THE CHALLENGE

The pressure is on for states to improve student achievement. The 2015 Every Student Succeeds Act (ESSA) transferred power and responsibility from the federal government to states to design school accountability systems. The law mandates that states adopt rigorous standards that are aligned with the demands of college and careers, assess students annually, identify clear academic performance indicators, set improvement goals, and assign ratings to schools. States are expected to develop assessment systems that not only measure students’ basic concept mastery, but also assess student’s ability to apply higher-order thinking skills such as critical thinking, reasoning, analysis, complex problem solving, and effective communication. Schools must provide quantitative evidence that all students are meeting performance measures or run the risk of state intervention.

Unfortunately, data indicate that many students are not receiving the targeted support needed to master basic mathematics and reading skills. According to the 2015 National Assessment of Education Progress (NAEP), only 40 percent of 4th grade students and 33 percent of 8th grade students scored at or above the proficient level in mathematics. Similarly, only 36 percent of 4th grade students and 34 percent of 8th grade students scored at or above the proficient level in reading.

As a result of these findings, states, districts, and teachers are redoubling their efforts to ensure students transfer what they learn in the classroom to high-stakes tests. They are moving away from more simple isolated skill work to activities that encourage students to work at increasingly complex levels. Educators are attempting to provide deeper learning opportunities that enable students to apply content knowledge to novel tasks.

Fortunately, schools and teachers can enlist technology to help them better meet the needs of an increasingly diverse student population. Research shows that the personalized online learning afforded by technology can be as effective as face-to-face instruction in improving academic achievement (Means et al., 2013; Pane et al., 2015). Moreover, technology can be an effective way of reducing achievement gaps in reading and mathematics (Stanford et al., 2010).

UPSMART: SUPPORTING JUST-IN-TIME INSTRUCTION

UpSmart is a supplemental, online test readiness program designed to help students in grades 6 to 8 demonstrate their achievement of state standards in English language arts and mathematics. Combining adaptive learning, just-in-time instruction, differentiated feedback, strategic scaffolding, and detailed reports, UpSmart empowers students with the critical knowledge and confidence needed to succeed at ongoing classroom assessments and on high-stakes tests. Researchers, testing experts, and teachers have pinpointed five hallmarks of effective instruction that contributes to test readiness. These research-based practices are incorporated into UpSmart.

1. **Teach to a curriculum that is grounded in rigorous academic standards.**

Research confirms that student performance on assessments is best supported by instruction that incorporates the full body of knowledge and skills represented in state curriculum standards, and is included on those assessments (Bishop & Davis, 2016; Bushweller, 1997; Crocker, 2005; Crocker, 2006; Mehrens & Kaminski, 1989; Miyasaka 2000; Perlman, 2003; Popham, 2001; Turner, 2009). “Teaching to the test”—instruction that is focused only on test items or on items similar to what might be found on an assessment—is harmful because it can narrow the curriculum and artificially inflate student test scores. Item drills do not allow students to experience full conceptual understanding and use the problem-solving skills that are in a high-quality curriculum; it only teaches students how to take standardized tests that are focused on low-level skills (Popham, 2001). As Popham (1991, p.17) notes, “No test preparation practice should increase a student’s test score without simultaneously increasing student mastery of the content domain tested.”
Our Solution

UpSmart was developed with a team of nationally recognized researchers and practitioners with expertise in mathematics and reading education. To create the program, the team carefully analyzed state standards aligned to college and career readiness outcomes. The scope and sequence of the program was then reviewed by domain experts and teachers to verify that it reflects both state standards and suitable student learning progressions.

Using the principles of backward design (an approach to curriculum design that sets end goals before creating lesson plans), the team outlined the conceptual understandings, potential misconceptions, and common errors captured in state reading and mathematics standards. Each standard was unpacked for its component skills. The team then created a set of anchor items designed to highlight the complex abilities and performances that students should be able to demonstrate with acquired content and procedural knowledge. The set of anchor items was reviewed by WebbAlign® to ensure it reflects the content, balance of representation, breadth of knowledge, and depth of knowledge levels required by the standards.

Component skills, derived from state standards, were identified to create the teaching and learning topics in the program. Each topic is organized into three levels, which represent the logical progression of the skill—increasing in cognitive complexity across the three levels. Once the progressions were organized, they were once again reviewed by academic advisors and practitioners. In this review, they ensured adherence to standards and determined the most common errors and misconceptions students are likely to experience in pursuit of the standard. These determinations were then used to anticipate areas of challenge for students, and create related instruction and feedback. Once learning resources were created, the academic advisors and practitioners went back and reviewed videos for instructional clarity, instructional format, and cognitive challenge.

<table>
<thead>
<tr>
<th>Common Core 6.G.A.4</th>
<th>Nets and Surface Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures. Apply these techniques in the context of solving real-world and mathematical problems.</td>
<td>Recognize the net of a three-dimensional figure.</td>
</tr>
<tr>
<td></td>
<td>Find the surface area of a figure using a net.</td>
</tr>
<tr>
<td></td>
<td>Use nets to solve problems about surface area.</td>
</tr>
</tbody>
</table>

Each UpSmart topic features three levels that gradually increase in complexity: bronze, silver, and gold.

2. Provide differentiated instruction, scaffolded support, and formative feedback.

Because every child learns differently and has different abilities and interests, experts agree that effective instruction should be differentiated based on students’ unique learning needs (Subban, 2006; Tomlinson & Sousa, 2011; Tomlinson, 2014; Turner, 2009). Differentiated instruction acknowledges students’ individual differences and is based on the idea that instruction should be slightly higher than a student’s level of mastery (Subban, 2006; Vygotsky, 1978; Hall et al., 2014). Differentiated instruction occurs when the content of what a student is learning is adjusted in relation to a student’s readiness to learn, interests, or ability profile (Hall et al., 2014; Moon, 2016; Subban, 2006; Tomlinson & Sousa, 2011; Tomlinson, 2014; Watts-Taffe et al., 2012). Indeed, decades of research show that academic achievement improves dramatically when instruction is aligned with a learner’s profile (Hall et al., 2014; Subban, 2006; Watts-Taffe et al., 2012).
The term scaffolding is often used to describe the instructional use of supports—including feedback and modeling—to help students carry out tasks, until they are able to do so independently. Research and expert opinion verify the use of scaffolding to realize learning goals, gradually withdrawing support as students build mastery (Archer & Hughes, 2011; Fisher et al., 2011; Lajoie, 2005; National Research Council, 2012; Rosenshine, 1995; Rosenshine & Stevens, 1986; Sweller, 2008).

A critical component of differentiated and successful instruction is formative feedback (Tomlinson, 2014). More than two decades of research confirms that formative feedback plays an important role in increasing student achievement and motivation (Black & William, 1998; Ferguson, 2011; Fraser, Walberg, Welch, & Hattie, 1987; National Research Council, 2012; Shute, 2008; Turner, 2009; Yuan & Min Kim, 2015). Formative feedback is information with “which a learner can confirm, add to, overwrite, tune, or restructure information in memory, whether that information is domain knowledge, metacognitive knowledge, beliefs about self and tasks, or cognitive tasks or strategies” (Butler & Winne, 1995, p.20). Formative feedback is effective when it is timely and clear, helps students address inappropriate strategies and misconceptions, and is actionable (National Research Council, 2012; Shute, 2008). Such feedback can accelerate the rate of learning by eliminating the gap between students’ conception of knowledge and the desired response (Archer & Hughes, 2011; National Research Council, 2012).

Our Solution

UpSmart capitalizes on the power of adaptive technology to deliver just-in-time individualized instruction, scaffolded practice, and tailored feedback based on students’ confidence and achievement level.

With UpSmart, students begin each topic with a very short, targeted assessment to determine the most suitable level of instruction for the topic. Based on the student’s performance on the assessment, he or she is placed into one of three performance levels: bronze (for students who have limited understanding of a topic), silver (for students who have an emerging understanding of a topic and are working toward proficiency), or gold (for students who are ready to tackle the most challenging aspects of a topic).

As students engage in tasks, the program builds a proficiency profile that adjusts the students’ experience based on their mastery of skills and the frequency with which they accessed instructional supports (e.g., asked for a hint or viewed a “Show Me” video). For example, if students use all the instructional support for a task and are still unable to complete it, they will receive additional instruction and practice with a similar task, at a similar level of challenge. Conversely, if students complete a task correctly on the first attempt with no instructional support, they may see a more challenging task next.

Each level features a highly adaptive set of tasks that assess students’ mastery of skills and that trigger a wide array of scaffolds and support. These include hints, answer-specific feedback, and direct instruction and modeling.

Edgenuity provides a number of supports to scaffold student learning.
• **Hints:** Students have access to contextual hints throughout the program. The first hint is designed to give students further guidance related to what the question is asking. Those students who need ongoing support can also ask for additional hints that will guide them toward the first step in completing the task successfully. The program notes each time a student requests a hint, contributing to the creation of individual student proficiency profiles.

• **Answer-Specific Feedback:** For each task, students receive immediate, explanatory feedback that is specific to the student’s response. For example, a student whose response shows the classic error of interpreting figurative language as its literal meaning might receive feedback explaining that figurative language often uses a comparison to show something is like something else. A student who computes the area of a triangle as “base times height” might be reminded that she needs to divide by two, since a triangle is half a rectangle. The answer-specific feedback is individualized for each student, in support of ongoing effort and learning. After the answer-specific feedback, students have the chance to try the task again.

• **Direct Instruction and Modeling:** Students who are struggling will view “Show Me” videos that guide them through the interactive topic and skill task—introducing appropriate strategies, modeling expert thinking, and teaching how to approach future questions about this skill.

### 3. Deliver explicit instruction.

Decades of research concluded that explicit, intentional, and systematic instruction enhances student performance on high-stakes tests (Archer & Hughes, 2011; Bangert-Downs, 1990; Crocker, 2005; Turner, 2009; Fisher et al., 2011; Guthrie, 2001; Rosenshine, 1995; Rosenshine & Stevens, 1986). Explicit instruction, systematic instruction and intentional instruction all share the following characteristics: 1) setting well-defined goals; 2) building background knowledge; 3) addressing misconceptions; 4) providing direct instruction through a wide array of models, demonstrations, and worked examples; 5) guiding student thinking through the strategic use of questions, prompts, and cues; 6) offering students meaningful tasks that allow them to solidify concepts and skills; and 7) requiring students to apply what they have learned (Fisher et al., 2011).

Experts, researchers, and practitioners agree that significant learning and superior preparation for high-stakes assessments results from rigorous instruction that promotes higher-order thinking skills. As Crocker (2005) points out, instruction “should not be limited to low-level content or basic cognitive processes” (Crocker, 2005, p.169). Students should be required to use higher-order thinking processes such as understanding, application, analysis, evaluation, and creation (Crocker, 2005; Krathwohl, 2002; Mayer, 2002). Students must build a broad array of problem-solving and metacognitive strategies that help them effectively solve learning tasks (National Research Council, 2012).

### Our Solution

UpSmart offers systematic instruction that presents clear explanations of concepts and skills. The program activates students’ prior knowledge by introducing each topic with an engaging video designed to build conceptual understanding and address major stumbling blocks related to complex content covered in standards. In providing relevant information that helps students better understand lesson content, the video provides an overview of critical concepts, highlights key characteristics of concepts and procedures, draws students’ attention to the structure of information, and explains how the different ideas or skills to be learned connect to one another.

Both Topic Introduction and “Show Me” videos capitalize on models, demonstrations, and worked examples to teach students critical concepts and procedures. Videos help students set goals and use clear language to define terms and model concepts and procedures through think-alouds. To ensure that learning is accessible to students, the content to be learned is presented in multiple formats, including verbal modeling, pictures, symbols, dynamic representations, graphs, and text.
Direct instruction videos explicitly model problem-solving and metacognitive strategies. Rather than teaching students a set of rules and procedures to apply to a single problem, UpSmart ensures that students learn how to approach general classes of problems. For example, in mathematics topics, students are taught specific problem-solving strategies they can use to approach tasks. In reading topics, students are taught how to use background knowledge, locate information, summarize, and self-monitor as they approach complex texts. All students learn how to use graphic organizers, checklists, and various strategies to check, process, and retrieve information.

UpSmart requires students to demonstrate higher-order thinking skills in solving complex problems and tasks. Technology-enhanced tasks challenge students to analyze, evaluate, and interpret information, as well as make inferences, draw conclusions, and apply knowledge to new situations. And as students advance to the gold level in each topic, they synthesize previous skills and apply them to novel tasks.

4. Distribute practice using a wide variety of learning tasks and assessment item formats.

Scientists have identified two main types of memory: working memory, where people consciously process information; and long-term memory, with a much larger body of connected information. After information has been organized and stored in long-term memory, it can be accessed again as needed without placing a large burden on working memory (Sweller, 2008). The knowledge in long-term memory is used to understand new memories.

More than 100 years of cognitive and neuroscience research suggests that learning is enhanced when students have opportunities for “cognitive closure,” and when learned material can be summarized over time (Dunlosky et al., 2013). During “cognitive closure,” students “attach sense and meaning to new learning” and increase the chance that “knowledge will be retained in long-term memory” (Sousa, 2008, p.202). Consequently, experts recommend providing students with opportunities to practice newly learned material rather than offering one-shot cram sessions (National Research Council, 2012; Dunlosky et al., 2013; Gerbier & Toppino, 2015). As Crocker (2005, p.168) writes, preparation for high-stakes tests should not be “a frenzied activity to be tackled just prior to administration of a major assessment, but rather a year-long activity to be incorporated into classroom instruction.”

Increasingly, states are incorporating technology-enhanced item formats into their high-stakes tests (Turner, 2009). These formats may include multiple choice, drag and drop, text selection and highlighting, equation builders, short answer, extended response, and multipart answers. Data show that students need exposure and practice with these item types to succeed on high-stakes tests (Crocker, 2005; Miyasaka, 2000; Popham, 2008; Turner, 2009).

Our Solution

UpSmart is designed to produce long-lasting learning gains when used as a companion to a core curriculum. The program provides an opportunity for students to continually revisit and reinforce skills introduced in classroom instruction, and its adaptive learning engine ensures that students spend more time on skills they find challenging.

With a wide variety of technology-enhanced tasks, UpSmart requires students to approach the same material from different perspectives. For example, students drag and drop numbers and words to construct equations and sentences, graph points and lines, create data displays, fill in true/false questions, identify text and images in “hot spot” tasks, and write short constructed responses. As a result, students also receive multiple exposures to critical mathematics and English language arts skills assessed on high-stakes tests.

Mrs. Salma’s class held a fundraising drive for a field trip. The amount of money each student raised is shown in the table.

<table>
<thead>
<tr>
<th>Amount Raised (Dollars)</th>
<th>Number of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-25</td>
<td>10</td>
</tr>
<tr>
<td>26-50</td>
<td>7</td>
</tr>
<tr>
<td>51-75</td>
<td>4</td>
</tr>
<tr>
<td>76-100</td>
<td>5</td>
</tr>
<tr>
<td>101-200</td>
<td>2</td>
</tr>
</tbody>
</table>

Use the data shown in the table to create a histogram by dragging the bar above each interval to the correct height.

Amount of Money Raised per Student

<table>
<thead>
<tr>
<th>Frequency</th>
<th>5-10</th>
<th>11-15</th>
<th>16-20</th>
<th>21-20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dollars</td>
<td>10</td>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

UpSmart tasks match the breadth of item types on high-stakes tests.
5. Boost student motivation.

Research indicates that motivation is a strong predictor of student achievement. Students who are motivated demonstrate greater conceptual understanding on high-stakes assessments, exhibit higher levels of satisfaction with school, and have more confidence than students who are unmotivated (Amrein & Berliner, 2003; Guthrie, 2002; Miyasaka, 2000; Usher & Kober, 2012).

Usher and Kober’s 2012 review of the literature suggests that there are four factors that contribute to student motivation: autonomy, competence, relatedness, and relevance (citing Murray, 2011; Pintrich, 2003; Ryan & Deci, 2000). Explicitly teaching students to set achievable goals, monitor their own progress, have a “stick-with-it” attitude, and be aware of their achievements can increase motivation (Usher & Kober, 2012).

Recent studies also suggest that technology and digital badges can play a critical role in boosting student motivation. Badges, for example, can motivate learners and help improve performance on high-stakes assessments (Gibson et al., 2013). In particular, Abramovich et al. (2013) found that obtaining badges may incentivize students to acquire new knowledge and skills. Digital badges act as markers of what students know and what they need to learn. Consequently, badges create a roadmap for learning, making a student’s instructional path more clear (Gibson et al., 2013).

Our Solution

UpSmart is designed to help students develop the motivation needed to succeed on classroom assessments and high-stakes tests.

UpSmart strengthens student autonomy by providing multiple opportunities for practice with temporary scaffolds (e.g., hints, answer explanations) that help students carry out tasks until they are able to do so independently. As students master content material in a topic, the complexity of tasks increases while access to support such as “Show Me” videos decreases. The program also builds cognitive autonomy by teaching students generalizable strategies to approach reading and mathematics problems. For example, UpSmart instructional videos model strategies such as:

- When solving a real-world problem, check that your answer makes sense.
- When you need to find the structure of a passage, figure out how the key ideas connect.
- When a problem has a lot of information, make a list, chart, or diagram to organize what you know.
- When reading an informational text, determine what the headings tell you about each section.
- When you have to determine a dimension needed to solve a problem, look for relationships between geometric figures.

Edgenuity builds student competency and relatedness by providing immediate, explanatory feedback that encourages persistence, resilience, and a learning growth mindset. For example, when a student has repeatedly struggled to master a task, the student may hear the feedback, “Let’s break this task down into smaller steps so that we can target your attention to what matters.” Conversely, a student who is successful at completing the task is praised for his or her efforts. For example, feedback might say, “You are getting the hang of this! Let’s strengthen these skills even more!”

UpSmart provides a robust dashboard that allows students to track their progress and engagement.
UpSmart uses a digital badging system to celebrate students’ skill acquisition. Students earn badges when they master the beginning skills in a topic and then level their badges up from bronze to silver to gold as they advance in proficiency. By connecting the badges to specific skills, UpSmart increases student ownership of learning, encouraging students to monitor their progress and celebrate their successful mastery of skills.

6. Capitalize on formative assessment to improve student learning

The Council of Chief State School Officers define formative assessment as a “process used by teachers and students during instruction that provides feedback to adjust ongoing teaching and learning to improve students’ achievement of intended instructional outcomes” (McManus, 2008, p.3). Formative assessment involves diagnosing student learning needs and adjusting instruction to meet student learning goals. Studies show that formative assessment is most effective when data is used to “1) make learning goals clear to students; 2) continuously monitor, provide feedback, and respond to students’ learning progress; and 3) involve students in self- and peer assessment” (National Research Council, 2012, pp.6-19).

In fact, a large body of research demonstrates that when teachers use data to shed light on learners’ strengths, challenges, interests, and aptitudes, and set instructional learning targets, student achievement improves (Black & William, 1998; Kingston & Nash, 2011; Lai & Schildkamp, 2013).

When educators have a clear purpose for data, as well as the ability to contextualize, categorize, summarize, and make sense of what the data mean, they can more effectively “set appropriate student learning goals; can monitor and check to see if students are reaching their goals; and can support students in developing the ability to monitor and check their own goal attainment” (Lai & Schildkamp, 2013, p.15).

Our Solution

UpSmart gathers and analyzes extensive data as students work through interactive tasks throughout the program. UpSmart captures students’ entry point into each level, when they acquired each skill, how difficult it was to do so, and how they are spending their time in the program.

This continuous capturing of data and analytics provides formative assessment that powers detailed reports on every topic, standard, and skill—allowing teachers to answer questions such as:

- How much time are my students spending in each topic, level, and overall in the program?
- Which skills and standards have my students mastered and for which skills and standards do my students need additional support?
- Which skills did my students master easily, and which were challenging for them (i.e., which skills should I plan to review)?
- Which students are at risk and require additional assistance?
- How can I group students for re-teaching?

UpSmart offers standards- and skills-based reporting at all levels.
UpSmart reports include:

- Progress by Standard: View progress against grade-level standards and component skills.
- Progress by Topic: Monitor student growth in each topic as students advance from bronze to gold.
- Progress by Skill: View the various proficiency levels of a class or group of students for all skills in the program.
- Detailed View by Student: Drill down to the single student view to see specific skills within a standard topic or standard.
- Pretest/Post-Test Growth: Track overall growth over the course of the program, as well as growth by domain.

**CONCLUSION**

In response to the 2015 Every Student Succeeds Act (ESSA), states have started to adopt new standards and assessment systems designed to ensure that all students are ready for college and careers. Rather than focusing on basic procedural knowledge, these new standards and assessment systems require students to demonstrate complex higher-order cognitive skills such as the ability to analyze, synthesize, compare, connect, critique, and hypothesize, and the ability to apply knowledge to new contexts.

Teachers face the challenging goal of building student content knowledge and higher-order thinking skills while also preparing students to perform on high-stakes tests.

UpSmart helps meet this need by translating the best research in online learning, neuroscience, pedagogy, educational psychology, and instructional design. By combining adaptive assessments, personalized instruction, differentiated feedback, strategic scaffolding, and detailed reports, UpSmart empowers students with the critical knowledge, higher-order thinking skills, and deeper learning competencies needed for success.

**REFERENCES**


