital technology. By their own reports, students spend over 10 hours a day using technology such as cell phones, computers and laptops, and surfing the Web (Rideout, Foehr, & Roberts, 2010). This usage represents a considerable increase within the past five years, and is driven largely by use of mobile computing devices with internet access, like smartphones, iPods and MP3 players, and tablet computers.

School districts have responded to the prevalence of media use among students by increasing the presence of technology in schools – adding new computers, multimedia devices, and high speed internet access (Gray & Lewis, 2009). As more devices are utilized in the classroom, there is growing consensus that mobile computing will be commonplace in all schools in the not too distant future (Johnson, Smith, Levine, & Haywood, 2010).

The Impact of Technology in School

Many in the education reform movement have hailed this growth of technology in the classroom; however, researchers investigating digitally-based programs have found mixed results. Dynarski et al. (2008) reported their usage does not have a significant impact on student achievement while a recent review performed by Cheung & Slavin (2011) revealed a significant, positive effect in math for educational technology, but the effects here were relatively small, especially when examining comprehensive math programs.

It is evident that the addition of technology into the classroom alone does not improve student performance. As the U.S. Department of Education (2010) suggests, inclusion of technology in classrooms must be done purposefully, with a thought-out plan of what technology will be deployed and how that technology will be utilized in (and beyond) the classroom for instruction. Successful educational technologies depend not only on the tools being used, but the content – digital programs must have high quality instruction and high quality content if they are going to be effective (Foundation for Excellence in Education, 2010).

Improving Algebra Instruction

Algebra is often considered a "gateway" subject as understanding of the content is necessary for advanced mathematics and success in the work force (National Council of Teachers of Mathematics, 2009). Despite the importance of Algebra, many students struggle with the subject. Unfortunately, the failure to master Algebra (along with other mathematical concepts) has resulted in a decline in math achievement in the U.S. as comparisons show that American students have fallen behind their international peers in advanced mathematics achievement (Provasnik, Gonzales, & Miller, 2009). Improving students' Algebra achievement is essential to ensuring students in the U.S. can compete in the global world. According to Drijvers and colleagues (2010), technological tools offer the promise of redefining traditional instruction of Algebra by providing students and their teachers new ways to engage with the subject.

HMH Fuse: Algebra I

In an effort to combine brand new mobile technology with a robust curriculum, Houghton Mifflin Harcourt created a fully functional Algebra educational app utilizing the Apple iPad. The iPad's design and touch-screen functionality offer many benefits and conveniences over traditional laptops. That said, most educational apps fall short of providing rich learning experiences that fully leverage the device's unique design and robust functionality (Murray & Olcese, 2011). Therefore, Houghton Mifflin Harcourt's *HMH Fuse: Algebra I* app was designed to fully utilize the functionality of the iPad and provide students with a comprehensive, multimedia educational experience.

HMH Fuse's foundation is rooted in award-winning mathematics instruction led by chief author Dr. Edward Burger and features curriculum aligned to either the Common Core State Standards in Mathematics or standard Algebra. The app complements this strong foundation by incorporating many multimedia components, such as 400 lesson videos featuring Dr. Burger. Several interactive tools, such as real time quizzes, note taking, graphing features, homework help and other supports were also embedded in the program to provide students with access to a variety of resources in a single app. Thus, *HMH Fuse: Algebra I* was created to be a complete educational program that harnesses the capabilities of the iPad to provide digital instruction using proven methods and cutting-edge technology.

HMH Fuse: Algebra I Pilot in Riverside, CA

To test the effectiveness of the *HMH Fuse* app, Houghton Mifflin Harcourt partnered with Riverside Unified School District to pilot the program in the 2010-2011 school year.

When officials from Riverside—a district comprised of 51 schools serving over 42,000 students—were given the opportunity to participate, Amelia Earhart Middle School was an obvious choice for the study. As principal Coleman Kells explained, Earhart has been a school eager to employ new technology in the classroom–Earhart had been an early adopter of a student laptop program, and was among the first schools to install interactive whiteboards. Naturally, the iPad *HMH Fuse* study was a perfect fit for the school.

As part of the study in Riverside, two teachers would each have one of their Algebra sections randomly selected to use the *HMH Fuse: Algebra I* app, while all other Algebra classes, taught by the same teachers, would use the textbook version of the same program. This would allow researchers to determine if using *HMH Fuse: Algebra I* led to changes in student performance.

Since the *HMH Fuse* app had never been used before and was part of an experimental study, this meant more work and time required by the teachers. Coleman approached his teachers about this opportunity and two teachers, Jackie Davis and Dan Sbur, were ultimately chosen to take part in the study. With the teachers on board and the iPad and *HMH Fuse* app delivered, the district began using the HMH Fuse app in the fall of 2010.

Earhart Middle School Snapshot1	
Teachers	43
Student Population	1072
White	49%
Hispanic	29%
African American	9%
Asian	8%
Other	5%
English Language Learners	4%
Free/Reduced Lunch	29%

Putting *HMH Fuse* to Work at Earhart Middle School

The school's past experience with new technology had taught Earhart's teachers and leadership that the right implementation and support was vital to a successful experience. Early on, the decision was made to give students full access to everything on the iPad, not just the *HMH Fuse app*. "We have always found that when kids have complete access to technology, their buy-in goes through the roof," explained Coleman. This meant that students were allowed to take the devices home and "customize them," adding their own music, videos, and additional apps. This approach also allowed students to have 24/7 access to the *HMH Fuse: Algebra I* program. The portability of the device meant that students could review their work and use the multimedia components of *Fuse* whenever and wherever they saw fit, regardless of internet availability.

The district also allowed students to use Wi-Fi features of the device and access the internet during and after school for both educational and personal pursuits. According to Coleman, these decisions made a big difference in the program's success: "Students never put down the device because it was important to their lives. When it was time to use it, it was right there…They felt ownership of the device." Teachers Sbur and Davis agreed; "Students definitely took ownership of the device," recalls Jackie Davis.

Changing Teaching with *HMH Fuse*

As one would expect, those students who were randomly selected to be part of the HMH Fuse study were very excited – as were their parents. In fact, Coleman quickly found that one benefit of the *HMH Fuse: Algebra I* app was enabling parents to provide more support to their children: "Parents could watch the videos or review problems with their children to help them if they did not understand."

Like any new technology, there was a slight learning curve with adopting a tablet in the classroom. "In the beginning of the year I tried a little bit of everything, trying to find out what was best for my class and for me," recalls Jackie Davis. Dan Sbur also found that "Over time, it became easier to use and I could use it more in my class as I became comfortable with the device and app."

But it didn't take long for the teachers to find effective strategies and routines for using *HMH Fuse: Algebra I.* Both Davis and Sbur utilized the Check it Out quizzes and the videos featuring Dr. Burger on a regular basis. They also used the graphing features, and tools like the Quadratic Explorer and the Know-it Notes so students could have their notes and assignments all in one place. "Instead of hunting around for different resources and page numbers with a book, with the app everything is right there", Dan Sbur recalled. "If you have a question, you have many things to review with a push of the button."

The teachers quickly saw that their students using the *HMH Fuse* app were more engaged in learning. Students were much more motivated during class and were more interested in the subject. Principal Kells remembers seeing the difference the *HMH Fuse* app made in both classrooms, "The kids were attentive to the teacher and information; they would do the problems, take notes, and repeat things as much as possible". Now students had more opportunities to learn Algebra as they were constantly interacting with the *HMH Fuse* app. As Dan Sbur saw it, *HMH Fuse: Algebra I* gave students the opportunity to personalize their learning: "Kids were more in charge of their own learning."

HMH Fuse: Algebra also led to changes in student learning outside of the classroom. Students reported reading more and trying to work independently outside of class when completing homework. Also, students were coming to class explaining that they had watched the video multiple times at home. "Students who were absent would come in with their homework done. They would say 'Mr. Davis, I reviewed the video and did my homework,'" recalls Jackie Davis. In addition, Mr. Davis found students took the initiative to use *HMH Fuse: Algebra I* to check their work during class, freeing him up to do more one-on-one work with struggling students in need of individual attention. In this regard, the HMH Fuse app essentially enabled a "flipped classroom" model in which students learned and worked independently at home, and then came to class ready to do problems and practice what they had learned (see Bergmann & Sams, 2011). This "flipped classroom" dynamic gave both Mr. Davis and Mr. Sbur the ability to provide personalized instruction to many students during the normal school day.

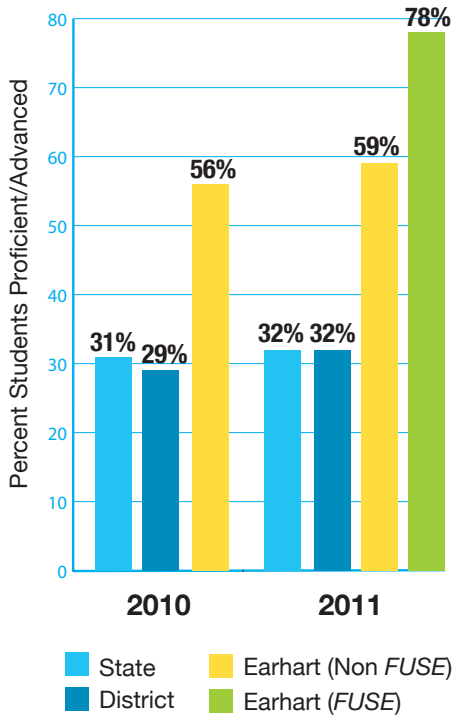
Academic Success with HMH *Fuse*

Most importantly, teachers saw that their students using *HMH Fuse* were beginning to outperform their peers using the traditional textbook program. The first sign that students were performing better than their peers was on the district Algebra benchmark given in the second trimester – students using *HMH Fuse* had average scores of about 10 percentage points better than other Algebra students at Earhart.

Both Sbur and Davis witnessed the marked improvement in student performances – although, to them it was more gradual and continuous: "There wasn't one point in the year we said 'Wow this is really good,'" Dan Sbur admitted, "It was an everyday thing…Students were more focused and more motivated over time." At the end of the year, that increased focus was reflected in students' scores on the spring 2011 California Standards Tests (CST).

As Figure 1 depicts, results of the 2011 CST found that using *Fuse* had a positive impact on student achievement at the end of the year. **Comparing student performance, over 78% of students using *HMH Fuse* scored Proficient or Advanced on the state test, compared to only 59% of their fellow students at Earhart – a difference of 19% in favor of students using the *HMH Fuse* app.** As students were randomly assigned to use *HMH Fuse,* the results indicated that use of the app was the chief cause behind the improvement in student test scores.

Figure 1
California Standards Test Results



Lessons Learned from *HMH Fuse*

While previous studies revealed technology often has a small impact on student learning, Earhart Middle School's pilot of *HMH Fuse: Algebra I* indicated this app had a substantial effect on student math achievement when compared to a traditional textbook–when the technology was strategically deployed. "The *Fuse*: Algebra app accomplished some of the things we attempt to do, but do not always do well," Principal Kells concluded.

With the school's technology plan allowing students to take ownership of the device, students quickly incorporated the iPad and *HMH Fuse: Algebra I* into their lives. Students took the initiative to do their work, read the chapter repeatedly, watch lesson videos when they did not understand, and take notes and study, while also being free to leverage the technology for personal use—namely, games and entertainment—in their free time.

Researchers have suggested that technology has the potential to fundamentally alter Algebra instruction and learning. According to educators at Riverside, *HMH Fuse: Algebra I* had that paradigm-changing effect. "The app was great! Students were motivated and were more in charge of their own learning because now they have an app. It is more like a 'my generation thing' as opposed to a textbook." Dan Sbur explained. Principal Kells expressed a similar feeling: "Students' interaction with the device was more personal. You could tell students were more engaged. Using the iPad was more normal, more understandable for them."

The results of the Riverside *HMH Fuse: Algebra I* pilot demonstrated that the program is an effective means of improving Algebra achievement. Using the app not only changed students' behavior inside the classroom, but outside the classroom as well. The *HMH Fuse: Algebra* I app led students to approach the subject differently, empowering them to be more vested in and accountable

for their own learning, while giving teachers the tools and opportunities to provide more robust, individualized instruction for all students. Parents, too, got more involved with their students' learning as *HMH Fuse* allowed parents to review material and help students figure out homework when both the parent and student were unsure.

As technology and mobile computing becomes ingrained in the classroom, researchers need to continue to assess how educational tools, like *HMH Fuse: Algebra I* and the iPad, can have a meaningful effect on student achievement. Simply adding technology into classrooms will not lead to greater learning. Rather, examining the conditions in which student performance is most greatly affected by technology is essential to the development of effective educational solutions. It is only when school districts and educators understand how to best utilize new digital learning tools that technology will have a large, long-term impact on education. While there is plenty more work – and research – to be done, the success of the *HMH Fuse* pilot in Riverside is a promising sign of the potential for technology, when effectively implemented, to positively improve student achievement.

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