Blend My Learning:

Lessons Learned From a Blended Learning Pilot

www.blendmylearning.com

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Executive Summary

Overview

With the coming of the information age, technology has the potential to transform the classroom as we know it. More and more educators are expressing interest in "blended learning" or bringing the best of online learning into traditional brick and mortar classrooms. This past summer, we set out to test several assumptions of the blended learning movement, measure its impact on student learning, and observe the effects on teacher experience.

The BlendMyLearning project brought together Envision Schools, Google, Khan Academy, and the Stanford University d.school to chronicle the performance and engagement of low-performing high school algebra students receiving a mix of traditional teacher-led instruction and self-guided instruction through the Khan Academy website. This report draws from qualitative interviews and observations (outlined at www.blendmylearning.com), as well as quantitative data from pre- and post-course assessments in algebra. Though the experimental methods and sample size are not sufficient for grounded empirical conclusions, a control group receiving 100% teacher-led instruction also took the pre- and post-course assessments to provide some level of comparison.

The quantitative results show that students in the "control" or traditional summer school course increased their average percentage of correct answers by 5.2% over the five-week period, while students in the "treatment" or Khan class, on average, showed a 6.4% increase in their percentage of correct answers. Since the teacher in the Khan classroom worked mostly 1:1 with students, and since students in this cohort learned content at their own pace, these results suggest interesting potential for the blended learning environment. Yet the results alone paint an incomplete picture because not all blended learning classrooms are similar. Accordingly, this report focuses on the key insights gained from our pilot and provides suggestions for the role of the teacher, student interaction, space configuration, software considerations, and hardware usage. The hope is that others similarly can experiment to find new models for School 2.0 and share their learning. Our key findings focus on three areas: (1) Evolving Role of the Teacher; (2) Evolving Role of the Student; (3) Use of Technology, Software, and Classroom Space.

Role of the Teacher

The teacher was able to spend significantly more 1:1 time with students in the blended learning classroom than she was able to do in the traditional classroom. Watching these 1:1 interventions, we observed how easily misconceptions could be

remedied with a few minutes of personalized instruction. Such interaction was made possible in part because of the Khan dashboard -- the ability to individually monitor student progress and see inside the "black box" of student learning. However, we also observed how challenging it was for the teacher to adapt her practice and focus attention on student data rather than on student interactions. Teachers learning to effectively use data is crucial for success in the blended model. Overall, we saw the role of the teacher in a blended learning environment involve four key elements: (1) fostering a class culture of hard work and persistence, (2) monitoring students throughout the period for motivation and learning, (3) personalizing instruction and intervening when data shows that students are struggling, and (4) building personal relationships of trust and caring. Many of these elements are essential in traditional classrooms as well, but it was striking to note how much of the class period the teacher devoted to these four responsibilities in the blended classroom versus what happens in a typical classroom.

Role of the Student

Although we worried about the potential for technology to distract, we were impressed by the students' ability to stay on-task and exhibit strong agency for learning in the blended classroom. We attribute much of this success to timely, specific, and relevant feedback that the Khan software provided to the students through hints, videos, badge attainment, and the "streak" feature of the program. In addition, the ability for students to control order and pacing of content was a welcome replacement to the "one size fits all" scope, sequence, and pacing of traditional curriculum. We observed students developing strong agency for learning and marveled as students organically formed subgroups to discuss or provide help to one another. Overall, our observations suggest strong potential for the blended learning model to: (1) increase student buy-in, (2) increase student ownership of class, (3) make learning more personalized, and (4) increase collaboration amongst peers.

Hardware, Software, and Classroom Space

On the hardware front, many educators and technologists are in a debate over the virtues of tablets, smart phones, netbooks, and computers. We remain agnostic on this point but offer feedback on the hardware we tested. The Google Chromebooks performed admirably in our project, especially in the areas of ease of use and technical support. We were particularly impressed by the fast boot-time, intuitive interface, and the ability of students swap out one Chromebook for another seamlessly due to cloud-based data storage. Chromebooks that use the centralized management option seem particularly promising for school settings.

The classroom size and shape was not optimal for a blended learning environment but we settled on a design of three to four students per small table, each with

his/her own Chromebook. Throughout the summer, we allowed students to experiment with different arrangements, and they ended up moving casually to the floor or to other spaces during individual practice time. From observation, we concluded that good individual or team workspace is at a much higher premium than having direct sightlines to the front of the room, and that flexible, configurable space will serve the blended classroom much better than traditional desks or tables.

On the software front, there exists no consensus model for using Khan Academy in the classroom. But, per the advice of the Los Altos pilot schools, we started all students in our pilot on Khan's first module (single digit addition). Although they knew the content already, this strategy allowed students to get a good feel for the mechanics of the site and experience success. Equally importantly, because students soon ran into foundational math knowledge gaps, this strategy allowed them to shore up deficiencies - something not often possible in a traditional classroom. The ability to tailor instruction to individual needs is a great benefit of the blended learning format and the Khan website. Additionally, the student-level data allowed the teacher to customize her approach during 1:1 interventions and whole class instruction. Generally speaking, the student data available on the Khan dashboard was impressive, but it also was challenging at times for the teacher to figure out how best to synthesize and use all the data – a key future needed if teachers are to maximize the potential of blended learning.

We were surprised to find that students preferred to teach themselves or each other through the practice problems and hints rather than watching the Khan videos. Our hypothesis is that the videos may be too long at eight to ten minutes or that the video content may be broader than the specific problems students were tackling. We would be interested to test a more modular approach to the Khan videos, with several two to three minute videos for each subject.

Key Takeaways

A five-week pilot is not enough time to reach definite conclusions, but the project team observed that the quality and adaptability of online courses is a key factor of success. We also observed how important the teacher's role remains. We hope teachers will continue to serve as leaders in the movement, embracing the chance to work more individually with each student, gaining more insight into each learner, and exploring all the potential new roles that teachers can play in the classroom. On the education technology front, better APIs are needed amongst the software providers to ease the integration of the variety of software solutions that will be used in schools. Finally, experimentation and innovation is still needed, as the movement is in its infancy and we have much to learn about how best to run blended learning classrooms and schools. However, as this paper details, the potential to individualize learning, increase efficiency, and give students more ownership over their learning are very exciting potentials of blended learning.

Background

This past summer (2011), Envision Schools, Google, and the Stanford d.school (Hasso Plattner Institute of Design) teamed up to pilot a new way to run classrooms via *blended learning*. We were interested in how technology might enable more individualization and improve student achievement, and how online learning might change the role of teacher and student. The setting was Envision Academy in Oakland, California. A group of high school students who had failed Algebra I were randomly assigned to one of two summer school classes. The "control" classroom received a traditional five-week summer school curriculum for Algebra I. The "treatment" classroom used the online software of Khan Academy each day. Both classes had the same teacher and were taught for the same two-hour time block for five weeks.

We documented the details of our learning on the blog www.BlendMyLearning.com. This paper focuses on the biggest takeaways from the experiment. Our goal is to help others in the field better understand blended learning and evaluate its potential for their own setting.

Our Approach

Our team tried to remain unbiased, focusing on learning everything we could about the benefits and challenges of blended learning. When confronted by a challenge, we explored various options, tried several different possible solutions, and observed the results. We also aimed for transparency, opening the classroom to outside visitors and trying to capture various perspectives. We did not have a philosophical point to prove, but rather we were genuinely curious about what would happen if we transferred control of learning to students. We used qualitative and quantitative measures to evaluate the program's success, but because our sample size was small, we knew that any empirical data would not be statistically valid. Yet we attempted to learn what we could by comparing pre- and post-course assessments of the two groups and by conducting twice-weekly observations in the classroom and interviews with the students and teacher.

The paper is structured in seven parts : (1) Change in the Role of the Teacher, (2) Student Perspective on Blended Learning, (3) How Space is Used, (4) Khan Academy Feedback, (5) Google Chromebook Feedback, (6) Quantitative Results of the Study, and (7) Questions that Remain

Change in the Role of the Teacher

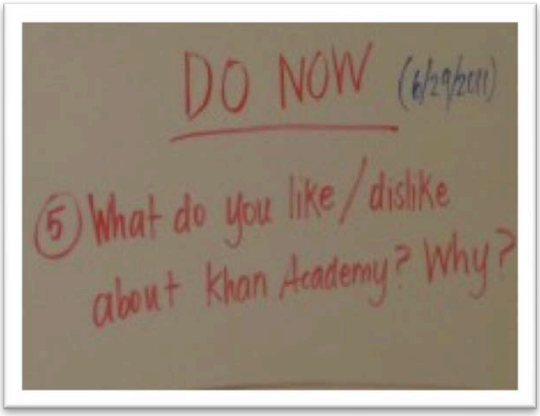
From the first day of class, it was clear that we were witnessing profound changes in the role of the classroom teacher. Specifically, blended learning: moved the teacher out from the front of the class, encouraged more 1:1 interactions, created more opportunities for small group instruction, and forced the teacher to look much more closely at data. It also required a lot more from the teacher in that she had to master the content *and* the unique method of delivery (Khan Academy) as well as become comfortable with students working at different paces.

Out from the Front of Class

In adopting a blended learning strategy, we tackled the essential question: *Who is in control of the learning?* In traditional pedagogy, the teacher determines content, pacing, activities, and assessment. With Khan Academy, our teacher realized she had a *choice* about when and how to be in control. One option was to still run the class tightly, assigning specific sections from Khan for set amounts of time, and essentially using the program solely as an instructional aide. However our team wanted to see the other end of the spectrum – what would happen if we turned the students loose? The teacher still "ran" the class, but the definition of what it meant to be in charge changed.

Here is how the teacher structured a typical day in her blended learning class:

1. Teacher greeted the class and set the tone.
2. Students engaged in a "Do Now" or "Anticipatory Activity" -- generally pencil and paper-based.
3. Teacher taught a mini-lesson to the whole group via direct instruction, focusing on a particularly important concept from the traditional curriculum or an area on which



students appeared to struggle
4. Students checked out Chromebooks from cart and worked on Khan Academy for approximately 45 minutes.
5. Students took a short break to stretch, use the restroom, socialize, etc.
6. Class engaged in a second extended individualized work period on Khan Academy for approximately 45 minutes.
7. Teacher collected Chromebooks and wrapped up the class.

With such a schedule, the teacher created two large blocks of time in which students were self-directed and in which she was free to experiment with how to use her time. The result? The teacher defaulted to significantly more 1:1 time with students. As the content was engaging and because students were motivated, the teacher knew the class could remain focused without her constant direction.

By monitoring the student learning screens in Khan, the teacher saw when a student was "Red" on a given subject – indicating a clear need for intervention. Generally, two or three minutes of 1:1 instruction was enough to clear up misconceptions or help steer the student toward success. In a typical class, the teacher is lecturing, questioning, or conducting class for almost the entire period and rarely gets 1:1 time with students. From the students' perspective, the important difference was that they received targeted, personalized attention in the exact moment they needed it, on the exact subject with which they were struggling. In a typical high school classroom, such targeted intervention rarely occurs. It is also extremely rewarding for the teacher to have continuous insight as to what exactly each student knows, rather than trying to design lessons for the class average or constantly circle the room looking over students' shoulders.

With blended learning, targeted small group instruction becomes a powerful tool for teachers. By observing the data screens, a teacher can easily see that a group of three or four students are all struggling with the same concept. The teacher can call these students together and provide a targeted mini-lesson. Even better, the teacher can call over a student who has *proven* mastery on the topic, and ask the student to provide the instruction to his/her peers. Afterwards, the teacher can redirect students back to their laptops to complete more practice problems and get immediate feedback on their learning.

This model (*attempt, intervene, monitor)* gives the teacher incredible options to provide a variety of interventions throughout the period. Such an approach is similar to stations-based teaching that happens in many elementary classrooms. Sadly, we generally see little of this kind of small group instruction in high school settings. But with excellent online content and strong classroom routines, teachers can more easily individualize learning.

Teacher as Data Interpreter

Strong online courses provide teachers with a mountain of data. Yet the challenge is avoiding the dilemma of being data-rich, but information-poor. One of the biggest challenges we see in the blended learning movement is helping teachers and principals effectively use the streams of data that soon will be available to them. Khan Academy provides some excellent teacher graphs and tables to help teachers figure out what individual students know and where they are struggling. However, it is important to remember how new it is for teachers to play this role of data interpreter. We provided feedback to the Khan team on this point and were pleased to learn that they actively are creating tools, videos, and tutorials to help train teachers to be more effective in this capacity.

We noticed how easy it is for the teacher to default to familiar approaches such as walking around the room, looking over students' shoulders, or waiting for hands to be raised seeking help. As teachers become more skilled, we hope that the decisions around grouping, when to intervene, and what material to teach to the whole class will be grounded in the real-time data from the class.

Likewise, we found that the rich data provided only the quantifiable side of a student's learning. Often, when we spoke with the students, they explained the "why" behind their data. One student, for example, skipped around not because he lacked the attention or dedication to finish a set of practice problems but because he used the method as a way to warm-up before tackling more difficult concepts.

One obvious challenge is that currently each online course or software uses its own data reporting system. For isolated pilots such as ours, these kinds of "walled gardens" can work fine. The teacher simply needs to learn how Khan Academy reports data. However, as teachers start using multiple products in a class or as schools blend technology into multiple courses, it becomes increasingly hard to make sense of all the data. We are pleased that some of the larger players in the blended learning space are thinking about this challenge and working on common standards. Twenty different "walled gardens" will not allow schools to succeed. Nor should schools have to settle on one provider/publisher to create a fully

integrated system for all content because there are too many effective new tools being developed by different organizations. We are excited about efforts to create integrated learning management systems (LMS's) that allow multiple content providers to plug-in to the same system.

Will Blended Learning Replace the Teacher?

Many have questioned what the new role of the teacher will be in a blended learning classroom. Some have even gone as far as to claim that teachers will not be needed once students have access to all the information in the world at their fingertips. We have a strong opinion on this front. Excellent blended learning still depends deeply on quality teachers. In our experience, the teacher still plays a very important role in: (1) Fostering a class culture of hard work and persistence, (2) Monitoring students throughout the period for motivation and learning, (3) Intervening to personalize instruction when data shows that students are struggling, and (4) Building personal relationships of trust and caring.

We believe most teachers will come to prefer the new roles in blended learning classrooms. We know few teachers who would not welcome less grading and more individual/small-group time. By reducing some of the drudgery of teaching, we free the teacher to be more of an artisan who designs fewer but higher quality lessons, targets mini-lessons to serve the exact needs of their individual students, and intervenes and questions rather than lectures and disseminates. As one educator put it, "I see the potential of blended learning to turn the teacher back into Socrates."

In our pilot, it was essential that the teacher herself "bought into" the blended learning concept. Although she had only a few days of advance notice, she agreed to the pilot herself and embraced the chance to redefine her role. We have trouble imagining blended learning succeeding against the wishes of the teacher. As administrators and policy advocates work to promote the blended learning movement, we see a tremendous need for teachers to experience and see proof points of success. Once experienced firsthand, the new role of the teacher in a blended learning classroom is actually pretty exciting.

Blended learning also can help change the way we structure our schools. For example, it is possible that schools could hire fewer teachers but pay them more to effectively teach larger groups of students via blended learning. Also the very concept of "grade-level" or even what we consider a "course" could be rethought under a blended learning model. Since the movement is so young, we hope that others will continue to ask such questions and experiment with new approaches before forcing blended learning into the traditional box of "how we run schools."

Student Perspective

Of the three areas we were interested in studying (change in teacher's role, gains in student test scores, and student response) we were perhaps most interested to see how students would react to this new way of running a classroom. The result? They really liked it. We noticed changes across four key areas: increased buy-in, ownership of learning, individualization, and increased peer collaboration.

Buy-In and Ownership

The Oakland, CA, students in our study all had failed Algebra I previously (sometimes twice) and generally hadn't experienced success in mathematics over the years. On the first day of class, we asked them who "hated math" and were met by almost universally raised hands. Within a few days, however, we saw dramatic changes in students' levels of personal commitment. For almost two hours of class each day, students stayed deeply engaged with math. Why? Their feedback and our observations point to a few key factors.

First, Khan Academy provided instant feedback to the students on whether they were learning a concept or not. In part because of Khan's streak feature and badges, we observed that students were highly motivated to demonstrate proficiency. At one point a student who had told us she "really hated math," muttered under her breath, "I am not going home until I get to ten (on this streak)." The "gamification" that Khan provides with the streak and badges clearly motivated students. The streaks in Khan Academy carefully straddle what James Paul Gee calls a "pleasantly frustrating" game experience (2007).

A second change we observed was students' increased sense of responsibility for learning. The traditional classroom too often pits the teacher and student on opposite sides of the learning process: the teacher has the knowledge, transmits it to the student, and then assesses understanding. By contrast, in a blended learning class, the teacher and student became partners on the path of discovery. The teacher is able to guide students and confer with them when they struggle. They are on the same team, working to achieve the same goals.

Similarly, through the Star Chart (see Khan Feedback later) students began to have a meta-understanding of their strengths and weaknesses in math. They were put behind the wheel of the learning process and had influence over the order and pacing of the content they tackled. There are obvious challenges of such a system, though. Some students can languish on easy problems or follow too slow of a pace. Others can bounce around and not sustain focus on a concept. As such, we found the teacher making several modifications to the "students are in control" framework.

After the first week, the teacher developed her own roadmap for the Khan Academy content to show students where the key algebra concepts lived within the program.

She provided "power standards" or the concepts she most wanted students to master over the summer. This approach helped students prioritize what content to work on and suggested a logical sequence for building skills. Since the teacher had built good rapport, she could encourage individual students or the whole class to tackle targeted areas while still allowing students to own their overall learning process. Additionally, through her warm-ups and direct-instruction time, she could spotlight such key concepts and highlight common misunderstandings. With this structure, the teacher played an important role in guiding the class – but students were the primary drivers of their own learning.

Individualization

All teachers know that teaching should be "differentiated," but most struggle to do so in practice. Typically, teachers are asked to make a couple of different lesson plans for each period or provide a few assignments that target high, middle, or low-achieving students. This approach means teachers either have to do even more work than usual, or instruction defaults to the same one-size-fits-all approach. The blended learning pilot, however, instantly turned those assumptions on their heads. Students who knew material quickly could demonstrate mastery and move to their "zone of proximal development." Students who were missing the underlying concepts could proceed more slowly and revisit/target their gaps in a private and shame-free manner.

Peer-Collaboration

A related (and encouraging) result of the blended learning model was that students began to work together much more collaboratively than usually observed in high school classrooms. Although the instructional videos were present (see Khan Feedback section), most students preferred to work though the practice problems themselves, with the help of the teacher, or by soliciting peer assistance. Since they wanted to answer the questions correctly to complete their streaks, we saw students take a "by whatever means necessary" approach to their learning. Students were surprisingly comfortable asking each other for help. One student told us, "Because we are all working on different things, it's easier to ask for help."

A typical class environment rewards high-achievers, leaving struggling students languishing under the radar. By making the learning individualized, students were much more comfortable relying on each other as resources. The typical class environment in the blended learning cohort was relatively quiet, with most students plugged-in with headphones on. The one or two pairs of students talking to each other usually were engaged in rich math dialogue.

In one example, we observed two students working on the same section at the same time. They worked individually but conferred before submitting their answers. If they disagreed on a solution, they tried to convince one another or they looked for possible errors together. Other times students would tutor each other on different sections as needed. We see tremendous potential in this peer-coaching model and are interested in thinking about ways for students to signal to peers that they need additional help or to identify themselves as coaches on given topics.

In the end, we asked students whether they liked the experience of the blended learning classroom and whether they wanted a blended or traditional classroom for the next school year. The vast majority preferred the blended approach, which was one of the most interesting findings of the pilot.

How Space is Used

Once the teacher removed herself from the front of the classroom, we found ourselves curious about how the physical classroom could be different in a blended learning environment. Rather than designing new classrooms from scratch, most schools will find themselves, like us, retrofitting traditional classrooms for blended learning. We had a particularly challenging setup because we were using a small classroom that was packed with students. We settled on three to four students per small table, each with his/her own Chromebook. Generally students faced forward in chairs as the teacher began with a traditional mini-lesson and then rotated to give themselves more space once individual learning began. As the Chromebooks hold more than eight-hours of battery charge, proximity to outlets was not an issue. Since we were all about learning what worked best for the students, we allowed them to experiment with different arrangements, and students ended up moving to spots on the floor or just outside the classroom door. The teacher, however, had immediate access to what students were accomplishing on a minute-

by-minute basis (through the Khan's analytics), so it was easier to give students a degree of freedom. We no longer had to rely on proxies of learning; we could monitor actual progress. Our attitude essentially became, "If it works for you and does not disturb others, let's try it and see the results."

Were the room larger, we would have loved to set-up a dedicated small group workstation in the classroom. Having a dedicated space to pull together 3-5 students at a time would have facilitated this instructional practice greatly. As we spent more time using blended learning, we found ourselves craving a different classroom design. Creating more space for students to have good individual or paired workspace was at a much higher premium than having direct sightlines to the front of the room. Similarly, more flexible space such as movable dividers and rolling tables would have served our purposes much better than traditional desks or tables. If we were creating a blended learning classroom from scratch, we think an ideal design would include a larger central area with smaller breakout spaces along the perimeter.

During Week One, we were amazed at the lack of noise/chatter in the room. We mentioned this to the teacher who answered, "Yeah, but is that a good thing?" At the end of one day, a student walked up to another and teased, "Is there something wrong with you? You haven't talked all period." The observation and comment underscored how immersed the sometimes challenging student was in her own learning. Yet we did not want individual learning to be the only approach used in class. We are now left curious about how technology might support more communication during the class period through class polls, displays of student progress, or having a virtual message board available to help target and guide paired and small group work.

The short time period of this pilot program did not allow us to experiment as much as we hoped with the physical configurations of the classroom. However, we saw how much flexibility blended learning affords. We hope others will continue to experiment with the various models that schools are currently using in blended learning settings. For a good primer on these current models, see the excellent summary "The Rise of K-12 Blended Learning" produced by the Innosight Institute.

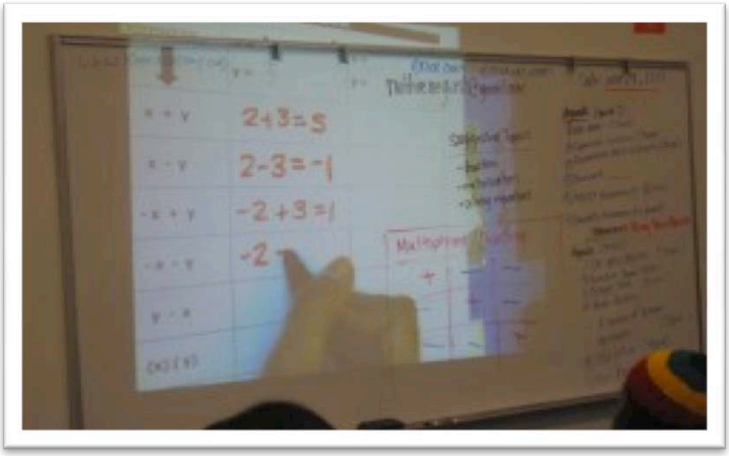
Khan Academy Feedback

We learned a tremendous amount about deploying Khan Academy as a class-based instructional strategy through this pilot. This section seeks to share that learning for other educators interested in deploying Khan, but the learning can also be generalized to other software options.

How to Structure the Class

One of the most important questions when starting this pilot was how much of the class to devote to Khan Academy. The question initially appeared to be: "How much time should students spend on computers?" However, the more we thought about it, the more we found ourselves actually asking, "How much of the learning time should be individualized?" We settled on 80-90% individualization, during which students generally determined their own pace and path. At the same time, the teacher ended up providing some significant structure with her mini-lessons at the start of each class, by highlighting the most important modules within Khan, and through her grading practices.

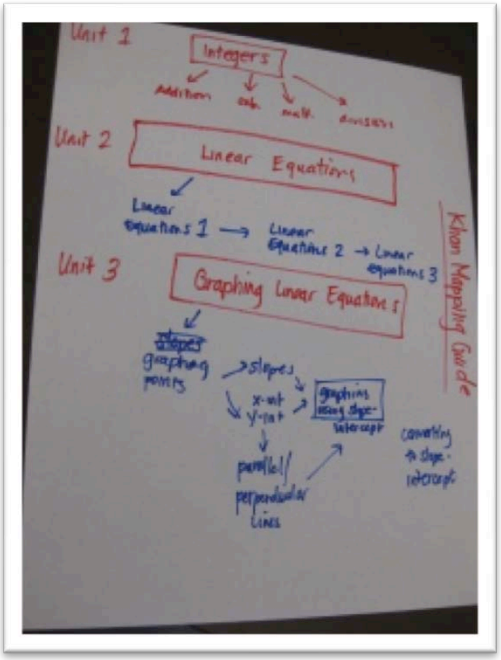
We had to decide where to start students within Khan. It was tempting to push them toward the most important content or the areas most closely aligned to the California algebra standards. However, we heeded the advice of the Khan Academy team and the teachers who had piloted Khan in Los Altos, and we started all students at the very beginning with single digit addition. It turned out to be good advice. Students learned the mechanics of the software on easy content first. They experienced immediate success, earned some quick badges, and became hooked on the program. They then were able to advance quickly to their actual skill level. Interestingly, many students hit their skill gaps on content that was decidedly pre-algebra. Khan made it instantly clear how many students had not mastered percentages, decimals, fractions, and even more basic multiplication and division. Initially, we allowed students to spend as much time as needed on pre-algebra content. Students appreciated the time to address their weaknesses and enjoyed feeling successful. Had we jumped these students directly to actual algebra content, it is easy to imagine that they could have become frustrated with Khan – because the instruction would have been at a level beyond their current abilities.



At the same time, we faced a dilemma in that we were trying to help these students pass an algebra class in just a five-week summer school program. There was no perfect answer to this challenge, and we settled on a compromise solution. The teacher mapped out her "power standards" or the most important California standards for students to learn in algebra. She then showed students where that content lived in Khan Academy. Students knew they had to pass a percentage of these standards with proficiency to

earn credit for the course, but they also were given credit for spending time working on pre-algebra skills as needed.

Grading



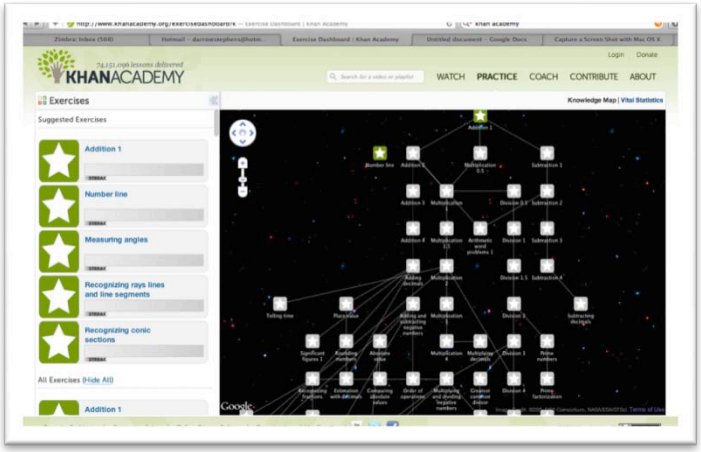
All the teachers and administrators we spoke to about the pilot wanted to know how we were grading the students using Khan. We do not claim to have a definitive answer in this area, but we share our experience as one possible approach. Our teacher built a grading rubric based off of the standard assessment rubric that Envision Schools employs: 50% Application of Knowledge, 40% Mastery of Knowledge, and 10% Work Habits. Our teacher used Khan Academy's metrics on how students had performed during the first two weeks of the trial on pre-algebra content to count as their work habit grade. She then used the information from her "Do Now" assignments in class, homework, and the number and breadth of modules completed within Khan to calculate the 50% Application of Knowledge section of the rubric. For the Mastery of Knowledge assessment, the teacher settled on her end of summer "final exam" (the post exam) that assessed general mastery of algebra content. This design meant students had an incentive to work on their underlying skill gaps while also tackling the algebra concepts necessary for credit in the course.

Students received a copy of the modules that the teacher identified as most important, and they tracked their progress while moving through Khan. Once the students knew how grades were calculated, they had incentive to attempt harder modules. After this change, we saw more students watching Khan's videos before attempting the practice exercises. Other teachers have told us that they found great success working with students to outline individual weekly goals for Khan. We think this approach has tremendous potential to chunk the learning process, develop students' meta-cognition, and increase their buy-in.

The Streak

One cannot use Khan Academy as a learner without quickly experiencing both the beauty and the frustration of the streak feature. For those unfamiliar with the Khan Academy website, most of the play patterns are centered on accumulating streaks and badges. Streaks result when ten consecutive math problems are answered correctly (Khan Academy has since revised the streak mechanics), and badges accumulate as you build streaks and work through the different levels of

content. While some students found interest in the badges they collected, the "stickiest" and most controversial feature was the streak. While many students complained of breaking streaks on the eighth or ninth problem, this challenge became a great extrinsic motivator. It was nice to see high-fives or short outbursts when a streak was completed on the second, third, or fourth try. Likewise, one student confessed that she found herself checking a problem two to three times before submitting an answer, as she progressed further within a streak. Any teacher can tell you how hard it is to build soft skills such as double-checking work and persistence in the face of failure, and we were pleased to see the unintended outcome of increased self-discipline.



That said, as the concepts proved more difficult, some students became disengaged when constantly breaking a streak on the third or fourth problem. It was easy, in these cases, for students to simply abandon the module and jump to a different topic. From observation, it appears that many students were unwilling to work on the harder modules if they could not see themselves eventually completing the streak. Khan Academy has since made revisions to the streak feature that address some of these challenges.

The Star Map that Khan uses to organize the various modules was sometimes confusing for students, especially on the smaller laptop screens. It is great for visualizing accomplishments and progress at a macro scale, but students struggled to understand their progress at the micro level, or to always see what the next logical topic should be. By the middle of the pilot, many students avoided the Star Map in favor of simpler roadmap created by the teacher.

Soft Skills

There were two interesting workarounds that students found for using Khan. First, Khan allows students to "take a hint" when stuck on a problem, and then provides a step-by-step solution. Doing so resets a student's streak though. Students soon realized that they could take the hint on the first question of a new problem set as a refresher and then begin tackling the ten problems to complete the streak.

One student explained to us how she copied down the entire algorithm/solution on scratch paper, and then used the steps to work through all subsequent problems in the set. She confided these strategies to us in an almost "Don't tell my teacher"

manner. Ironically, many teachers in traditional pedagogy beg their students to write out algorithms and apply them to subsequent problems. The gamification in Khan and the ownership around learning encouraged students to be much more diligent in finding solutions. The learning question subtly shifted from *"Do you know this answer?"* to "*Do you know how to get this answer?"* That said, we also see validity in the critique that students need to understand concepts deeply and not just learn the algorithmic steps to solve problems.

A second soft skill strategy that students employed involved finding additional web resources to solve complex problems. We observed a student who, frustrated by continually resetting her streak, found a complex equation/expression solver on the Internet. Our first thought was that she might be quite a clever cheater, but we soon discovered that she only used the solver *after* attempting the problem on her own. Khan's multiple-choice answer set often includes "None of the Above." If the online solver gave an answer that was different than her response of "None of the Above," she went back to her work and revisited her steps. If the solver concurred with her answer of "None of the Above," she confidently submitted her response. The student exercised a real-world skill by seeking out additional support that she could use to increase her understanding and her chances of success. These types of skills are not often taught in an algebra class, and certainly the level of determination far exceeds what one would expect in a typical remedial summer school course.

Value of the Videos

A final interesting perspective on Khan involves the value of the site's videos. Most people are drawn to Khan based on its massive video library and Sal's own charming and engaging teaching style. Like many, we assumed the videos would be the predominant learning mechanism for students tackling new material. In fact, the students rarely watched the videos. This result is consistent with some of the observations in the Los Altos pilot. The students greatly preferred working through the problem sets to watching the videos. Students turned to their peers, the hint, and the classroom teacher much more often than they did the linked Khan video. One possible reason is that the videos are aligned to the broader concept, but do not link directly to the problem students are struggling with. A second hypothesis is that the videos may be too long at eight to ten minutes. If students have 60-90 minutes to work through multiple concepts in a class period, an investment of ten minutes for a single video feels like a lot. The badges and stars within Khan may also be a disincentive, as there is no immediate reward for watching videos as there is when completing streaks. Lastly, we wonder how many of us really enjoy watching instructional videos for extended periods of time. We are left curious about whether Khan's videos need to be even more modular and shorter in duration and also about the value of video based instruction.

Google Chromebook Feedback

During this summer experiment, we only scraped the surface of Google Chromebooks' functionality, but they worked extremely well for our purposes. In full disclosure, Google donated a class set of Chromebooks for this pilot study and eventually donated a grade-level set for Envision Academy prior to the completion of this report. The editorial comments and reviews, however, are entirely from the perspective of the BlendMyLearning team and are independent of Google or Khan Academy.

Pros

When compared to textbooks, desktops, and laptops, the Chromebooks were lighter, more streamlined, and a bit simpler for students to use. One significant benefit is that no student work is stored locally on the Chromebooks because they are entirely cloud-based devices. Thus, if a computer is having a problem or if students want to work on a different computer during the day, it is easy to swap out one Chromebook for another. Similarly, if a battery is running low, one Chromebook can be exchanged for another and students only lose a moment or two of working time. Since the Chromebook's battery lasts for eight hours, we were able to charge them in a computer cart each night, and we never had to worry about plugging them in during the school day. This aspect also freed students from power cords and proximity to outlets.

The Chromebooks booted up in eight seconds, meaning it only took about thirty seconds to get students actually working on Khan exercises. Compared to the three to five minute boot and login experience for desktops and traditional laptops, the time saving is significant and it reduced the chances of distraction. The Google Chromebook team told us that their goal was to build hardware that "disappeared" in the learning process. We found the Chromebook to be a significant step forward in this regard. The ease of the device, long battery life, and entirely cloud-based storage made the computers easy to use without some of the typical headaches we experience when using technology in the classroom.

Perhaps the biggest benefit we saw in using the Chromebooks was the ease of distribution and tech support. Envision Schools previously had been almost an entirely Apple-based organization. There frankly was some trepidation from the tech team about supporting a new format, as our previous experiment with netbooks had proved more troublesome than beneficial. We received the donated Chromebooks only a few days before the pilot began, and our tech team was concerned about the usual process of imaging, connecting to servers, installing filters, and completing the setup tasks to deploy new computers. The blog post on the www.blendmylearning.com site captured the reaction of Envision Schools' Vice President of Technology, Brad Rigney, who had the unenviable task of getting all of the new Chromebooks set-up in just three days before summer school started:

> *So we got 36 Chromebooks this week, and I'll admit that I didn't think we had the time we needed to get them set up on our network and ready for summer school in 3 days. It turns out that the whole process took less than 2 hours. The hardest part of their setup was taking them out of the packaging. We literally removed them all from the boxes, opened them up (they power on when you open the notebook), selected our network and entered our password. 5 minutes later they had all updated and presented us with a login screen… Amazing, virtually zero setup!*

Using the "managed" Chromebooks that Google deploys to schools, the operating system, pre-set bookmarks, and other software elements of the Chromebooks all can be updated or changed centrally and then deployed to the Chromebooks with the push of a button. This feature is one of the most beneficial elements of Chromebooks in a blended learning school setting. The normal tech support needed for 1:1 computing is a huge headache and expense for schools. What we've seen so far from the Chromebooks makes us rethink many of our assumptions about what is needed to support 1:1 computing.

Cons

Quite frankly, there few technical issues with the Chromebooks during the pilot study. The single biggest gripe from the students was the super-sensitivity of the mouse pad, which sometimes led to typos or incorrect clicks within the Khan exercises. This problem, however, had serious implications for students who accidentally ended their streak on Khan - a gaffe that could cost them 15-20 minutes of progress.

The cloud-based nature of the Chromebooks, which we praised above, also presents a potential shortcoming because they require a network connection. In our school setting, connecting was not an issue because we had Wi-Fi coverage in all of the areas where the Chromebooks were being used. However, we can foresee several settings where having better offline support would help make the Chromebooks more useful. Google already has deployed some offline support and is working on addressing this challenge. For a setting with spotty Wi-Fi access, the Chromebooks are significantly less useful. That said, the trend is towards web-based software for education, and thus we can't really imagine doing good blended learning in a setting without reliable Internet access.

There were some network latency issues from time to time during the pilot, but they appeared to be mostly a result of the Khan Academy servers and they occurred on non-Chromebook devices as well. The Khan IT team was proactive in addressing these issues, and we generally did not see the problems continue after the first couple of weeks. Small disturbances like these did not have any appreciable effect

on learning and instruction, but they do raise a cautionary point about how easy it is for tech problems to disturb the learning environment. Blended learning requires teachers to rethink many elements of how they run their classroom and asks tremendous faith from teachers. It is up to the blended learning movement to ensure that the software and hardware being used warrants such faith. In an office setting, a short-term disruption to a server is an annoyance, but one can always shift to other tasks. In a classroom, even short-term challenges can lead teachers (and students) to give up on technology. We over-supported the classroom during the first two days of this experiment with two to three additional adults in the room to handle any initial login or tech issues. These efforts ensured a smooth launch, and got students over any initial hurdles quickly and easily. After the first two days, the teacher supported the class herself. Our teacher also had pen and paper resources and activities on hand in case students ever were unable to access the network.

Quantitative Results Of The Study

Caveats

Before we discuss the quantitative results of the pre- and post-course assessments for the control and treatment classes, we should mention a few important caveats. First, no statistician will take our results particularly seriously, and they shouldn't. The sample size is too small to attribute any real significance to the findings. Secondly, the pilot was very brief, lasting only five weeks, or twenty-four class sessions of two hours each. Thirdly, there is always the risk of the Hawthorne effect, or observational bias because the students inevitably knew they were part of a study. Finally, and perhaps most importantly, it was difficult to find the right measure by which to evaluate the progress of students in the two classes. After consultation with several researchers, we settled on the University of California's Mathematics Diagnostic Testing Program (MDTP) and their Elementary Algebra Diagnostic exam (EA50A90). The exam is designed to measure students' readiness for an Algebra II course. We settled on this exam in consultation with the team at MDTP as an appropriate means to measure students' success at the end of an Algebra I course. A major concern with this assessment, however, was that it would not pick up any gains made on pre-algebra content because it focuses primarily on algebra content.

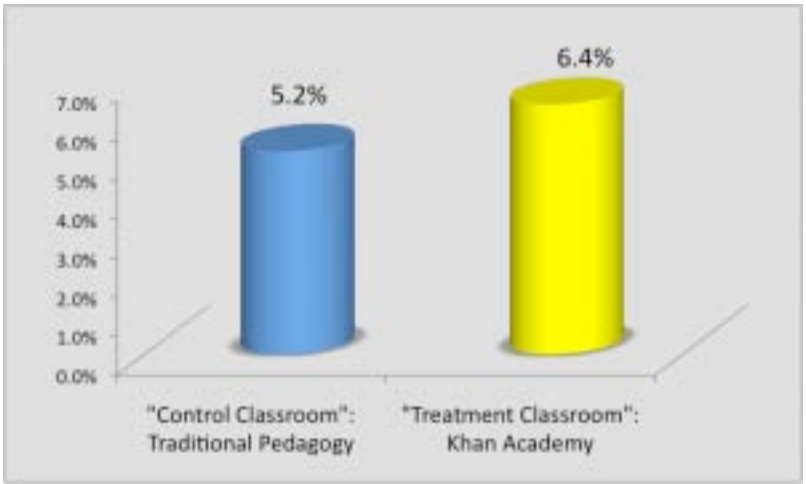
From the beginning, we knew that the pre- and post-course assessment data could not definitively assess the success of the pilot. For all the reasons listed above, we view the data as a single quantitative measure that should only be considered alongside the qualitative observations and feedback discussed throughout this paper. Our hope is that others will not cite these data as proof one way or the other of the effectiveness of Khan or blended learning. It would be dangerous to overgeneralize our findings. We see this pilot as providing one small piece of data

that suggests reason to be cautiously optimistic, while also clearly showing that there are no silver bullets in improving schools.

Results

Among the students in the study who had valid scores on the pre- and post-course assessment, the results were similar for the treatment and the control group. Students in the "control" or traditional summer school course, on average, increased their percentage of correct answers by 5.2% over the five-week period. Students in the "treatment" or Khan class, on average, increased their percentage of correct answers 6.4%. For example, a student who started the summer knowing 60% of the correct answers in the traditional class ended the five weeks knowing 65.2% of the correct answers. The same student in the Khan class would, on average, be able to answer 66.4% of the answers correctly at the end of the same period.

Increase in Percentage of Questions Answered Correctly on the MDTP Algebra II Readiness Exam



Averages obviously can be deceiving. In terms of distribution, in each class approximately one-third of the students saw some significant gains (10% or higher gains in number of questions answered correctly), whereas two-thirds of the students' scores were essentially flat (less than 4% increase or decrease). There were no particularly strong findings regarding the topic areas in which the two classes saw the most concentrated gains. The one exception is that the students in the traditional class saw most of their gains in the areas of "Graphical Representations" and "Polynomials and Polynomial Functions," whereas in the Khan class, students saw gains spread out among almost all the categories.

Implications of the Data

Remembering the reliability limits of these data, it is interesting to note that students in the two groups scored roughly the same, each showing some slight

improvement over the five-week course. We wonder whether this trend would hold over a full-year course, and whether the slightly higher gains that the Khan students showed would be multiplied or would be reduced over the course of a school year.

It would be easy (and wrong) to use these results to conclude that blended learning and Khan are without value. If anything, we find it interesting that the teacher "doing her best" in the control class, produced gains roughly equivalent to the students using the Khan Academy. In the treatment class, the teacher ended up doing mostly 1:1 conferencing with pupils, and the students progressed through the assignments at their own pace and sequence. If it is true that Khan-centered classes can match or even exceed the traditional teacher-led pedagogy, there could be interesting implications for the future.

Regarding the more concentrated student gains on "Graphical Representations" and "Polynomials" in the teacher-led class, it is plausible that this concentration of gain was due to the teacher focusing more time on these topics. In the Khan classroom, the teacher had less control over which content students devoted the most time to. It therefore makes sense that the gains were more evenly spread across the various topics.

It is also interesting to note that in the Khan classroom, many students spent a significant amount of time (at least two to three weeks) working on pre-algebra skills such as fractions, percentages, decimals, and even basic computation. Students in the Khan/treatment group therefore spent up to 50% less time than the control group on the algebra content that the MDTP exam measured. Yet the treatment group made comparable gains to the control group that focused all five weeks on algebra-related content.

If we could do it over again, we also would have used a second measure to evaluate student progress on pre-algebra skills. Our hypothesis is that the Khan students made much more significant gains on these basic building block skills.

Questions that Remain

As with any pilot, we are left with as many questions as answers. Here are our biggest takeaways and the questions we are left pondering: First, we are struck by how powerful true individualization can be for education. In blended learning, the technology is not the game changer; it is the personalization that technology affords. Once you envision a classroom that meets the needs of each learner in real-time, it is hard to go back to the traditional approach. It can be painful now to visit traditional classrooms where more than half of the students are too advanced or too far behind to benefit from the instruction at hand. In contrast, we are bullish on some of the early 1.0 adopters of blended learning. The results from Rocketship, Carpe Diem,

and KIPP Empower, for example, show great promise – especially given how nascent the sector is and how many potential benefits are yet to come.

As we think of the 2.0 version of blended learning, some clear needs exist. Most importantly, the quality of online courses and software needs to improve and become more adaptive. Khan Academy is impressive when compared to many of the current online courses, especially given that Khan's videos and practice sets are not specifically designed to be online courses. Some of the other online courses currently are little more than digitized textbooks, and we fail to see them truly engaging learners and delivering the promise of blended learning. Secondly, the various content providers are going to have to learn to "play nice" for schools and districts to really go blended. By "play nice," we refer to open API's and making it easy for schools to package various programs and providers into a single seamless experience for students. Similarly, the data on student learning from various programs need to talk to existing student information systems and integrate with other data systems.

We remain convinced that teachers will be at the center of the blended learning movement. Rather than replace teachers, we see blended learning as potentially transforming or redefining the role of teacher back to its Socratic origins. Teachers should play a central role in figuring out what works in School 2.0 and how to get there. We hope that thought leaders in the field will continue to message this important point. If not, it is easy to imagine how blended learning could be portrayed simply as hype or as a job-killer for teachers. With teachers at the center of the movement, we believe they will come to love the new role of the teacher in blended learning schools. More individual time with students, better insight into what students know, and the ability to truly meet the needs of each learner – these are the foundational reasons that many teachers go into the teaching profession.

More than anything, the blended learning movement needs some time to experiment, to make mistakes, and to figure out what works. With many people jumping into blended learning, there inevitably will be failures. It will be essential to balance the spirit of innovation and experimentation with our own Hippocratic oath that, above all else, we do no harm. Blended learning is in its infancy. We hope the education sector and general public will not strangle the infant in the crib and will give it the time it needs to mature.

We are left wondering:

1. What will prompt existing districts, charters, and private schools to experiment with blended learning and share their results? There has been amazing interest in blended learning, even in the last six months, and the number of thoughtful educators and schools that are entering the space encourages us. That said, we still see mostly the traditional early adopters participating and wonder what it will take to get larger districts to jump in.

2. Will blended learning classrooms work with less skilled teachers? The teacher in this summer pilot had a positive rapport with students, good classroom management, and was a good motivator to both classes. In the hands of a less-than-good teacher, we wonder if the results would hold.

3. Can schools do partial blended learning, through pilots or in isolated pockets, or is the real impact only seen when we redesign how we run entire classrooms and schools?

4. What vestiges of the existing school model should be kept if innovators redesign schools and create blended learning environments from the ground up?

5. Will students continue to find blended learning engaging and "sticky" over time especially as more courses include online components? Or, is novelty a large part of its early success?

6. If blended learning can in fact produce as good or better learning outcomes in less time, how will we choose to use this additional time? Could schools embrace more project-based learning, "flip the classroom," focus more on small group discussions and Socratic conversations, or add back in more arts and other elective offerings?

There is no shortage of exciting possibilities to consider. We look forward to excellent educators in this country tackling these questions and are eager to see and learn from one another's endeavors.