Increased Student Achievement with Mastery Learning and Continuous Personalization

White Paper

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I Introduction

Research has shown that one-to-one tutoring yields higher achievement outcomes, but it is impractical to provide a private tutor for each student. Thus, began a search for a more practical and realistic solution to obtain similar or higher levels of student achievement.

It took almost a decade and a half for researchers to develop the ***Mastery Learning Strategy*** which recommended a *set of practical and highly effective methods* to achieve similar outcomes. Also, recent advancements in technology have made it possible to deliver personalized learning on a large scale like never before. This white paper outlines how ScootPad's SkillsDNA™ platform incorporates these research-based strategies and advanced technologies to deliver the highest level of student achievement.

Important Definitions:

Mastery Learning:

By definition, mastery learning is a method of instruction where the focus is on the role of feedback in learning. Furthermore, mastery learning refers to a category of instructional methods which establishes a level of performance that all students must "master" before moving on to the next unit. *https://en.wikipedia.org/wiki/Mastery_learning*

Personalization (Adaptive Learning):

Personalized learning is the tailoring of pedagogy, curriculum and learning environments by learners or for learners in order to meet their different learning needs and aspirations. Typically technology is used to facilitate personalized learning environments. *https://en.wikipedia.org/wiki/Personalized_learning*

II Theory & Research Behind ScootPad

ScootPad is a practical realization of the mastery learning strategies resulting from the ground-breaking research conducted by renowned education scholar Dr. Benjamin Bloom.

Dr. Bloom found that tutoring was the most effective teaching method, but not practical to implement in every classroom. He conducted extensive studies to find the best practices for attaining high levels of achievement. Bloom found that certain methods, with the commitment to mastery learning, produced a 2 sigma gain in student achievement in comparison to conventional classroom practices. In other words, these students performed 98% better than their counterparts. Mastery learning consists of *formative assessments*, followed by *corrective procedures* and *parallel formative tests* to identify where the student stands in their grasp of the subject matter. These methods prevent students from moving on before mastering the subject matter. The next section presents Bloom's recommended methods in the order of effectiveness, along with how they were incorporated and enabled on the ScootPad platform.

1 **Reinforcement** is a crucial method for knowledge retention. Students who practice concepts after learning them do far better than if they don't.

ScootPad is built to align with classroom instruction. Teachers are able to design learning paths to mirror their curriculum and instruction sequence. In addition, assignments targeting specific concepts taught in class provide students with rigorous practice and reinforcement.

2 **Feedback-Corrective Process.** Students do better when they receive immediate feedback on their performance and instruction right at that moment to fill knowledge gaps.

In other words, learning is more effective when a student learns from the mistake right after answering a question on a practice or an assignment. This gives him/her the opportunity to update his/her knowledge right away, so they can move on confidently and with the prerequisites needed to master the next concept.

While students are working on assignments and practices on ScootPad, students are given immediate feedback to let them know whether they answered a question correctly. If a student gets an answer wrong, s/he is able to fill the gap in understanding by watching a quick Scootorial.

3 Student learning increased 1.5 sigma over conventional learning with improved instruction offering **higher quality explanations**.

ScootPad's Scootorials offer a brief yet thorough step-by-step audio-visual instruction. Scootorials complement classroom instruction by offering concept explanation when the student needs it the most. ScootPad's recommendation engine pushes personalized Scootorials to each student's dashboard based on individual learning needs. Scootorials are conveniently placed within practices and assignments so students can quickly launch them when they find themselves stuck on a problem.

4 Students learn better when they are **engaged** and become **active participants** in the learning process.

ScootPad's built-in gamification features make the entire learning process visual, competitive, and fun. Students are further engaged and motivated with built-in intrinsic and extrinsic rewards while learning both inside and outside the classroom. Seamless communication between teachers and students using the Class Wall also reinforces student engagement. Intelligent ScootBoard messages engage students and educators with timely reminders and updates.

5 **Student time on task**. Each student learns at their own pace and hence they need their own time to learn concepts that they need most help.

Students need more time on concepts they are struggling with and less on those they've already mastered. ScootPad identifies areas of difficulty for each student and automatically provides more practice and student time in those concepts.

6 When student assignments and **homework** are **graded immediately**, students receive feedback quicker and thus learn faster.

ScootPad auto-grades assignments, adaptive practices, and assessments in real-time providing students with immediate feedback. This not only enables students to learn faster but also makes students take ownership of their own learning. Teachers save time with this process and can focus their time on teaching and small group or 1:1 interventions.

7 **Classroom morale** and classroom culture matter in student learning. Students are influenced by how teachers nurture the classroom learning environment.

Teachers are challenged to continuously find something positive and encouraging in each student and ways to engage all students in the learning process. ScootPad is a toolkit available for teachers that includes rewards, coins, shoutouts, behavior points etc. to not only enhance their classroom culture but also to reinforce positive student behaviors continuously.

8 Curriculum should be organized to enhance students' **initial cognitive prerequisites** while mastering interrelated concepts in a sequence.

Bloom's research highlighted the need to organize curriculum and instruction materials to enable effective mastery learning process. ScootPad incorporates these techniques into the learning process in the following ways: 1) learning paths are organized into units of interrelated concepts 2) concepts are sequenced to reinforce cognitive prerequisites 3) students master one unit of concepts before moving to the next unit.

9 Bloom's research found that **home environment and parent involvement** have great influence on student learning especially at the elementary school level.

Parents are linked to their child's account on ScootPad, giving them direct access to their child's learning data. ScootPad provides insightful updates and reminders to keep parents constantly involved and aware of their child's academic progress. Also, ScootPad offers the "At-Home Learning Zone" for parents to get further involved and provide necessary intervention outside of the classroom.

10 **Higher order questions** call for critical thinking and as a result, students become more effective learners.

ScootPad's content was developed to enable higher order content with increasing levels of Depth of Knowledge (DOK) for each curriculum standard. Each standard is further divided into mini-standards called concepts which are organized in a sequence to enable progressive depth. Students are challenged with questions that push them to think strategically, to ensure that they understand concepts deeply and retain that knowledge.

11 **Rich and Engaging Curriculum.** Students learn better when the curriculum is rich and engaging.

Content on ScootPad was designed to be dynamic and interactive. Unlike traditional static item banks, most of our practice content is "programmed" (by our engineers and content designers) to deliver dynamically. Our 50+ technology-enhanced formats assess various levels of depth of knowledge while challenging students to approach problems from different angles. Our open content platform provides educator-created and curated content available to all teachers to assign to their students.

12 **Peer groups** will have considerable influence on student's activities, behavior, attitudes and academic expectations.

ScootPad offers several ways to engage students and promote peer group collaboration. Friends and Shoutouts on ScootPad help students collaborate with their peer groups. Leaderboards inspire friendly competition among students so they are self-motivated to make it to the top resulting in more practice and learning time.

III The SkillsDNA™ Platform

At ScootPad, we are constantly thinking about how we can iterate on and improve the algorithms powering our SkillsDNA™ platform to continuously learn from the data collected and enhance the entire learning experience for each student. Here's a quick look at some of the approaches incorporated into our adaptive learning platform:

Learning Paths

Personalization is achieved on ScootPad through a systematic orchestration of the assigned curriculum (learning path) and the level of rigor needed to achieve desired mastery, all in real-time and dynamically by our SkillsDNA™ algorithms. SkillsDNA™ is an artificial intelligence system that continuously learns and maintains each students' unique skills profile.

Learning paths are essentially individualized curriculums that are customized to attune to each student's academic needs. Each learning path consists of interrelated groups of concepts organized into a sequence of 10 units. Students must master all interrelated and prerequisite concepts in each unit before they automatically progress to the next unit and thus moving along their learning path. Students eventually move to the "Comprehensive" unit where they are revisit all concepts they've mastered thus far.

Figure 1: Diagram of a learning path. Concepts are organized into 10 sequential units.

Teachers having to manually identify where each student stands and assigning tasks accordingly can be extremely cumbersome. SkillsDNA™ and learning paths work together to automate the process, paying attention to each student's needs and presenting them with practices/assignments corresponding to their proficiency. Teachers are then informed of a student's progress through reports and are able to use the insights to adjust instruction and provide targeted interventions.

Data Driven Insights

Each student interaction (i.e. problem solved) will result in data collection – including the concept, difficulty level, student response and time taken. Our sophisticated algorithms analyze the data in real-time to piece together the student's skills profile with an up to date learning snapshot of each student. Data is then further analyzed by our analytics algorithms (a set of data aggregation, data mining, forecasting and simulation techniques) to

develop actionable insights. Our descriptive analytics deliver insight into the past including mastery & proficiency reports. Our predictive analytics deliver insight into the future including learning trend reports and intervention dashboards. Our prescriptive analytics deliver insights and advice on possible outcomes including the recommended concept Scootorials for each student and next set of concepts for practice.

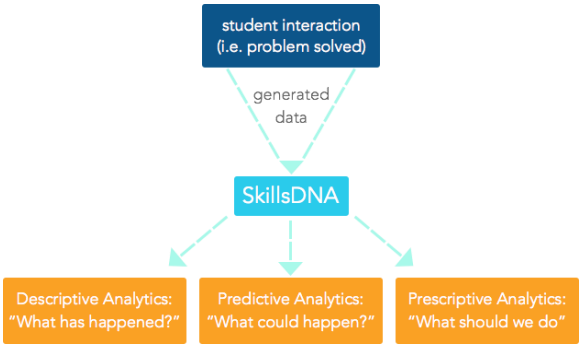

Figure 2: The process of data analysis on ScootPad.

Continuous Personalization

Traditionally, products claiming adaptive learning capabilities identify a student's level of proficiency in a subject matter only at a *single point in time* and also *using a fixed number of questions (with a diagnostic test, knowledge check, quiz, assessment etc.)*. Then, it will seek to develop a curriculum to fill the gaps of knowledge. In such cases, the rigor and the curriculum remain static.

ScootPad, however, provides ***continuous personalization***. Our platform analyzes each student activity in real-time taking into account their latest performance and will adjust the rigor (number of questions and their depth of knowledge) and adjust the curriculum (the next set of concepts to learn). In other words, ScootPad's adaptive learning platform is dynamic and thereby constantly adapting to a student's needs and optimizing the path continuously to achieve the desired mastery.

IV Platform Differentiation & Effectiveness

ScootPad is unique and different from the other products in many ways. Here are the key differentiators that make ScootPad the most comprehensive and effective platform:

Depth of Knowledge & Rigor

ScootPad facilitates deep problem solving and knowledge retention by presenting quality content with multiple levels of rigor and depth of knowledge. ScootPad identifies the aptitude of a student and aims to push the student to his/her highest academic capabilities, not just proficiency standards.

Conventional classroom methods and other platforms will present the same problem over and over again in the same context. While this may be effective for recall and reproduction learning, students also need to be exposed to a concept in varying contexts to reflect real-life situations.

ScootPad prevents students from answering questions purely by memorization. Instead, ScootPad equips the student with the ability to think critically about each problem at hand by placing these problems in multiple contexts with progressively deeper levels of content (driven by DOK). Depth of Knowledge is the measurement of how difficult a problem is and what type of thinking the question requires.

- Level 1 - Recall & Reproduction
- Level 2 - Working with Skills & Concepts
- Level 3 - Short-Term Strategic Thinking
- Level 4 - Extended Strategic Thinking

(For more information, see Webb's DOK Guide at http://www.aps.edu/re/documents/resources/Webbs

Configurability & Customization

Technology should empower teachers, not replace them. Studies have shown that teacher involvement, structure, and autonomy results in positive learning outcomes for students (Skinner & Belmont, 1993). ScootPad gives educators the ability to set their own bar for student achievement. Teachers can configure the desired rigor and proficiency goals, giving them the ability to fully implement their own expectations within ScootPad to drive student achievement. That includes setting the minimum number of questions per concept to achieve mastery, maximum number of questions to exhaust self-learning, and a set point to flag for teacher intervention.

Educators are also able to design learning paths that align with their classroom instruction. They can differentiate for any groups of students using an unlimited number of learning paths designed with concepts from any grade level including creating their own content. ScootPad provides over 50 technology enhanced item formats, giving teachers full flexibility in designing their own questions.

Gamification

ScootPad's intuitive user interface and data visualization techniques make student progress transparent to both teachers and students. Gamification techniques are incorporated to self-motivate students to take ownership of their own learning. As a result, students feel accountable and are motivated to compete against their own past performance (Hattie, 2009). In addition to such powerful intrinsic motivators, teachers and parents can also enable several extrinsic motivators to further challenge and accelerate student learning. Leaderboards engage students in friendly competition with their peers and other schools. Students earn virtual coins on ScootPad when they solve problems correctly – more correct answers result in more coins. Students have fun earning coins and moving up on the leaderboards. Coins are the currency on ScootPad to unlock features such as avatars, color themes, wall papers, games and rewards. Teachers and parents have the ability to custom design their own rewards based on what motivates their students.

Tech Enhanced Content

ScootPad continuously evaluates and implements advanced scalable technologies to make the user experience more engaging and personalized. In addition to ScootPad's adaptive algorithms, content available on the platform is tech-enhanced with over 50 unique TEI formats making it the most engaging and advanced curriculum available on the market. With these tech-enhanced formats, students are able to interact with problems in assorted ways, simulating real-life problem solving. ScootPad's platform leverages its technology to provide educators with real-time feedback on student work while saving educators valuable time. This allows for predictable early intervention providing ample time for educators to prepare students for success.

Mobile 1:1 Learning

ScootPad's responsive design allows the user interface to dynamically adapt to all resolutions and screen sizes. ScootPad Mobile App is also available to download for free on most popular mobile platforms including Google Chrome (chromebooks), iOS (iPads), Android (android tablets), Kindle (Amazon devices) and Windows (Surface tablets). Content, including all 50+ tech enhanced item formats, is tested and supported on mobile devices offering a highly interactive mobile user experience for students. ScootPad is also available at all times making it accessible for students to learn on-the-go whenever and wherever they wish.

V Proven & Measurable Results

ScootPad has developed a simple yet powerful metric called the Rate of Learning (ROL) to measure student progress. Rate of Learning refers to the rate at which a student attains mastery in their respective grade level with just one hour of practice each week. For example, 2.5x Rate Of Learning means students are mastering 2.5 times the number of concepts compared to the average student on ScootPad at their grade level. ScootPad's algorithms calculate and update each students' ROL in real-time as they practice on ScootPad. ROL is also calculated and updated for each classroom, school and district to help teachers and school administrators track students' progress and ScootPad's learning impact.

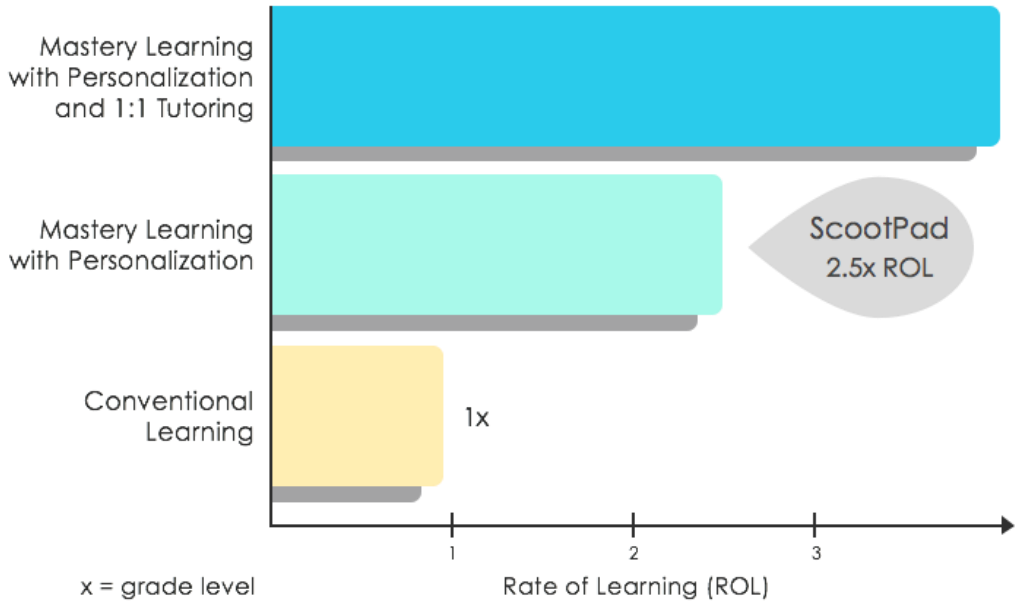

Figure 3: Students who use ScootPad for an hour a week have an average of 2.5x the ROL.

ScootPad's ROL leaderboard showcases the Top 10 Schools achieving the highest Rate of Learning in Math and ELA. ROL Leaderboard is updated in real-time and can be accessed online at https://scootpad.com/results/rateoflearning

VI Case Studies

Hundreds of schools and districts have submitted case studies, usage/learning metrics and teacher feedback reflecting how ScootPad has directly improved learning for their students. Two key findings across most case studies include: 1) significant increase in student engagement and 2) significant gains in student achievement.

"It has provided individual student driven instruction, which is what we wanted. I can assign 3rd, 5th, or 8th grade level work to my students because I have access to all of these. The entire class no longer has to be on one grade level. ScootPad also provides immediate feedback for both students and teacher opposed to waiting a week to get a test back. As a result, students can receive instruction immediately." - *Elena Lee, Math Coach, Huntsville City School District.*

Hillsborough Elementary saw their students become more motivated to learn and more engaged than ever!

Hillsborough Elementary School, located in Hillsborough, New Jersey, implemented ScootPad for the entire school. *"Overall, my students have become more motivated to learn. Not only do they ask to use ScootPad more often throughout the day, but they are using it at home every night. They have taken control of their own learning and their desires have exploded. They are more engaged than ever!"* said Ms. Gradone, a 4th grade teacher.

After ScootPad implementation, Fort Gibson students demonstrated significant gains in math and reading.

Fort Gibson Public Schools, located in Fort Gibson, Oklahoma, adopted ScootPad to deliver one-on-one learning for students at their Early Learning Center and Intermediate Elementary Schools for the 2014-2015 school year. There were significant student gains in math and reading scores on State Department of Education-led tests. More specifically, classrooms that were using ScootPad displayed more gains and success compared to their counterparts. *"When we asked our teachers who showed the most gains and success on the test what they were doing, we found that those teachers used ScootPad math as part of their daily blended instruction time"*, says Cheryl Hill, District Curriculum Director. One classroom in particular showed a 180

point gain. Impressed with the results, Fort Gibson administration mandated ScootPad to be part of their daily blended instruction for all students.

> At **Highland Park Elementary**, students' benchmark scores in reading climbed while using ScootPad.

Michelle Shelton taught a class of low-income fifth graders, whose reading skills were below grade level. She decided to try ScootPad with her students. Ms. Shelton allowed students to use ScootPad spelling as morning work and customized sentences students could relate to. With the platform, student engagement increased. *"My students were much more excited when they learned that they could have more interesting passages, some short answer multiple choice questions, and even earn rewards through ScootPad,"* wrote Ms. Shelton. After taking the benchmark tests, student scores were found to be higher than prior to using ScootPad.

Here's a list of select few case studies:

Hillsborough Elementary School
Hillsborough Township SD, Hillsborough, NJ
https://scootpad.com/results/case_study_detail?csId=CS20

Akers Elementary School
Central Union School District, N.A.S. Lemoore, CA
https://scootpad.com/results/case_study_detail?csId=CS13

Riverside Elementary School
Riverside School District, Chattaroy, WA
https://scootpad.com/results/case_study_detail?csId=CS7

Farley Elementary School
Huntsville City Schools, Huntsville, Alabama
https://scootpad.com/results/case_study_detail?csId=CS15

Kapowsin Elementary School
Bethel School District, Graham, WA
https://scootpad.com/results/case_study_detail?csId=CS2

Hermon Hutchens Elementary School
Valdez City SD, Valdez, AK
https://scootpad.com/results/case_study_detail?csId=CS26

Lorraine Elementary School
Rockdale County Public Schools, Rockdale County, GA
https://scootpad.com/results/case_study_detail?csId=CS9

St. Charles Catholic School
A Blue Ribbon School, Bloomington, IN
https://scootpad.com/results/case_study_detail?csId=CS4

Review hundreds of case studies and teacher testimonials online at:
https://www.scootpad.com/results

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About ScootPad

Founded in 2011, ScootPad is a leading adaptive learning platform for grades K-8. Delivering highly personalized and accelerated learning through adaptive algorithms, predictive analytics, data visualization, and gamification, ScootPad has become a "go-to" platform for 37,000+ schools across 9,000+ districts. With its comprehensive design, ScootPad has become a classroom staple, providing teachers and students with a full suite of features that are accessible anywhere, any time, on any device. For more information, visit www.scootpad.com or follow us on Twitter @ScootPad.