INTRODUCTION

Blended learning—the method of using multiple media and methods to teach—has been around for decades. Only recently, however, has it come to mean combining face-to-face learning with technology-based learning. Blended learning has evolved significantly in the last 20 years, and with increasing pressure on schools to ensure that all students achieve higher standards of learning with fewer resources, it has never been more important. Online and face-to-face interaction is a powerful combination that makes the most of every moment for both student and instructor. Blended learning can help ensure that every elementary school student receives the education—and specifically the foundational math understanding—to succeed both now and in the future in increasingly competitive domestic and international environments.
THE NEED FOR A NEW APPROACH

Charles Vest, former president of the Massachusetts Institute of Technology, warned, “America faces many challenges … but the enemy I fear most is complacency. We are about to be hit by the full force of global competition. If we continue to ignore the obvious task at hand while others beat us at our own game, our children and grandchildren will pay the price. We must now establish a sense of urgency.”

According to a recent Harvard University study, the United States could enjoy a remarkable increase in its annual GDP growth per capita by enhancing the math proficiency of U.S. students to the levels attained in Canada and Korea.

To Vest’s point, in December 2012, the Organisation for Economic Co-operation and Development (OECD) released its latest review of global education and achievement. Every three years, the Programme for International Student Assessment (PISA)—a program of the OECD—assesses half a million students between the ages of 15 and 16. Students are from 65 countries, representing 80 percent of the global economy.

Average scores in mathematics literacy ranged from 613 in Shanghai, China to 368 in Peru. The average U.S. mathematics score was 481, which was lower than the OECD average of 494. Overall, the United States ranked 36th; below the OECD average in mathematics, but with average scores in reading and science. The United Kingdom did slightly better, ranking 26th overall, equaling the average score for OECD countries in both math and reading, and performed above average in science.

By 2018, America will need three million highly skilled employees to fill vacancies in engineering, math, and science-related jobs. At least 70 percent of these jobs will require post-secondary education. So in essence, the jobs will exist, but our citizens will not be prepared and educated to thrive and innovate in them. Currently, only about a third of our bachelor degree holders are educated in science and engineering, as compared to students in Asia. Internationally, the United States is ranked 17th in the list of countries awarding the most number of science degrees.
Students performance matters, and math performance in particular matters, not only to individual students, but to the nation as a whole. What methods can we use to improve critical thinking and student learning, particularly in elementary school?

THE BLENDED LEARNING SOLUTION

Incorporating classroom instruction, online individualized learning, and one-on-one support in a blended learning model has demonstrated a highly personalized and more productive learning experience that improves achievement. In order to be truly effective, blended learning programs should stem from local and state standards and include the ability to collect relevant data. Then, consciously select formal education programs, content, and delivery methods that are aligned with these goals to drive decision making.

The International Association for K–12 Online Learning (iNACOL) describes blended learning as:

- A shift from lecture to student-centered learning in which students become active and interactive learners
- Increased interaction between student–instructor, student–student, student–content, and student–outside resources
- Integrated formative and summative assessment mechanisms for student and instructor

According to a recent Harvard University study, the United States could enjoy a remarkable increase in its annual GDP growth per capita by enhancing the math proficiency of U.S. students to the levels attained in Canada and Korea. That increase would lift growth rates by 30 to 50 percent. By calculating these percentage increases as national income projections over an 80-year period—and providing for a 20-year delay before any school reform is completed and the newly-proficient students begin their working careers—research suggests achievable gains of nothing less than $75 trillion over the period. That averages out to around one trillion dollars per year. 

As Michael Brown, Nobel Prize winner in medicine stated, “If America is to maintain our high standard of living, we must continue to innovate…Math and science are the engines of innovation. With these engines we can lead the world.”

The bottom line: Student performance matters, and math performance in particular matters, not only to individual students, but to the nation as a whole. What methods can we use to improve critical thinking and student learning, particularly in elementary school where a foundation for math learning is developed?
Technology allows educators to support learning more effectively to better serve all students. Selecting a learning program that has the ability to customize a child’s mathematics lessons and provide differentiated learning based on real-time student data is important in accelerating student achievement.

**BLENDED LEARNING BENEFITS**

Educators have seen many ‘reforms’ in education. It is common to hear “We tried this. It didn’t work.” This new model of innovative learning may resemble previous technology models on the surface, but it is deeply different. The difference is that “disruptive innovations” will make classrooms—as well as all education—driven by the needs and learning patterns of the individual learners. This is a revolution in education that may be uncomfortable for some, but what is needed to foster and sustain the growth of children, teachers, and administrators in a highly competitive world.

According to a recent study from the Gates Foundation, blended learning benefits both educators and students. In summary, blended learning provides:

- Access to high quality, relevant, and engaging content in a variety of forms
- More flexible class time and structure
- Ability to adapt to the learning needs of students
- Student access to multiple sources of lessons and assessment, and diagnostic tools to help direct the pace and format of their learning
- Capability for teachers to tailor their instruction and guidance to ensure progress and mastery for all students, with a focus on those who have historically been underserved
The availability of programs that support lessons aligned to the Common Core, and that promote ingenuity, innovation, and creativity, will allow teachers to spend more time with each student, personalizing their educational experience and becoming more efficient.

Teachers implementing research-driven blended education models will be able to understand how to address the six educational issues outlined below:

Doing More With Less
Many schools and districts are reluctantly cutting staff and dropping courses as a response to tighter budgets. Ultimately, the overriding reason to adopt a blended learning school model isn't because of its cost savings, but because of the benefits that result from its implementation.

Early Intervention
Against a backdrop of complex and ever-changing regulatory settings, a consensus view has emerged that education must support all students in meeting grade level proficiency standards, even in an environment with diminishing resources to address those needs. Current research has documented that early preparation in mathematics is the most significant predictor in later school achievement.\(^8\)

Blended learning overcomes many of these constraints by combining strong alignment to math proficiency goals and advances in technology to deliver truly individualized learning.\(^9\)

Continuous Progress Assessment
Academic progress reporting that is facilitated with software provides access to insights about student proficiency as well as the data needed to review participation and progress of students in your school or district. By continuously assessing student achievement, individually and in the aggregate, lessons can be differentiated and overall performance evaluated for greater effectiveness. Such robust reporting can also be accomplished without the traditional pencil-and-paper diagnostic assessments that consume class time and create anxiety for students.
Differentiated and Self-Directed
The best blended learning environments allow math students to progress at their own pace, inside and outside of the classroom. It also provides the opportunity for self-directed learning. By definition, blended learning creates some level of learner control. For many students, the ability to make some choices about what to study—or having the sense that they are directing their own progress—can make a huge difference in their academic success. With the right online program—especially one that seamlessly and uniquely adapts—math students who are at different levels of conceptual understanding, or have different interests, can interact with lessons presented in a way that is engaging and meaningful to them.

Improved Communication and Parent Partnership
The “anytime, anywhere” availability of online programs, when combined with ongoing reporting of student progress to both educators and teachers, can foster a closer home/school connection between elementary school administrators, teachers, students, and parents. Programs that offer online parent dashboards and communications regarding student academic progress can provide a useful starting point for teacher and parent discourse regarding the academic achievements and needs of students. By accessing the online resources, parents gain more insight into how the topics are taught, and are thus better prepared to help their children understand concepts and complete assignments.

Technology allows educators to support learning more effectively to better serve all students. Figures show that the power of blended learning is being leveraged across the U.S. in growing numbers, and it is projected to continue on that path.

BLENDED LEARNING ESSENTIALS FOR ELEMENTARY EDUCATORS

BLENDED LEARNING MODELS
To achieve the student-centered approach in the iNACOL definition provided earlier in this white paper, a student learns at least in part through online learning, with some element of student control over time, place, path, and/or pace; at least part of the time in a supervised brick-and-mortar location away from home; and the modalities along each student’s learning path within a course or subject are connected to provide an integrated learning experience.

While blended learning is evolving, as of this writing, there are two primary settings and four major models for blended learning delivery of coursework or subjects. The Clayton Christensen Institute for Disruptive Innovation (formerly the Innosight Institute) offers the most widely accepted and clear description of blended learning models. A chart and abbreviated model definitions are provided here.11
1) Rotation model: Students shift between learning modalities, with at least one mode as online learning.

a) Station Rotation (also referred to as Classroom Rotation or In-Class Rotation):
Within a given course or subject (e.g., math), with at least one station for online learning, students rotate on a fixed schedule or at the teacher's discretion among classroom-based learning modalities. Other stations might include activities such as small-group or full-class instruction, group projects, individual tutoring, and pencil-and-paper assignments. Some implementations involve the entire class alternating among activities together, whereas others divide the class into small-group or one-by-one rotations.

b) Lab Rotation: Within a given course or subject, students rotate on a fixed schedule or at the teacher's discretion among locations on a brick-and-mortar campus. At least one location is a learning lab for online learning, while the other(s) are classroom(s) for different learning modalities. The Lab Rotation model differs from the Station Rotation model, because students rotate among locations on the campus instead of staying in one classroom for the blended course or subject.

c) Flipped Classroom: Within a given course or subject, students rotate on a fixed schedule between face-to-face teacher-guided practice (or projects) on campus during the standard school day and online delivery of content and instruction of the same subject from a remote location (often home) after school. The primary delivery of content and lessons is online, which differentiates a Flipped Classroom from when students are only doing homework practice online at night. The Flipped Classroom model includes some element
of student control over time, place, path, and/or pace because the model allows students to choose the location where they engage in learning online.

d) Individual Rotation: Within a given course or subject, students rotate on an individually customized, fixed schedule among learning modalities, at least one of which is online learning. An algorithm or teacher sets individual student schedules. This model differs from the other Rotation models because students do not necessarily rotate to each available station or modality.

The next three models tend to be better suited to students past Grade 5:

2) Flex model: Online learning is the backbone of student learning, even if it directs students to offline activities. Students move on an individually customized, fluid schedule among learning modalities, and the teacher of record is on-site. The teacher-of-record or other learning guide provides face-to-face support on a flexible and adaptive as-needed basis through activities such as small-group instruction, group projects, and individual tutoring.

3) À La Carte model (formerly known as the Self-Blend model): Students take one or more courses entirely online with an online teacher-of-record, and at the same time continue to have brick-and-mortar educational experiences. Students may take the online courses either on the brick-and-mortar campus or off-site. This differs from full-time online learning and the Enriched Virtual model (below) because it is not necessarily a whole-school experience but an individual one.

4) Enriched Virtual model: A whole-school experience in which within each course, students divide their time between attending a brick-and-mortar campus and learning remotely using online delivery of lessons. Many Enriched Virtual programs began as full-time online schools and then developed blended programs to provide students with brick-and-mortar school experiences. Different from the Flipped Classroom, students seldom attend the brick-and-mortar campus every weekday. It differs from the À La Carte model because it is a whole-school experience, not a course-by-course model.
BLENDED LEARNING IN THE ELEMENTARY MATH CLASSROOM

Blended learning provides an exceptional way to implement best practices and support effective, standards-based elementary math lessons. This is backed up by research, including a major 2010 study by the U.S. Department of Education, *Evaluation of Evidence-Based Practices in Online Learning: A Meta-Analysis and Review of Online Learning Studies,* and in the practical experience of schools across the country.

The right online math learning programs (particularly those that are game-based) keep student engagement at a high level while ensuring improved learning. A good program should also be designed to provide tasks that activate a student’s prior knowledge, while helping the student make new connections to concepts, procedures, and understanding. During face-to-face time in classrooms or in small-group sessions, students can then explain thinking and meaning, as well as work on rich problems and tasks in the school’s curriculum. With blended learning, students are guided to devote the correct amount of time to tasks, and can receive the remedial support or advanced lessons as necessary.

ROTATION MODELS IN THE K–5 MATH CLASSROOM

Referring to the models of blended learning chart on page 8 the rotation models in the left column—Station Rotation, Lab Rotation, Flipped Classroom, and Individual Rotation—are most popular in K–5 classrooms. As noted education author Michel B. Horn states, “The simplest way for elementary schools to embark on blended learning is by setting up a rotation model, which involves students rotating on a fixed schedule within a given subject between online-and offline-learning stations…The rotation model appears simple for elementary schools to implement because a large number already employ activity-center classroom models that lend themselves to adding an online-learning station.”

SUPPORTING FOUNDATIONAL MATH SKILL DEVELOPMENT AND UNDERSTANDING

As the National Council of Teachers of Mathematics states in their Principles and Standards for School Mathematics, ‘Students must learn mathematics with understanding, actively building new knowledge from experience and prior knowledge.’ This is exactly what blended learning supports. By making use of the data that emerges and is collected from the math student’s time spent online, the teacher can see and understand where the student is in their knowledge, how the student is progressing, ask and understand how they are sense-making, and address gaps in a timely and meaningful way.
In rotation models, specific student needs can then be addressed individually or students can be selected for small-group instruction. This is the power of blended learning—the ability to give each student what they need, when they need it. Making the best use of time for educators and learners boosts deep understanding, skills development, and ultimately helps students become confident, life-long mathematical thinkers.

BLENDING LEARNING EMPOWERS EVERYONE IN THE LEARNING ECOSYSTEM
Blended learning offers strategic, data-empowered opportunities for everyone in the elementary math learning community. For administrators, an effective blended learning program affords greater insight into the overall progress of each student and the collective performance of each classroom. For teachers, differentiation is simplified; it’s much easier to know where and how to intervene, thereby making one-on-one math instruction more meaningful. Parents can more fully engage with their student to provide support. Blended learning models level the playing field and allow access to the world-class math education needed to build the foundational math skills needed for success in the 21st century.
Ease of Adoption
Technology that requires a steep learning curve or is time-consuming to implement is a barrier to creating a strong partnership with teachers. Look for a program that is intuitive and makes their efforts more immediately productive.

☐ Is it easy to implement and use?

Technology Integration
Technology should simplify tasks so that they can be completed quickly, resulting in more time that can be spent analyzing the outcomes.

☐ Is content available in the cloud and delivered online or does it require server installation?

☐ Does the program work on all operating systems and/or platforms?

☐ How is content delivered?

☐ How are learning experiences and lessons accessed by students?

☐ Are there minimum computer tablet or bandwidth requirements?

☐ Is there an ability to customize content and reporting?

Student Reporting
Data-driven decision making can only happen with timely, easily accessed and usable data. Students, teachers, parents, and administrators can quickly and easily monitor a complete view of each student’s learning progress. The personalization of this content is crucial to the success of the child and the program; it cannot be a one-size-fits-all model, but must be a one-size-fits-one solution.

☐ Can student performance data be automatically brought together with attendance data on benchmarks and state assessment, and personalized goals?
Endnotes


5 ibid.


DreamBox Learning was founded in 2006 in Bellevue, Washington, and launched its first online learning product in January 2009. DreamBox Learning Math has won more than 30 top education and technology industry awards and is in use in all 50 U.S. states and throughout Canada. The DreamBox Learning Math platform offers a groundbreaking combination of Intelligent Adaptive Learning™ technology, a rigorous elementary mathematics curriculum, and a highly motivating learning environment. DreamBox Learning Math captures every decision a student makes while working in the program and adjusts the student’s learning path appropriately, providing millions of individualized learning paths, each one tailored to a student’s unique needs. It is a platform designed to support teachers and their practice in every type of learning environment, off- or online. For more information about DreamBox Learning Math and the DreamBox Math for iPad app, please visit: www.dreambox.com

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