



LEARNING TO ADAPT:

UNDERSTANDING THE ADAPTIVE
LEARNING SUPPLIER LANDSCAPE

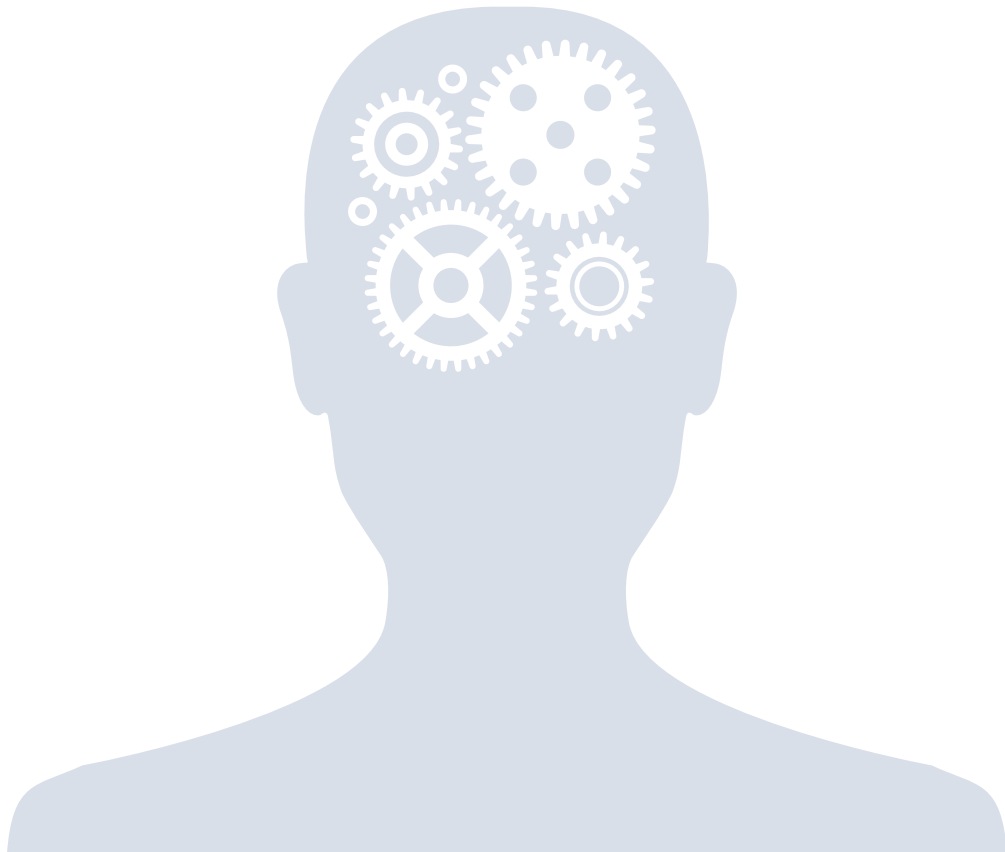


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INTRODUCTION

Among the innovations sweeping across the higher education landscape, adaptive learning may remain one of the least understood and most misrepresented. At the same time, few “true” adaptive learning solutions have achieved meaningful market awareness and scale of institutional adoption. However, given the challenges facing higher education institutions today and the profound rethinking of their missions and models taking place, now may be an ideal time for administrators and faculty to take a closer look at what an increasing number of suppliers are offering. In support of that goal, this paper provides the necessary signposts for more in-depth understanding of this still emergent segment.

In March 2013, we published *Learning to Adapt: A Case for Accelerating Adaptive Learning in Higher Education*, which outlined for college and university administrators and faculty the potential for adaptive learning to help them address the “Iron Triangle” of cost, access, and quality. *Learning to Adapt* sought to clarify adaptive learning as an approach within a broader personalized learning landscape and laid out an argument for why adaptive learning and why now. The goal was – and is – to encourage colleges and universities to look beyond the headlines and take a more informed look at suppliers and solution capabilities in this segment.

In this companion piece, we provide institutional stakeholders with frameworks and resources to facilitate campus conversations regarding evaluation and adoption of adaptive learning solutions. This differentiated analysis is especially important because the range of solutions provided by adaptive learning suppliers varies substantially in appropriateness for different institutional environments and implementation scenarios. Additionally, an institution’s optimal approach to adaptive learning may have as much to do with internal considerations of capacity and teaching and learning strategy as it does with the capability of a particular vendor. Given these circumstances, teasing out the distinctions between suppliers and their solutions can be not only confusing, but can also create barriers to more rapid institutional uptake.

To address this challenge, we provide insight into solution variability through three organizing lenses – Approach, Taxonomy, and Maturity – that describe solution design and development characteristics relevant to institutional decision-makers. Building on these lenses, we pivot to frame how an institution or instructor might use a set of contextual considerations and instructional objectives to winnow the field of adaptive learning suppliers, honing in on those whose solutions best align with user needs before engaging in a deeper dive analysis and potential pilot activity.

Which companies and organizations actively delivering adaptive learning solutions to colleges and universities today merit attention? To begin to address that question, we have profiled eight suppliers representative of the diverse options available to institutions interested in pursuing adaptive learning. Please note that inclusion as a profiled company or organization should not be interpreted as an indication of being among the “best” or “leading” providers of adaptive learning solutions, nor do we attempt or intend any degree of prioritization or ranking among them.

In addition, to support more in-depth market understanding, we also highlight in Appendix D a broader set of companies and organizations that bear watching in this space. Some have solutions available today, others are working on ones, and still others would seem to have development of adaptive capabilities as a logical, if not likely, component of their product roadmap.

LENSES INTO ADAPTIVE LEARNING SOLUTIONS

In *Learning to Adapt*, we established a distinction between “personalized learning” and “adaptive learning.” We define **personalized learning** as a “pedagogical method or process that draws on observation to inform tailored student educational interventions designed to increase the likelihood of learner success.” Thus, personalized learning functions as an umbrella term describing a range of approaches and models such as competency-based learning, differentiated instruction, tutorial models, and adaptive learning, among others. While the application of technology is not essential or even required, it does facilitate personalized learning models at scale.

As an approach to creating a personalized learning experience for students, **adaptive learning** takes a sophisticated, data-driven, and in some cases, non-linear approach to instruction and remediation, adjusting to a learner’s interactions and demonstrated performance level and subsequently anticipating what types of content and resources learners’ need at a specific point in time to make progress. Within the context of this paper, we generally use the terms **adaptive** or **adaptivity** in reference to product-level attributes or qualities of suppliers’ solutions. Rigorous “adaptive learning” solutions leverage various strands of academic research in areas such as intelligent tutoring systems, machine learning, knowledge space theory, memory, cognitive load theory, etc. in the development of technology-enabled delivery models. As such, adaptive learning solutions represent one instantiation of an institution’s approach to personalized learning.

The learning sciences underpinning adaptive learning solutions may be an important consideration for some decision-makers, and may be overwhelming to others. In either case, stakeholders generally want to understand “how” solutions work, including a set of descriptive solution attributes that address issues such as openness of the content model, scope of course coverage, interoperability with existing institutional resources, and

support services, among others. To support institutional stakeholders and their evaluation processes, we have established three lenses through which to better understand adaptive learning solutions:

- **Approach** describes the mechanics of “how” suppliers’ solutions employ adaptivity to create a more personalized learning environment
- **Taxonomy** illustrates primary product attributes vis-à-vis a set of pedagogical considerations
- **Maturity** addresses a core set of operational and technology attributes that any institution will need to understand relative to product adoption

Each lens provides a framework to highlight design and development decisions made by suppliers in pursuit of a specific strategy at a particular point in time. Importantly, these lenses do not necessarily provide a mechanism for rank-ordering the caliber and quality of suppliers’ adaptive learning solutions. For one, suppliers may be applying adaptive models towards very different ends; as an example, what a company like Cerego is trying to achieve with its platform is fundamentally different than what a firm like Knewton is aiming for. Secondly, as we will highlight later, institutional or individual instructor needs and context should be the primary starting point through which evaluation of adaptive learning suppliers occurs; after thoughtful consideration, institutions and/or instructors are likely to find that certain suppliers and their solutions will logically recommend themselves for adoption.

APPROACH

As noted in *Learning to Adapt*, one approach to adaptivity – what we term “**Facilitator-driven**” – occurs when professors and instructors receive robust, yet actionable, student and cohort performance profiles (i.e., dashboards) enabling them to differentiate instructional experiences for students. *Facilitator-driven* solutions rely heavily on content metadata and require the ongoing presentation of these pull or push dashboards in a visually effective manner. This is a content-driven approach that generally links a specific course’s content inventory within a system of standards or learning sequences. Instructors are given the tools to adapt instruction at a degree of scale (i.e., number of students) and granularity of learning objective that could likely not otherwise be achieved.

Another approach – termed “**Assessment-driven**” – is enabled by ongoing evaluation of learner performance and/or mastery that results in fairly dynamic (i.e., near to real-time) adjustments in the instructional content, learning resources, and course pathways presented. One example of this might be an asynchronous online statistics course in which individual students proceed through a common set of learning objectives in different ways and at different rates.

Assessment-driven solutions require an ability to correlate assets, items, and learning objects to standards, outcomes, or other frameworks. This can be done by editing the metadata in the items, content assets, or learning progressions, or by using a tool such as semantic analysis to correlate the content dynamically. This mechanism requires similar linkages as the *Facilitator-driven* model; the primary difference is that learners can move

through an *Assessment-driven* solution individually or in a group scenario with no or limited instructor interaction.

In addition, more sophisticated *Assessment-driven* solutions model and categorize learners through the aggregation of cognitive *and* non-cognitive data, resulting in a more three-dimensional “profile” of the learner. This profile enables the solution to recommend and personalize a learner’s experience through a combination of previously modeled paths through the content and objectives. This approach requires the greatest degree of technical acumen, as the system must monitor, track, and analyze extensive, large-scale data ranging from previous learner/s’ experiences to cognition, modalities, and social learning, among others.

These two approaches – *Facilitator-driven* and *Assessment-driven* – are not mutually exclusive. Most suppliers have elements of both embedded in their solution model – albeit with different emphases and levels of sophistication – which can provide insight into their adaptive “philosophy.” A first step in differentiating between and among suppliers is better understanding their approach to adaptivity, and the benefits and limitations therein.

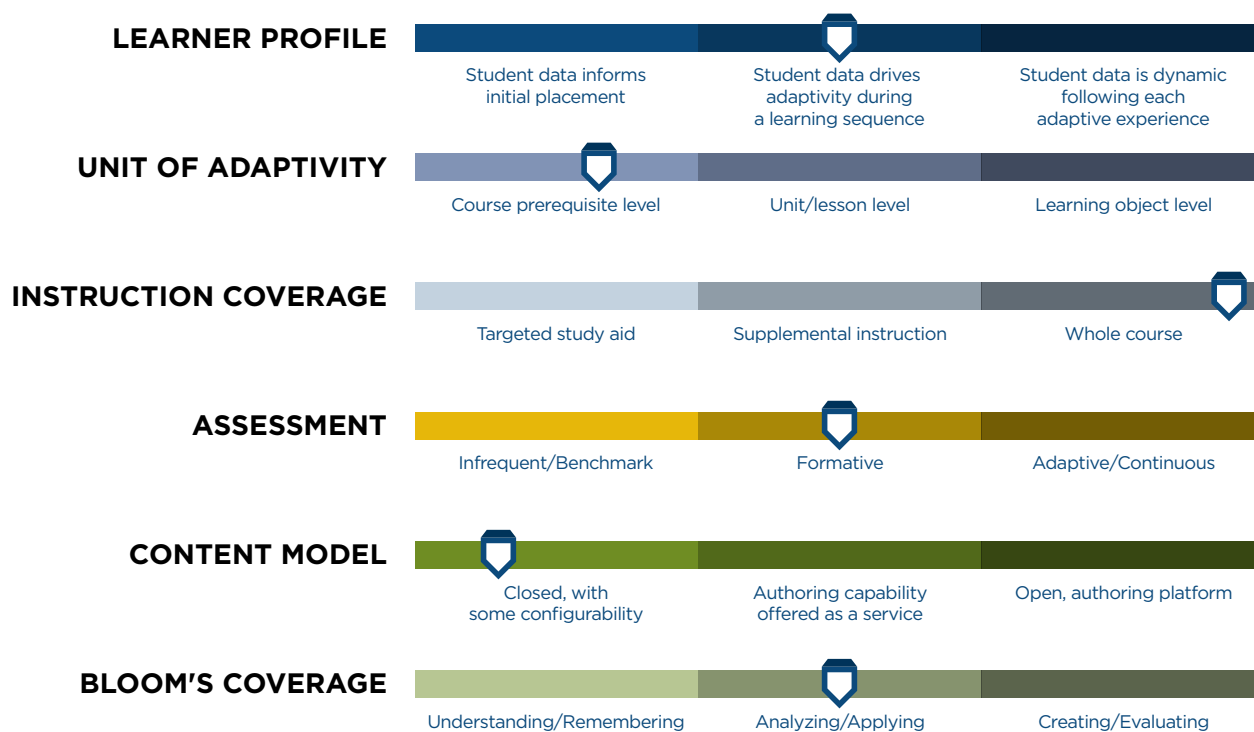
TAXONOMY

If Approach is an effort to address the “how” of an adaptive solution, then Taxonomy aims to capture some of the “what.” We have initially identified six attributes that illustrate pedagogical components of an adaptive learning solution:

- **Learner Profile** is a structured repository of information about the learner used to inform and personalize the learning experience
- **Unit of Adaptivity** refers to the structure of the instructional content and the scale at which that content is modified for specific learner needs
- **Instruction Coverage** refers to the pedagogical flexibility of a product to deliver an adaptive learning experience and the scope/scale of that experience within the context of a course
- **Assessment** is the frequency, format, and conditions under which learners are evaluated
- **Content Model** describes the accessibility of the product’s authoring environment to instructors or other users and their ability to add and/or manipulate instructional content in the system
- **Bloom’s Coverage** highlights to what extent a product can support the learning objectives within the Cognitive Domain of Bloom’s Taxonomy

Each of these attributes can be viewed along a continuum and the composite view highlights the scale, scope, and sophistication of adaptivity enabled. **The following graphic** illustrates the potential continuum for each attribute.

ADAPTIVE TAXONOMY OVERVIEW EXAMPLE SOLUTION



Each adaptive solution is located at a point along the continuum for each attribute, and we have illustrated that for each supplier profiled beginning on page 16. Thus, the Taxonomy details begin to serve as a matrix for institutional evaluation and decision-making. For example, an instructor who wants an adaptive solution that allows her to author and source her own content will likely seek out a solution on the right side of the Content Model continuum. An instructor seeking to incorporate an adaptive lab environment into a broader Chemistry course would want a solution at roughly the mid-point of the Coverage continuum. And an instructor and/or institution evaluating solutions at the right side of the Coverage continuum is likely pursuing one that enables a potentially fundamental redesign of the course experience.

Among the organizations profiled in this paper, most are operating at a learning-object level of adaptivity (i.e., the right side of the “Unit of Adaptivity” continuum) and at the mid-point of Bloom’s continuum. At the same time, there exists a fair degree of differentiation regarding suppliers’ positioning relative to the Instruction Coverage and Content Model attributes. Each attribute provides insight into what an adaptive learning solution offers, and the aggregated view establishes a solution “profile” that institutions and instructors can align with envisioned implementation scenarios (virtual or in-class).

MATURITY

This lens addresses core issues of interoperability, technical maturity, support, and maintenance, among others. As such, this set of considerations is generally not specific and/or exclusive to adaptive learning solutions, but rather illustrative of the types of software characteristics required for adoption in a postsecondary institutional environment. Naturally, the inability of suppliers' solutions to meet basic performance thresholds in these areas would prove an impediment to adoption.

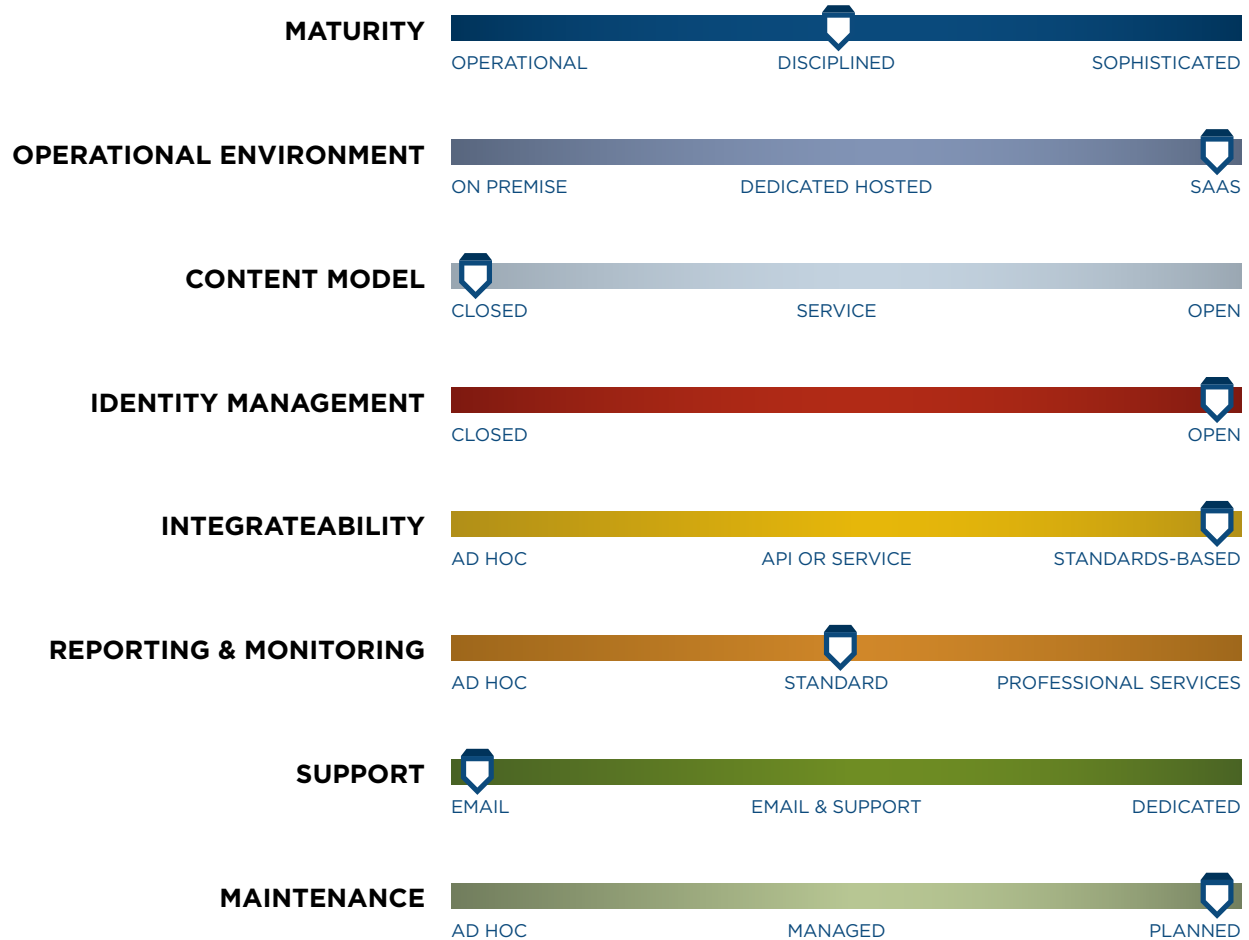
For example, while the solutions we reviewed have their own authoring and delivery capabilities – and thus might be viewed as an LMS – most can be delivered through a third-party LMS environment. From a technical support standpoint, most of the suppliers profiled offer both email and call center support to institutional customers.

Through a request for information (RFI) submitted to and completed by profiled institutions, we reviewed the following attributes:

- Operational and technical maturity
- Physical deployment and operational environment
- Content creation and learning object approach
- Identity management and single sign-on
- Degree and approach to interoperability and integration
- Reporting and monitoring
- Technical and help desk support
- Software and solution maintenance

For each profiled company, we have identified its solution's relative position for each attribute; a generic illustration of this graphic is included below. In addition, a more detailed description of each attribute and its specific criteria is included in Appendix B.

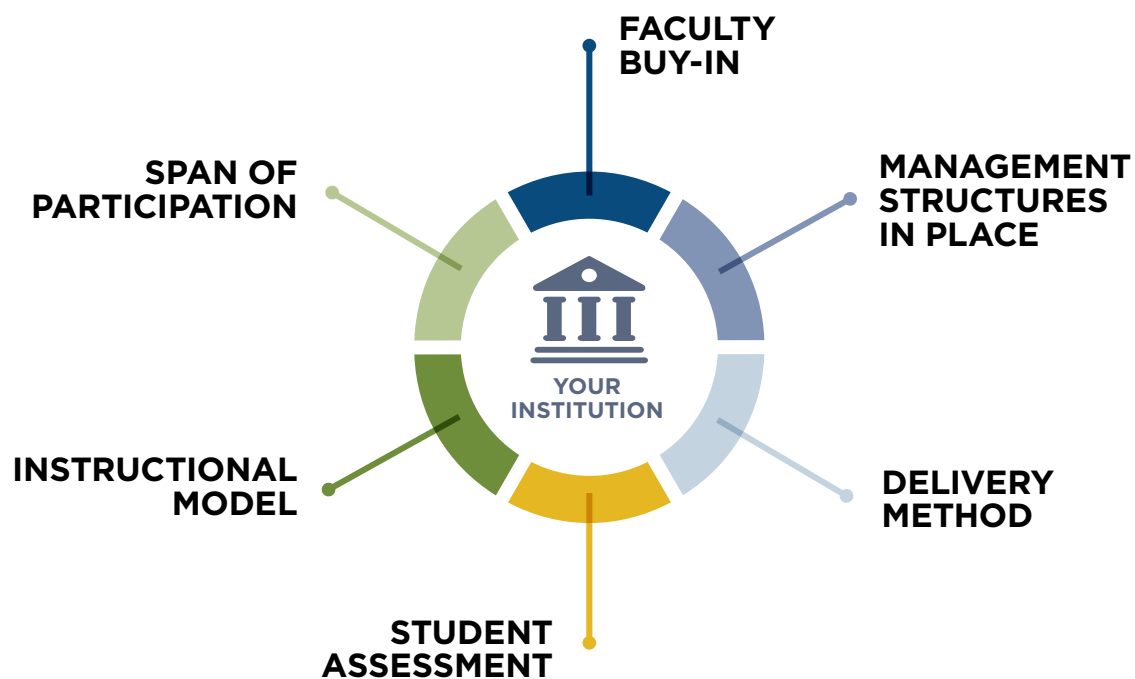
MATURITY OVERVIEW EXAMPLE SOLUTION



As institutional stakeholders progress through their review and evaluation process for adaptive learning solutions, the lenses of Approach, Taxonomy, and Maturity will provide a working set of frameworks within which they can make best-informed choices. In the following section, we offer an illustrative view of that process to jumpstart more nuanced adaptive learning conversations on college and university campuses.

A FRAMEWORK FOR INSTITUTIONAL DECISION-MAKING

The oft-cited mantra “Context is King” applies well to the adoption and implementation of adaptive learning for higher education institutions. As colleges and universities investigate adaptive learning, a thoughtful self-appraisal of key operating and instructional characteristics should shed light onto which approach might best align with the institutional milieu and improve chances for a successful implementation. The following graphic highlights six core areas on which decision-makers will want to review and reflect.



On the following page, we offer a series of detailed questions in each area that aim to reveal an institution’s decision-making character, ranging from “Autonomous” to “Collaborative” to “Highly Interdependent”. What distinguishes these categories from one another is the way in which authority is distributed within a given organization. Understanding which model of authority and decision-making predominates at your institution can assist you in considering how organizational complexity may open or foreclose certain types of adaptive learning approaches.

PLEASE CHOOSE THE RESPONSE THAT MOST CLOSELY MATCHES THE CONDITIONS FOR YOUR ADAPTIVE LEARNING INITIATIVE.

HOW MANY ORGANIZATIONAL UNITS OR FUNCTIONS WILL BE INVOLVED IN YOUR ADAPTIVE LEARNING INITIATIVE?

- A.** Just our unit - we have our own faculty and our own technology team so we'll handle this independently
- B.** The initiative will be a partnership between our unit and one or two others but we will be driving it
- C.** We're a very decentralized organization, so many units and functions will be involved

HOW DIFFICULT WILL IT BE TO ACHIEVE FACULTY BUY-IN TO COLLABORATE WITH YOU ON THE INITIATIVE?

- A.** We have our own faculty, most of whom are part-time, so we can drive the curriculum
- B.** We will want to involve one or two enthusiastic faculty and we'll collaborate with them closely
- C.** Faculty will play the lead role in designing the curriculum, sequencing, assessments, and we'll provide support

DO YOU HAVE THE RIGHT STRUCTURES IN PLACE TO MANAGE AN INITIATIVE OF THIS TYPE SUCCESSFULLY?

- A.** We have our own faculty and our own instructional designers and have done online learning for a long time, so we're in good shape
- B.** We outsource some of the design and delivery work to a commercial firm so we've learned how to collaborate with third-parties
- C.** Our faculty drive things here, so we may need to create some new services and management roles to support them effectively

HOW WILL THE INSTRUCTIONAL MODEL SHIFT IN DEPLOYING THESE SOLUTIONS?

- A.** Our initiative involves developing self-paced adaptive learning courses, so the faculty role in delivery is minimal
- B.** We see adaptive learning as creating new opportunities to deliver a "flipped classroom" form of instruction
- C.** Faculty will lead the courses and manage the classroom and use the adaptive learning material as an adjunct to that

WHAT TYPES OF STUDENT PERFORMANCE ASSESSMENT DO YOU PLAN TO UNDERTAKE IN THIS INITIATIVE?

- A.** We're open to experimenting - with competency-based assessment, portfolios - we'll probably try a few different things
- B.** We'll want to engage with faculty and see what they think about that question and design something appropriate from there
- C.** Our faculty are responsible for determining what counts as meaningful assessment and we'll use our traditional methods

WHAT TYPES OF DELIVERY METHODS ARE YOU PLANNING TO USE FOR YOUR INITIATIVE?

- A.** We're open to a variety of approaches - online and hybrid are both likely
- B.** We will predominantly deploy these as adjuncts to face-to-face classes, but we may experiment with hybrid as well
- C.** Our faculty aren't interested in online learning, so this will augment traditional classroom instruction

FOR EACH ANSWER, SHADE IN AN APPROPRIATE BOX AND COMPARE RESULTS ON THE NEXT PAGE.

AUTONOMOUS

A

A

A

A

A

A

COLLABORATIVE

B

B

B

B

B

B

HIGHLY INTERDEPENDENT

C

C

C

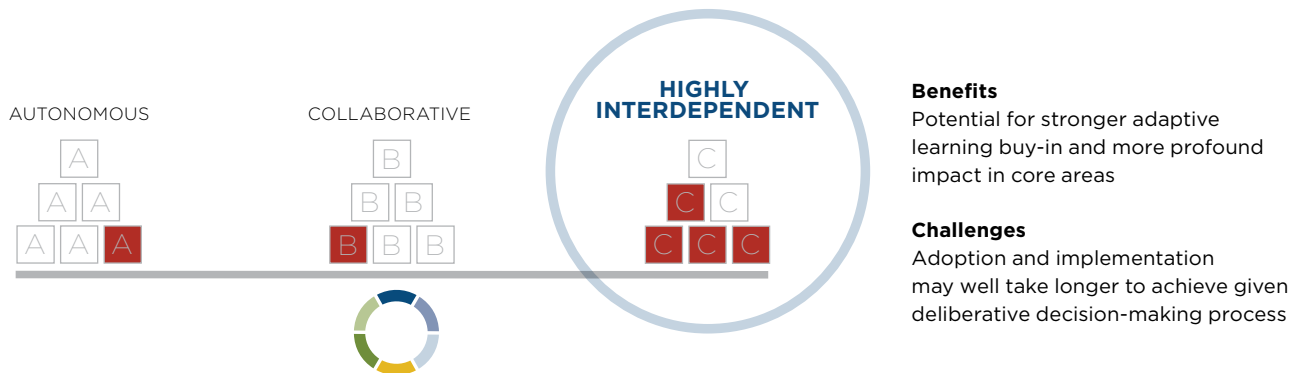
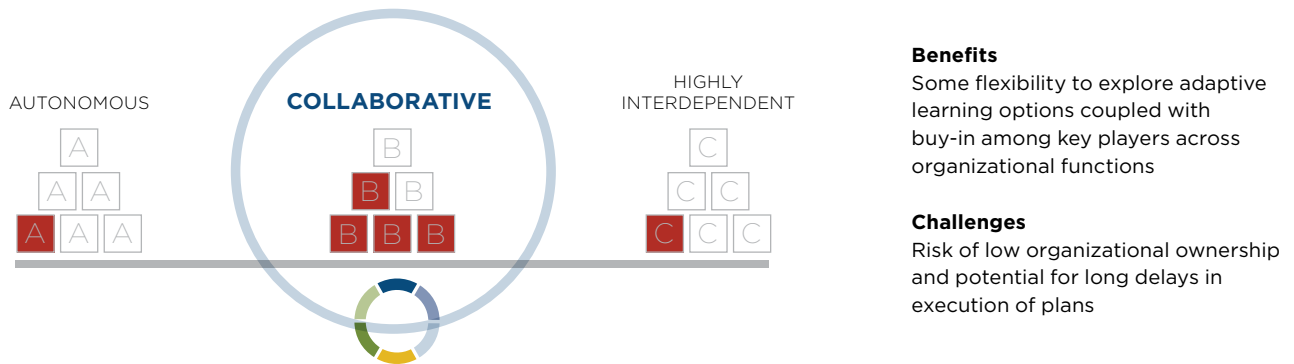
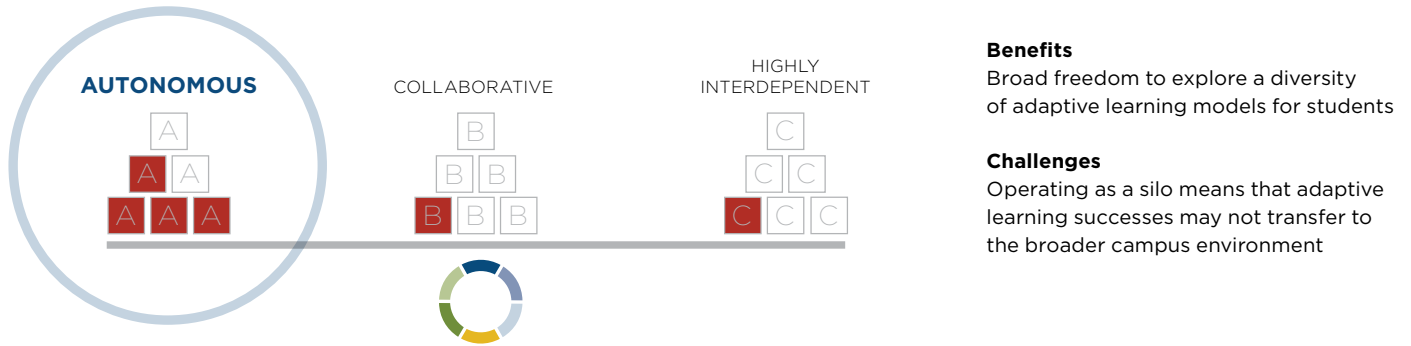
C

C

C

READING THE RESULTS

Based on responses to the prior questions, organizations will fall into one of three categories. Each scenario has its benefits and challenges, highlighted succinctly below.



This self-assessment exercise can be used to facilitate important discussions that can inform an institution's consideration of innovative teaching and learning models, such as adaptive learning, and make more productive the evaluation of prospective suppliers.

SNAPSHOTS OF ADAPTIVE LEARNING SUPPLIERS

Sourcing, evaluating, and selecting suppliers can be a challenging process for institutions, particularly in emergent markets with considerable hype and limited transparency into the range of available options. This dynamic certainly applies to the adaptive learning segment. Moreover, the nuance and differentiation across suppliers' solution models can quickly veer into highly technical discussions regarding the merits and interplay between rule-based and algorithm-driven systems, recommendation engine methods, and broader research- and evidence-based adaptive personalization strategies. In short, this confluence of factors and resulting confusion threatens to stifle the adaptive learning market's maturation.

The following profiles introduce eight suppliers to facilitate awareness of vendors in the adaptive learning landscape and their current offerings.¹ Companies and organizations profiled include:

- Adapt Courseware
- Cerego Global
- CogBooks
- Jones & Bartlett Learning
- LoudCloud
- McGraw-Hill Education (LearnSmart)
- Open Learning Initiative
- Smart Sparrow

These suppliers are *not* the only ones delivering adaptive learning solutions to colleges and universities today, nor does inclusion here imply endorsement. Instead, our goal in highlighting them is simply to accelerate consideration by institutions and instructors of this exciting category of academic technology tools and resources to improve student learning experiences and outcomes.

Our summary review and analysis offers insight into these suppliers in several areas, including:

- Company background, including brief history, business model and financing
- Adaptive product capabilities and positioning relative to the Taxonomy and Maturity attributes
- Most current outcomes evidence from institutional customers

1. Appendix A describes the process by which organizations were selected for inclusion and the sourcing of information for the profiles.

As noted, these suppliers should not be interpreted as the “best” or “leading” providers of adaptive learning solutions, nor do we intend to suggest any degree of prioritization or ranking among them in the subsequent profiles. In addition, our review of suppliers vis-à-vis the Taxonomy and Maturity lenses is not a comparative value assessment. Rather, this analysis is intended to help college and university stakeholders better understand distinctions between suppliers and to highlight the diversity of offerings available for context-specific institutional evaluation and implementation.

Each profiled supplier has active implementations of its solution; however, the higher education market remains an emergent one, and few suppliers have an extensive installed base today. The following table highlights the primary customer targets and use cases supported by the profiled suppliers’ adaptive solutions through January 2013. It is important to note that all organizations are actively targeting and/or supporting college and university pilots and adoptions as of January 2013.

SUPPLIER	PRIMARY CUSTOMER SEGMENT TO DATE*	TARGET USER	PRIMARY INSTRUCTIONAL APPLICATION	INSTALLED STUDENT BASE OF PRIMARY USE-CASE**
ADAPT COURSEWARE	<ul style="list-style-type: none"> Postsecondary 	<ul style="list-style-type: none"> Professors Students 	<ul style="list-style-type: none"> Whole course delivery 	<ul style="list-style-type: none"> Small
CEREGO GLOBAL	<ul style="list-style-type: none"> Corporate Consumer 	<ul style="list-style-type: none"> Executives and employees Individuals 	<ul style="list-style-type: none"> Practice aide Test prep 	<ul style="list-style-type: none"> Large
COGBOOKS	<ul style="list-style-type: none"> Corporate 	<ul style="list-style-type: none"> Trainers Knowledge workers 	<ul style="list-style-type: none"> Whole course delivery 	<ul style="list-style-type: none"> Small
JONES & BARTLETT LEARNING	<ul style="list-style-type: none"> Postsecondary 	<ul style="list-style-type: none"> Professors Students 	<ul style="list-style-type: none"> Homework tool Practice aide Test prep 	<ul style="list-style-type: none"> Small
LOUDCLOUD SYSTEMS	<ul style="list-style-type: none"> Postsecondary K-12 	<ul style="list-style-type: none"> Professors Teachers Students 	<ul style="list-style-type: none"> LMS eReader platform 	<ul style="list-style-type: none"> Small
MCGRAW-HILL EDUCATION (LEARNSMART)	<ul style="list-style-type: none"> Postsecondary 	<ul style="list-style-type: none"> Professors Students 	<ul style="list-style-type: none"> Homework tool Interactive labs Practice aide Test prep 	<ul style="list-style-type: none"> Large
OPEN LEARNING INITIATIVE	<ul style="list-style-type: none"> Postsecondary 	<ul style="list-style-type: none"> Professors Students 	<ul style="list-style-type: none"> Whole course delivery 	<ul style="list-style-type: none"> Moderate
SMART SPARROW	<ul style="list-style-type: none"> Postsecondary 	<ul style="list-style-type: none"> Professors Students 	<ul style="list-style-type: none"> Homework tool Interactive labs Simulations 	<ul style="list-style-type: none"> Small

* Represent primary customer segments as of January 2013

** “Small” = < 100,000 users; “Moderate” = 100,000 – 500,000 users; “Large” = > 500,000 users

This summary analysis represents a snapshot in time of suppliers' capabilities and market approach. The range of instructional applications and scale of customer base will change for these organizations across 2013, and all have significant market and product investments and outreach initiatives in place.

The overview of each supplier's commercially available adaptive learning solutions is current as of March 2013. Future solutions and/or enhancements may be referenced, but were not considered for the purposes of the Taxonomy and Maturity lenses highlighted in the supplier profiles. Additionally, each supplier has had the opportunity to review its profile to address issues of factual accuracy; the suppliers have approved the current profiles with minimal changes from those originally drafted by Tyton Partners.

PROFILE: ADAPT COURSEWARE



FOUNDING & FUNDING

2010

Adapt Courseware has completed two rounds of financing at an undisclosed amount. The Company also has a strategic partner supporting the multimedia development aspects of its courseware.

SOLUTION MODEL

Publisher - Emergent

WEBSITE

<http://adaptcourseware.com>

OVERVIEW

Adapt Courseware was founded in 2010 to develop online offerings based on a core set of empirical best-practice instructional design principles identified by members of the founding team. Within the Company's courseware, multimedia interactives are organized into "adaptive stacks," a collection of learning activities of varying degrees of difficulty supporting a specific learning objective, augmented by instructional video and text-based resources. The Company's courseware resides on an internally developed interaction, authoring, and analytics platform that integrates with an institution's existing LMS.

Adapt Courseware's methodology is grounded in multimedia design principles, mastery-learning techniques, student choice to support motivation and engagement, and social learning theory. The Company's courseware is informed by the concept of "optimal challenge," i.e., providing learners with instructional experiences right at the limit of their ability. The Company aims to provide an immersive, adaptive experience for students through alignment of these design principles with an optimal challenge environment for learners, which encourages collaboration, effective learning, and course completion.

Adapt Courseware is currently in the market with *Intro to Psychology*, which has been adopted by a still small, but diverse, array of institutions at the community college, four-year private, and for-profit levels. The Company anticipates that five courses will be available for institutional adoption by Fall 2013, including *Intro to Sociology*, *Organizational Behavior*, *Statistics*, and *Financial Accounting*, and three more by the 2013 calendar year-end. The Company has secured funding for a 22-course general education roadmap, which is also expected to include sufficient courses for an associates' degree in business.

BUSINESS MODEL

Currently, Adapt Courseware is licensing its courseware on a per-seat fee model at a level comparable to that of traditional textbooks. While the offerings have been developed for fully online delivery, some current clients are employing them in a blended learning model. The Company has also received interest from institutions regarding licensing the authoring platform on which the courses are built. Should the Company pursue this model, it would also build out dedicated training and support services to ensure that institutional clients have access to assistance with instructional design and content authoring activities.

ADAPTIVE CAPABILITIES OVERVIEW

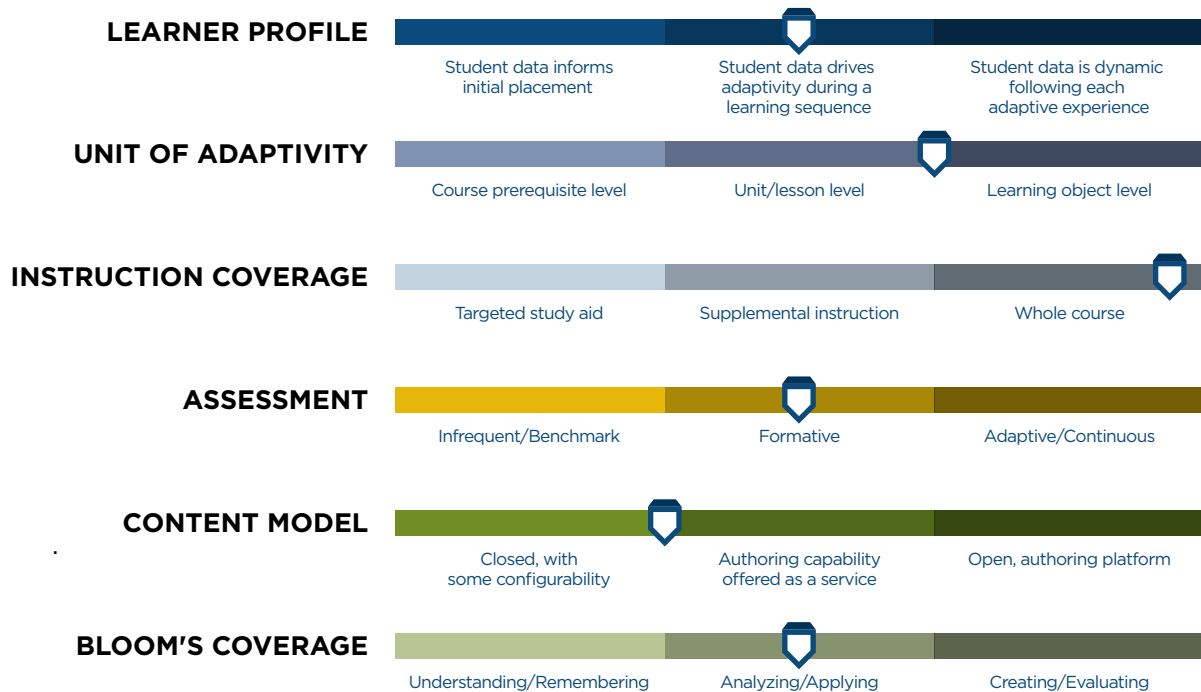
Adapt Courseware measures a student's mastery progress relative to a defined set of learning objectives. The Company's solution also captures behavioral attributes and metrics to understand at what level – and degree of success – students are engaged in the course materials and demonstrating mastery of the objectives. The Company invests considerable resources in developing its courseware, which include three instructional modalities – instructional videos, digital text, and multimedia interactives. Each modality contains complete course content coverage.

The primary adaptivity in the Company's solutions today resides within an Adaptive Stack, which represents an ordered set of learning interactives organized by learning topic/objective. For example, *Intro to Psychology* includes more than 200 learning topics; an Adaptive Stack exists for each discrete topic. Students are presented with learning interactives based on their success rate, ranging from fundamental, single concept activities to more complex, applied, and multi-concept ones. This design approach aims to optimize the challenge level for each student, facilitating a customized pathway for each. A rules-based engine provides different types of hints/feedback within the context of students' efforts and the "Mastery Meter" demonstrates the degree to which students can achieve higher performance levels.

To date, Adapt Courseware has focused on executing against a core design methodology that results in rich multimedia learning experiences and a simple adaptive approach. The analytics and algorithms underlying the Company's platform remain an area for continued investment and tuning to introduce more sophisticated adaptivity into the courseware.

The graphic below highlights Adapt Courseware’s solution capabilities across the six attributes in the Taxonomy framework.

ADAPT COURSEWARE’S ADAPTIVE TAXONOMY OVERVIEW



INSTRUCTOR RESOURCES

Adapt Courseware currently provides instructors with performance dashboards highlighting more than 20 behavioral metrics that can be viewed at a student or cohort/class level. This granular data - e.g., amount of time performing course activities, projected course completion timeframe, most common initial activity when entering a unit, average number of activities to master a concept - facilitates greater insight into an individual student’s performance trajectory and where/how instructors can intervene to provide additional scaffolding and support. The Company also provides learning object-level analytics to instructors, highlighting the number of attempts students require to demonstrate mastery - at a granular level - within the Adaptive Stacks, further supporting instructor-led interventions where gaps exist.

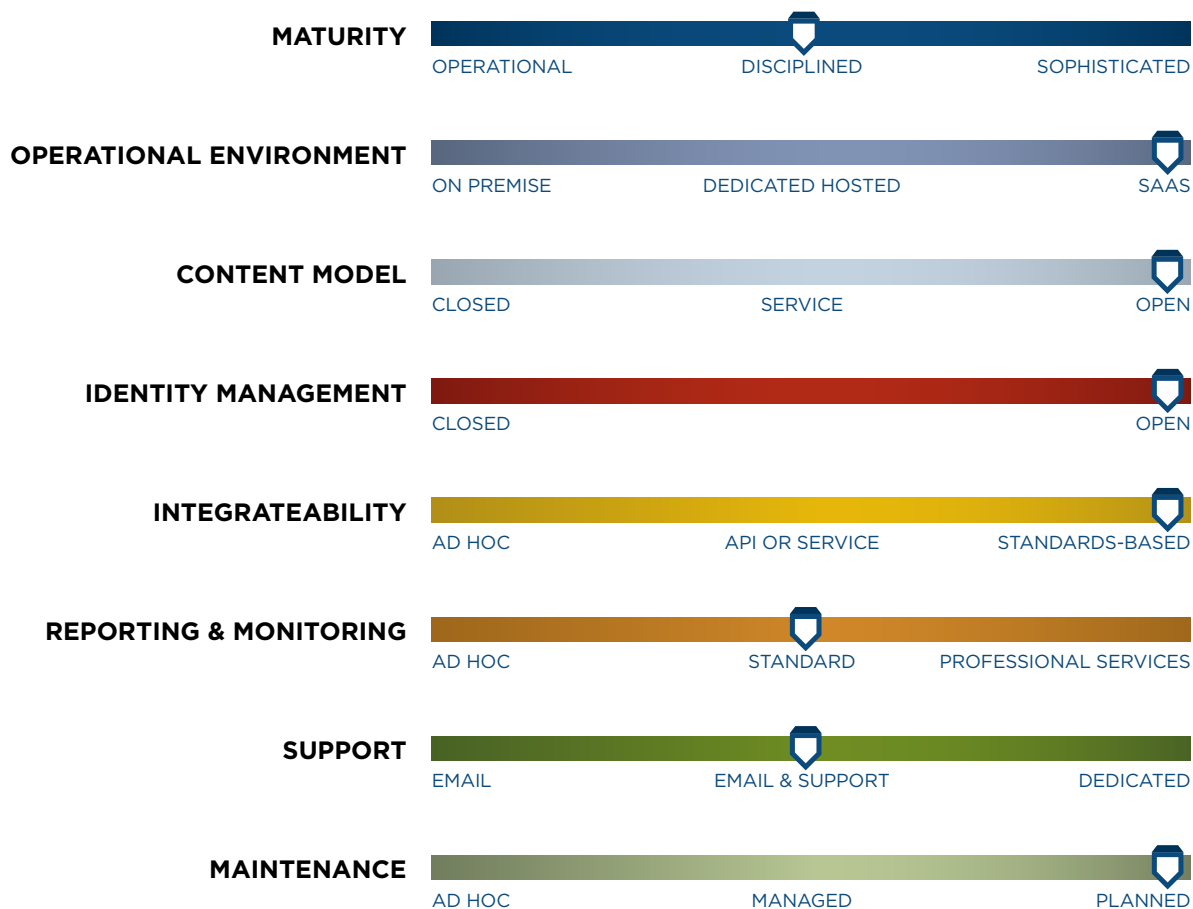
EVIDENCE OF OUTCOMES

Given the recent launch of its first offering, *Intro to Psychology*, Adapt Courseware has disclosed one semester (Fall 2012) of student performance data. This preliminary data, when compared to a comparable online program using more traditional instructional resources, suggested greater student satisfaction and stronger academic performance, along with higher course completion rates. The Company is currently conducting similar studies with five institutions during the Spring 2013 semester.

TECHNOLOGY MATURITY

The graphic and commentary below offer insight into core operational and technology attributes that an institution will need to understand relative to adoption of Adapt Courseware's solution. More specific descriptions of the options for each attribute are found in Appendix B.

ADAPT COURSEWARE'S MATURITY OVERVIEW



MATURITY & OPERATIONAL ENVIRONMENT

Adapt Courseware has developed and implemented a comprehensive suite of tools enabling its course assets to deliver a rich student and instructor experience. The Company's solution has been developed with postsecondary institutions as its primary customer base, and can be deployed independently or integrated into an institution's existing LMS.

CONTENT MODEL & INTEROPERABILITY

The content model is open, allowing instructors and instructional designers to create and/or import content, configuring the adaptive parameters within its publishing and content creation system. The current Flash-based approach restricts Adapt Courseware from playing in the iOS marketplace today, but the product roadmap does indicate plans to support this environment in the future.

The Company takes a standards-based approach to interoperability, delivering its integration to other elements via IMS-GLC Learning Tools Interoperability. The current implementations can be extended for deeper integration.

MONITORING, SUPPORT, & CHANGE CONTROL

Adapt Courseware's solution is delivered with availability guarantees to its customers based on the cloud service provider's service level agreements. This pass through is a common technique used in Software as a Solution businesses to ensure maximum elasticity for virtual hardware scaling and balancing operational costs while delivering an optimal customer experience. The solution offers industry-standard infrastructure monitoring, enabling integration of its monitoring activities into its support models. The solution has a mature maintenance and deployment model with planned delivery of updates across its client base.

cerego

FOUNDING & FUNDING

2000

Raised ~\$28 million over the past 12 years primarily from high net worth individual investors. In 2009, NTT, Japan's largest telecommunications company, became an investor in the Japanese subsidiary.

SOLUTION MODEL

Platform

WEBSITE

<http://cerego.com>

<http://ceregoenglish.com>

<http://iknow.jp>

OVERVIEW

Cerego has offices in Palo Alto, California, and Tokyo, Japan. Though content-agnostic by design, Cerego's initial commercial implementation was developed to support students and professionals seeking to improve their English language learning skills. The Company's cloud-based platform is composed of a proprietary learning engine, user databases, and an open content architecture that can be applied to any fact-based field of knowledge.

Cerego views itself as a "memory management platform" and its adaptive capabilities focus on individuals' ability to learn and retain information across an extended period of time. Development of the Company's cloud-based platform has been based on extensive research that identified memory as the key learning variable, with a particular emphasis on semantic memory, which allows learners to convert general information into personalized knowledge. Cerego has developed patented learning algorithms - with patents granted in the U.S., Japan, and Taiwan - that underpin its solution.

Cerego's system has been implemented primarily in the English language learning market in Japan, serving both corporate and individual consumer clients. Since the 2008 launch of its initial learning platform in Japan, Cerego has collected data from more than 1.1 million users who have completed a cumulative 3.7 million hours of studying using the system. The Company launched its U.S.-based initiatives in December 2012 at www.cerego.com; executives report plans to target general consumers with an open learning platform as well as supplemental instructional service opportunities within the MOOC ecosystem, in addition to delivery through more traditional ground-based institutions.

BUSINESS MODEL

In its Japanese English language learning business, Cerego employs a subscription model targeting both individuals and corporate customers. Individual consumers can access the Company's iKnow! platform and courses for subscription terms of 1, 6, or 12 months. Corporate customers, including leading Japanese firms Rakuten, Softbank, and NTT, sign annual contracts to offer English language learning courses to a range of employees.

With the December 2012 launch of its consumer-oriented Cerego.com site, the Company plans to pursue a freemium model. Users will have access to the platform and freely available content; for a monthly subscription fee, users will gain access to premium features and content specific to individual domains/subject areas. Cerego also anticipates pursuing revenue-generating content and distribution partnerships, as well as institutional relationships (i.e., K-12, postsecondary, government), enabling the development of purpose-built sites for learning and training use.

The Company also plans to license its proprietary memory management system to developers by providing access to core APIs, creating monetization opportunities for itself as well as for third-party developers who co-create new learning applications.

ADAPTIVE CAPABILITIES OVERVIEW

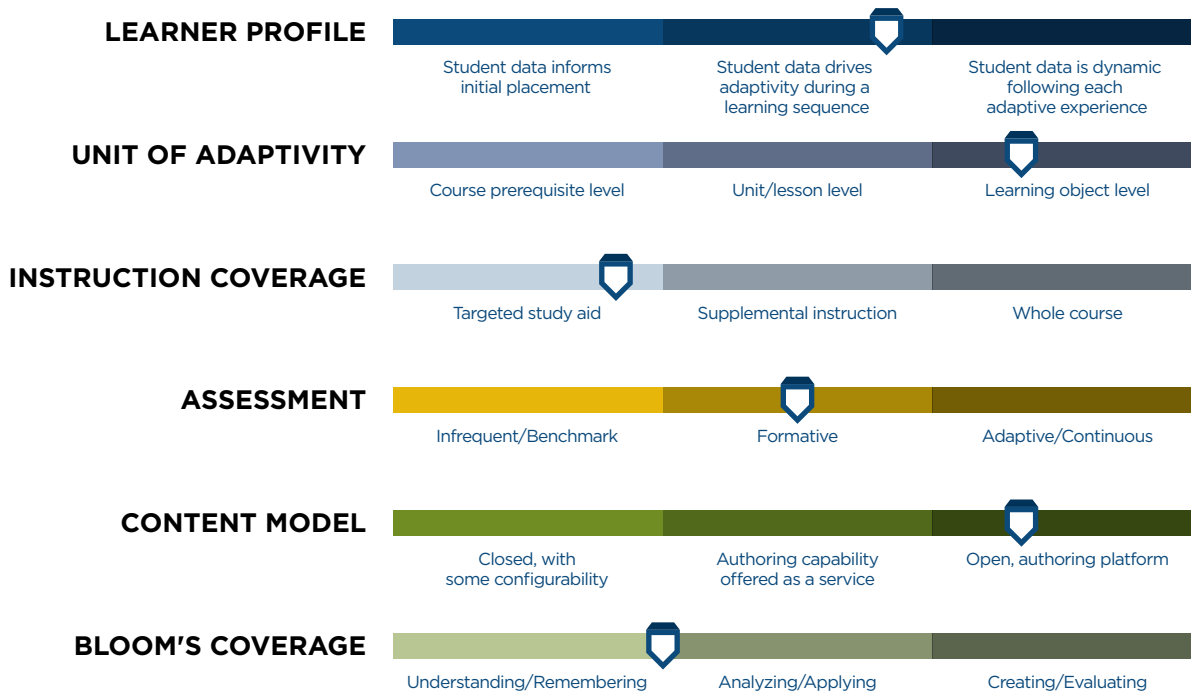
Cerego seeks to establish foundational fluency for learners and applies adaptivity and personalization to measure and effect memory acquisition. The underlying algorithms of Cerego's platform decide which items (i.e., general information) should be presented to users over the duration of their learning experience and calculates the optimal moments to review these items to convert them to retained knowledge. Cerego seeks to create a more efficient learning process, one in which the process of review is not left to chance.

The Cerego platform creates an evolving profile of an individual's memory strengths for any piece of information encountered within the system. The platform tracks memory strength and decay on an item-by-item basis, providing learners and instructors with a highly granular view of performance and insight into individual "learning and forgetting" patterns. The solution enables time-based learning models whereby a personalized learning pathway is established based on an individual's profile, memory map, and time required to demonstrate information fluency.

Cerego's solution has an open content architecture and authoring environment that allows for importation of third-party publisher and user-generated content. All content brought into the system utilizes the Company's underlying adaptive technologies with no specific requirements or responsibilities for the developer. While anyone can create adaptive learning resources on the platform, Cerego anticipates working with some established content providers to showcase the solution's capabilities to drive demand and adoption in 2013. The Company also plans to open the platform's APIs to let other organizations and individuals build and connect applications that leverage the Cerego system.

The graphic below highlights Cerego’s platform capabilities across the six attributes in the Taxonomy framework.

CEREGO'S ADAPTIVE TAXONOMY OVERVIEW



INSTRUCTOR RESOURCES

Cerego’s open content architecture and diverse content sources facilitate individual and/or collaborative development of course-specific adaptive learning resources among professors and instructors. From a tracking and reporting perspective, the system offers instructors a “Memory Bank” visualization that details a learner’s evolving memory profile at any point in time; instructors gain insight into what learners have mastered – and the strength of that mastery at an item-specific level – rather than simply having a point-in-time assessment measure.

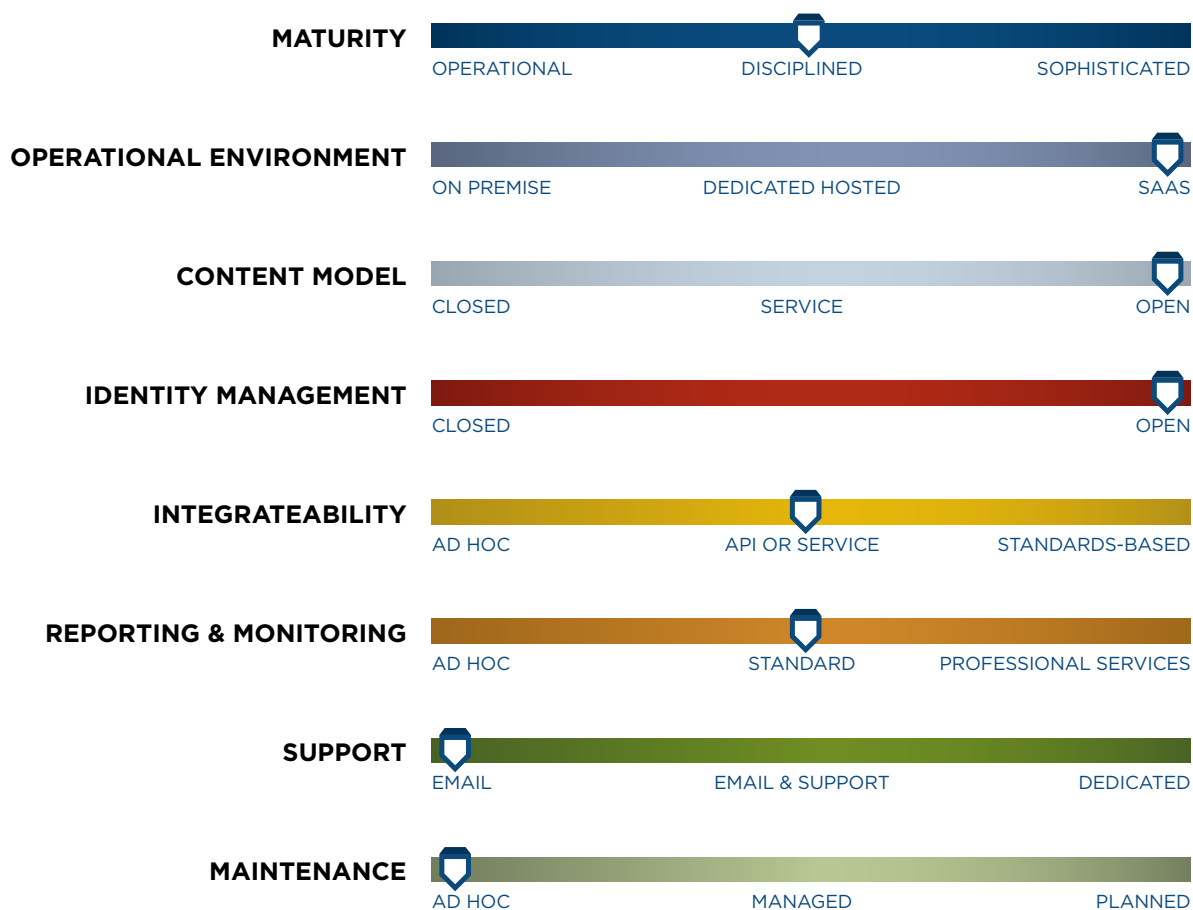
EVIDENCE OF OUTCOMES

Cerego has commissioned researchers from the University of Hawaii’s Laboratory for Interactive Learning Technology to evaluate the effectiveness of its iKnow! learning platform. Historically, in Cerego’s English language learning business, the measure of success has been individuals’ performance on the TOEIC exam. The Company also works with researchers in learning and cognition, including scientists at NYU and CUNY, to assess and improve product efficacy. More recently, the Company has added a new head of research to its team in Japan who is responsible for drafting and executing long-term efficacy studies. The Company has also authored white papers of its own and makes these materials available to prospective customers on a selective basis.

TECHNOLOGY MATURITY

The graphic and commentary below offer insight into core operational and technology attributes that an institution will need to understand relative to adoption of Cerego’s platform. More specific descriptions of the options for each attribute are found in Appendix B.

CEREGO’S MATURITY OVERVIEW



MATURITY & OPERATIONAL ENVIRONMENT

From a technical competency perspective, Cerego has developed a solution predicated on delivery of its technology to myriad devices. The solution, while not confined to a university delivery model, must factor in an “always on” model. This delivery requires a degree of operational maturity that is not governed by a specific service level agreement (SLA), but rather by the ongoing subscription to and availability of its service.

CONTENT MODEL & INTEROPERABILITY

Cerego has built an open content model that enables learners and administrative staff to add or modify content without degradation of the Company’s adaptive model. The security model is largely confined to operating within the domain of the Cerego network. It is based on an accepted standard and is relatively simple, but not readily scalable to the access and authorization requirements of many colleges and universities. This approach may have been influenced by the Company’s initial emphasis on a consumer-oriented adoption model, as opposed to a proxy buyer such as a college or university.

Cerego has not developed its solution to aggregate data up the value chain from student, teacher/professor, to administrator. Based on the technologies selected for creating the solution, extending the product suite to support additional models would be technically straightforward.

MONITORING, SUPPORT, & CHANGE CONTROL

Cerego generally represents a direct-to-consumer approach and this operational driver informs the Company’s approach to monitoring and change control. The support model associated with this business and delivery model is, with few exceptions, a level-one support model consisting of issue resolution via email.

CogBooks™

FOUNDING & FUNDING

2007

Primarily self-funded through 2012, the Company recently closed its first round of funding to support expansion in the U.S. higher education market.

SOLUTION MODEL

Platform

WEBSITE

www.cogbooks.com

OVERVIEW

CogBooks is a small and growing company run by former Silicon Valley entrepreneurs, now based in Scotland. The Company aims to help institutions to deliver high-quality learning experiences for online learners at scale through its core product, a cloud-based learning platform. This platform helps people learn more in less time and delivers personalized support, by intelligently assessing learners' needs and delivering instructional resources and assessment in the optimum sequence and speed for an individual.

CogBooks stresses the application of learning/cognitive sciences research in the development of its product, and has based the models used for its adaptive algorithms on published research. The specific combination of models is proprietary, but includes elements related to prerequisite sequencing, retention, cognitive load and attention, and level of engagement, among others. The approach used is intended to support large-scale delivery of integrated curricula.

CogBooks' solution has been implemented primarily in the corporate training market to date, and the learning products/courses developed on the platform are used in a range of Fortune 500 companies in the U.S. and U.K. The Company launched a number of pilots in the U.S. postsecondary market in 2012 and anticipates expanding its presence in this space in 2013.

BUSINESS MODEL

CogBooks currently supports two distinct revenue models. In the corporate learning market, CogBooks partners with organizations that deliver training products into enterprise accounts. CogBooks licenses its adaptive learning platform to its partners, supporting their ability to develop courseware and programs that leverage personalized learning pathways. In this model, CogBooks receives licensing fees as a percentage of revenue generated by its partners based on their use of the Company's platform.

More recently, CogBooks has begun to license its platform directly to postsecondary institutions and corporate clients as a self-service platform for authoring and delivery of adaptive courses by the institution. While still early in its pursuit of these opportunities, the Company offers an annual licensing fee based on institutional size or on a per-user basis, as well as fees for related development and professional services supporting implementation and launch.

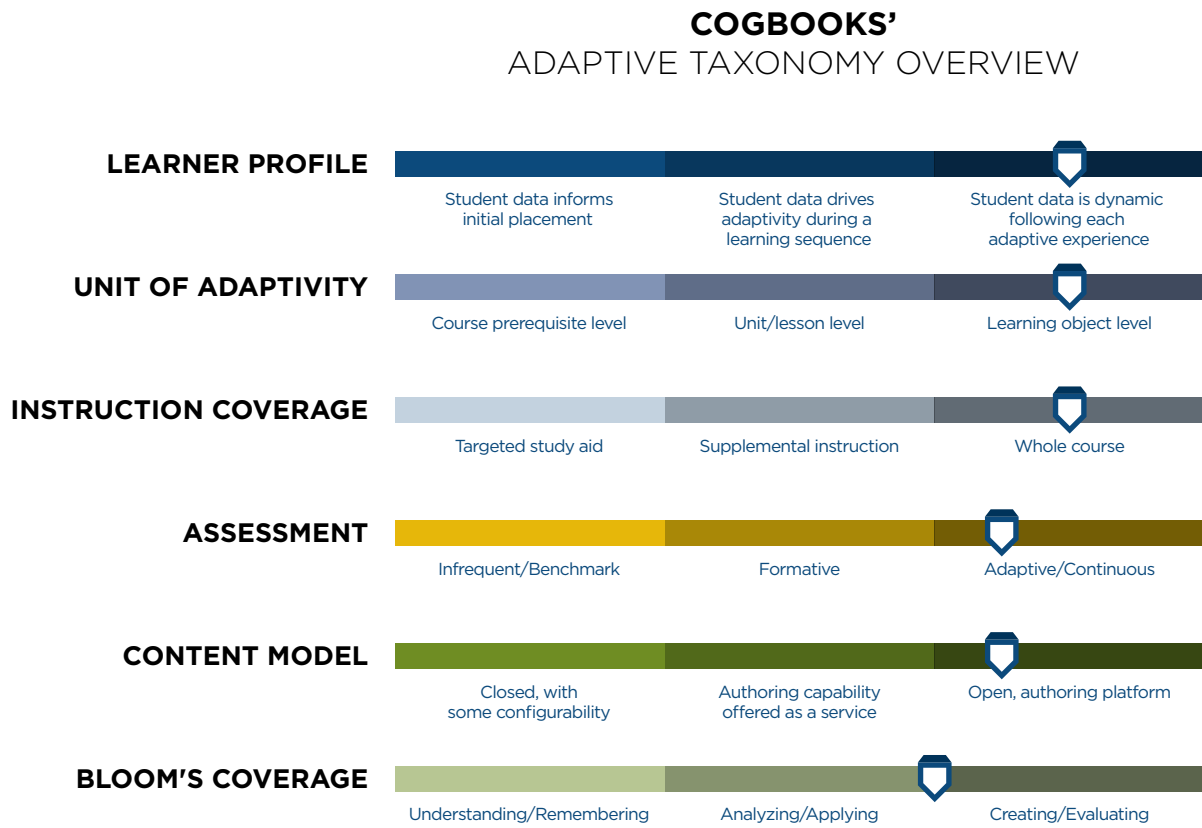
ADAPTIVE CAPABILITIES OVERVIEW

The learning theory applied to the CogBooks platform draws on the concept of prerequisites married with repetition, which is needed to achieve retention. The CogBooks platform initially manually structures the relationships between learning activities to create a network of relationships and selects a default path for student learning; if students encounter difficulty, they are provided a different path. CogBooks has developed an 18-parameter learner profile and instructional content algorithm that enables dynamic adjustment of the learning sequence and experience for individual students.

CogBooks' solution is an "open" platform in that it is used as an authoring environment for the development of adaptive courseware and content across a diverse range of disciplines and subject areas. It supports content created within the platform, developed in third-party systems, and open-source resources from the web. Typically, CogBooks' instructional designers – both dedicated staff and contractors – will work with subject-matter experts to create adaptive content for the platform for the first client project.

Courses on the CogBooks platform are wholly and dynamically adaptive. The learner's path is remapped after each screen, in response to the learner's most current profile. Course authors/instructors are provided a high level of configurability of the learner experience, a flexibility that enables them to control whether learners can navigate freely through content (e.g., as a revision aid) or follow a more fixed sequence through certain mandatory activities (for example, online learning as part of a time-tabled course). The platform also provides seamless integration of learning across courses, which allows learners to get the specific help they need, even if from another knowledge domain. This allows the platform to support competency-driven progression through courses in large-scale curricula.

The graphic below highlights CogBooks' platform capabilities across the six attributes in the Taxonomy framework.



INSTRUCTOR RESOURCES

Instructors can create and edit content, learning relationships, and course sequences. The platform's detailed content and assessments reporting enables instructors to identify potential issues and make adjustments and/or enhancements to the material and sequencing on an ongoing basis. Reporting at the class level allows instructors to identify general issues across an entire cohort. At the learner level, reporting provides insight into performance, as well as the status/tracking of every learner action/interaction, enabling a high degree of granularity for evaluating individual learner characteristics.

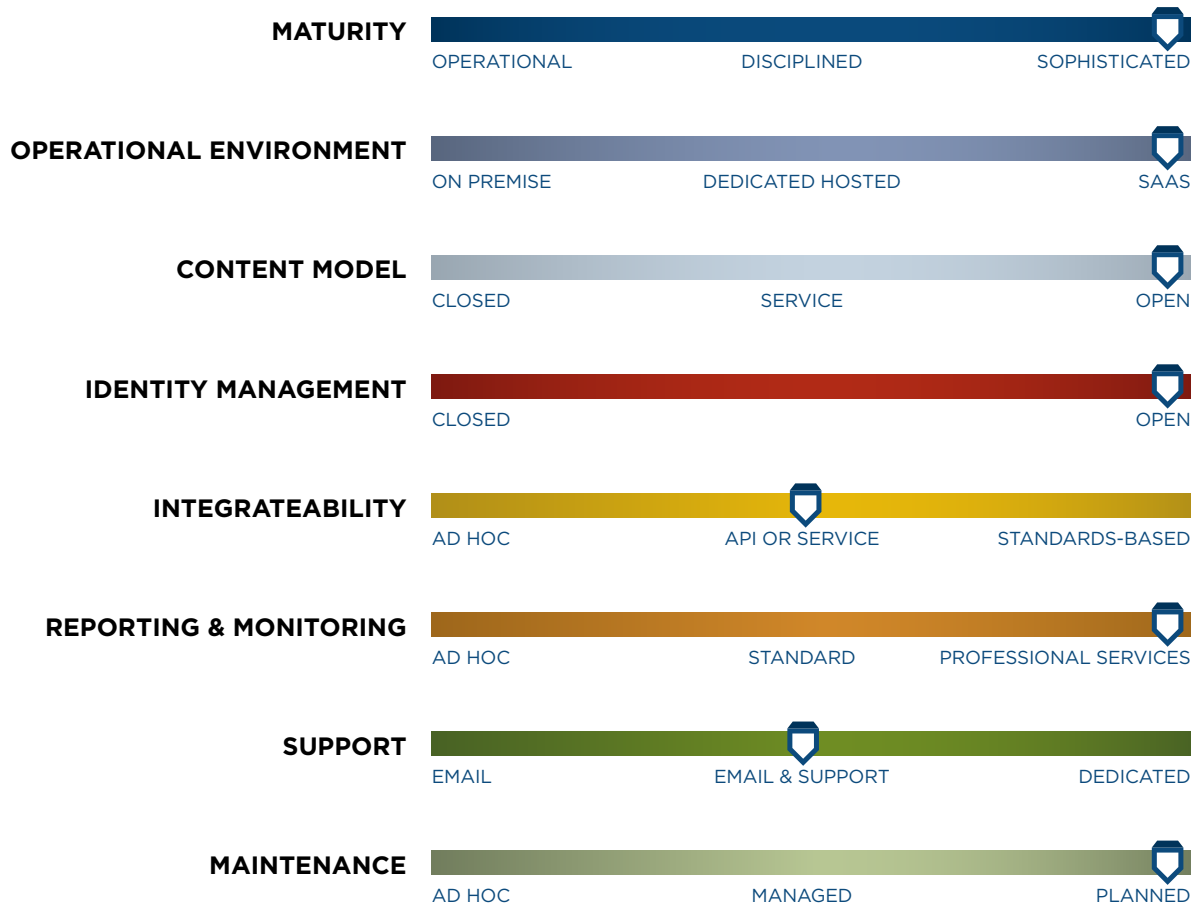
EVIDENCE OF OUTCOMES

CogBooks has been successfully implemented in corporate learning environments since 2007. As of December 2012, CogBooks does not have any current clients or outcomes evidence to share in formal postsecondary education applications. The Company is working with researchers from Cambridge University on a multi-year study in which the CogBooks system is being used to teach science to U.K. high schools students; results from this initiative are not yet available.

TECHNOLOGY MATURITY

The graphic and commentary below offer insight into core operational and technology attributes that an institution will need to understand relative to adoption of CogBooks' platform. More specific descriptions of the options for each attribute are found in Appendix B.

COGBOOKS' MATURITY OVERVIEW



MATURITY & OPERATIONAL ENVIRONMENT

CogBooks represents a mature and full-featured adaptive learning solution that has been deployed across several different operational models both in the U.S. and internationally. The Company's solution can be delivered as a stand-alone product or integrated into an institutional or corporate LMS.

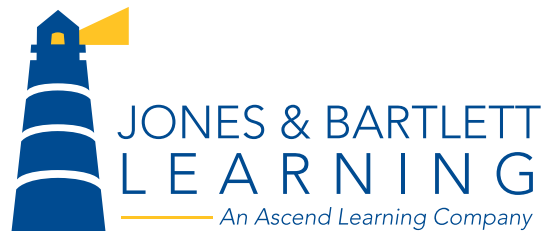
CONTENT MODEL & INTEROPERABILITY

The CogBooks platform provides an open adaptive engine as well as integrated analytics. Learning objects can be created outside the system but may require configuration within it to support data collection within the adaptive engine. At the most basic level, the system integrates with SCORM-compliant LMS out-of-the box. For more advanced integration requirements, the platform has an added standards-based integration bus that aims to simplify integration with third-party systems.

MONITORING, SUPPORT, & CHANGE CONTROL

The Company offers a mature support option including both level-one email support and level-two help desk/technical support for users and stakeholders. Maintenance is a controlled and managed activity resulting in predictable support and service levels.

PROFILE: JONES & BARTLETT LEARNING



FOUNDING & FUNDING

1983

Jones & Bartlett Learning (“J&B Learning”) is a division of Ascend Learning, a portfolio company of Providence Equity. J&B Learning was founded in 1983 and was acquired by Ascend Learning in 2010.

SOLUTION MODEL

Publisher - Established

WEBSITE

www.Jblearning.com

OVERVIEW

Jones & Bartlett Learning (“J&B Learning”) is a leading provider of instructional, assessment, and related solutions for the secondary, postsecondary, and professional markets. The Company’s content and course offerings are primarily focused in vocational segments including electrical trades; EMS, fire, and safety; health sciences; and nursing, among others. J&B Learning’s personalized learning capabilities originated from its acquisition of the adaptive technology platform capabilities of PrepMe in July 2011.

J&B Learning has seeded the PrepMe adaptive capabilities across several current solution categories and models including:

- **PAL**, a direct-to-student study product that aids learners in developing subject matter mastery
- **Navigate Course** and **Test Prep Products**, which contain adaptive learning, personalized remediation, and reporting within the Company’s course and test prep products
- **eLearnics**, a web-based institutional/enterprise offering that integrates with a school’s LMS or SIS to facilitate campus-wide adaptive learning, custom remediation, and advanced dashboard analytics

Currently, J&B Learning’s adaptive learning capabilities primarily support the Company’s existing textbook and courseware programs. In the student-focused PAL model, the adaptive capabilities were initially deployed in the computer science and astronomy disciplines; they are now available within all of the discipline areas where the Company sells Navigate courses. In the Navigate offering, adaptivity is an attribute embedded across many disciplines and products. The Company anticipates staying focused on applying its capabilities to vocational areas that have good enrollment and job-growth prospects.

BUSINESS MODEL

J&B Learning's adaptive solution is generally priced on a per-user basis, depending on the implementation model. The stand-alone PAL product is sold to students for an individual student fee. Within the Navigate courseware model, institutions adopt the package – inclusive of textbook, digital courseware, labs, PAL, etc. – for a per-student fee, of which the adaptive solution (i.e., PAL) is a component of the overall price. Finally, the eLearner offering is priced as a per-student licensing fee for institutions.

ADAPTIVE CAPABILITIES OVERVIEW

J&B Learning's solution establishes an individual pathway for each learner with recommendations stemming from PAL's various adaptive learning domains and continually adapts to maximize the learner's experience. These domain sets – noted below – work together to calibrate an individual's learning by determining what content to present in what order, what type/format, what frequency, what amount, and at what time, drawing on the following data sets of information:

- The **Hierarchical Domain** specifies the learning objectives for a course and the linear relationships between these objectives. Learners using the PAL solution are presented with learning content that aligns with objectives in a predetermined, hierarchical manner.
- The **Learning Profile Domain** stores information on learners' preexisting knowledge and skills that is obtained through comprehensive diagnostic pre-assessments and is continuously updated as learners advance through the system.
- The **Data Domain** tracks other events related to engagement, such as when a learner interacts with the system, whether or not he has viewed specific content, or whether or not he has completed an assignment. The information steers the adaptation toward the learning goal of demonstrating proficiency.
- The **Goal Domain** is composed of proficiency goals for each objective. The system determines whether a learner surpasses these goals or should be required to complete additional remediation.
- The **Adaptation Domain** consists of a series of "if...then" rules. For example, if a learner meets the proficiency threshold for an objective then he is marked as proficient on this objective. If he does not meet the proficiency threshold for the objective, then he is assigned additional remediation. Remediation content is always slightly above a learner's proficiency level to stimulate engagement and optimally support learning.

The system's proficiency computation uses differential weights that take the types of content presented and mastered by the student in a remediation cycle into account to obtain an accurate estimate of a user's proficiency level.

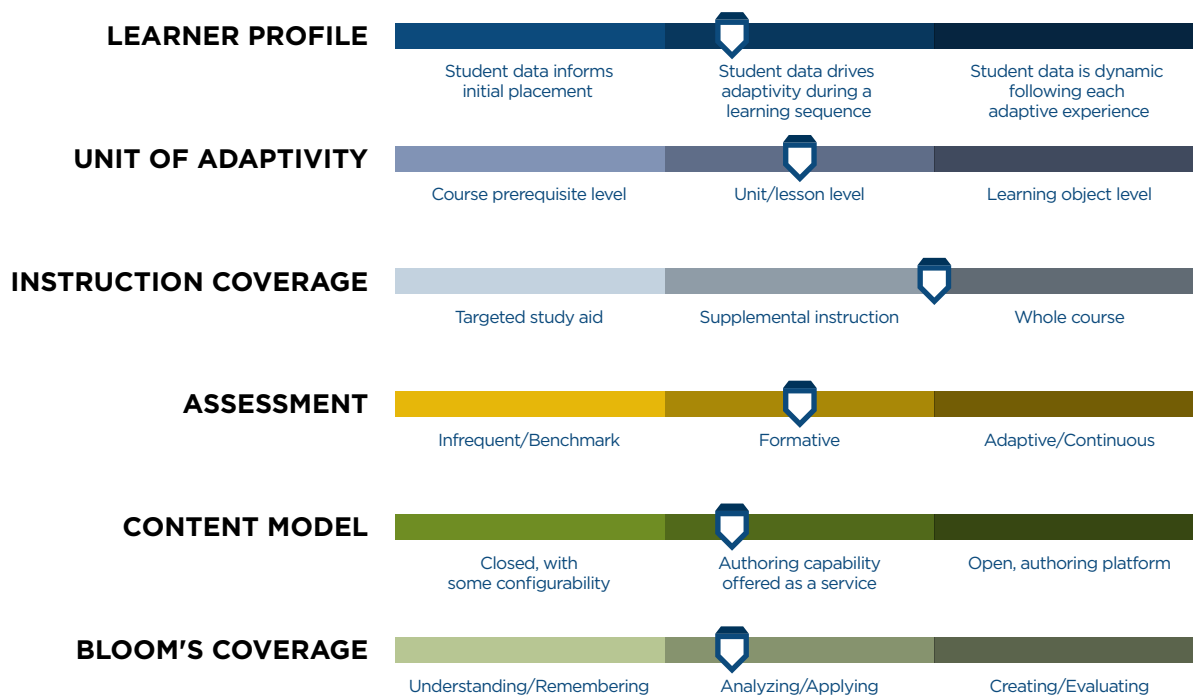
The Company’s adaptive learning solution is provided in three product formats and services:

- Stand-alone student study product (i.e., PAL)
- Adaptive learning features within hosted Navigate Course and Navigate Test Prep products
- Enterprise-wide adaptive learning web-service platform integrated into an institution’s existing LMS and SIS systems

In each case, the learner is prompted to study at various intervals by launching the adaptive learning features and study environment. Once within the Company’s adaptive learning environment, individuals can choose one of four study modes: personalized study plan, custom practice tests, full-length practice tests, or search for activities.

The graphic below highlights J&B Learning’s solution capabilities across the six attributes in the Taxonomy framework.

J&B LEARNING’S ADAPTIVE TAXONOMY OVERVIEW



INSTRUCTOR RESOURCES

Professors and instructors have access to a host of reporting functions and dashboards providing perspectives that range from course- and cohort-level analytics down to individual learner performance profiles. Based on reviewing class and/or individual performance, instructors can generate targeted assessment activities for learners to reinforce and/or remediate gaps. J&B Learning's system also facilitates targeted and/or broadcast communications to learners.

J&B Learning's adaptive learning feature has a WYSIWYG editor that allows schools - and instructors - to assemble their own adaptive learning program. The Company also provides instructional design services to facilitate institutions and instructors' ability to draft and build well-mapped adaptive programs and related instructional resources.

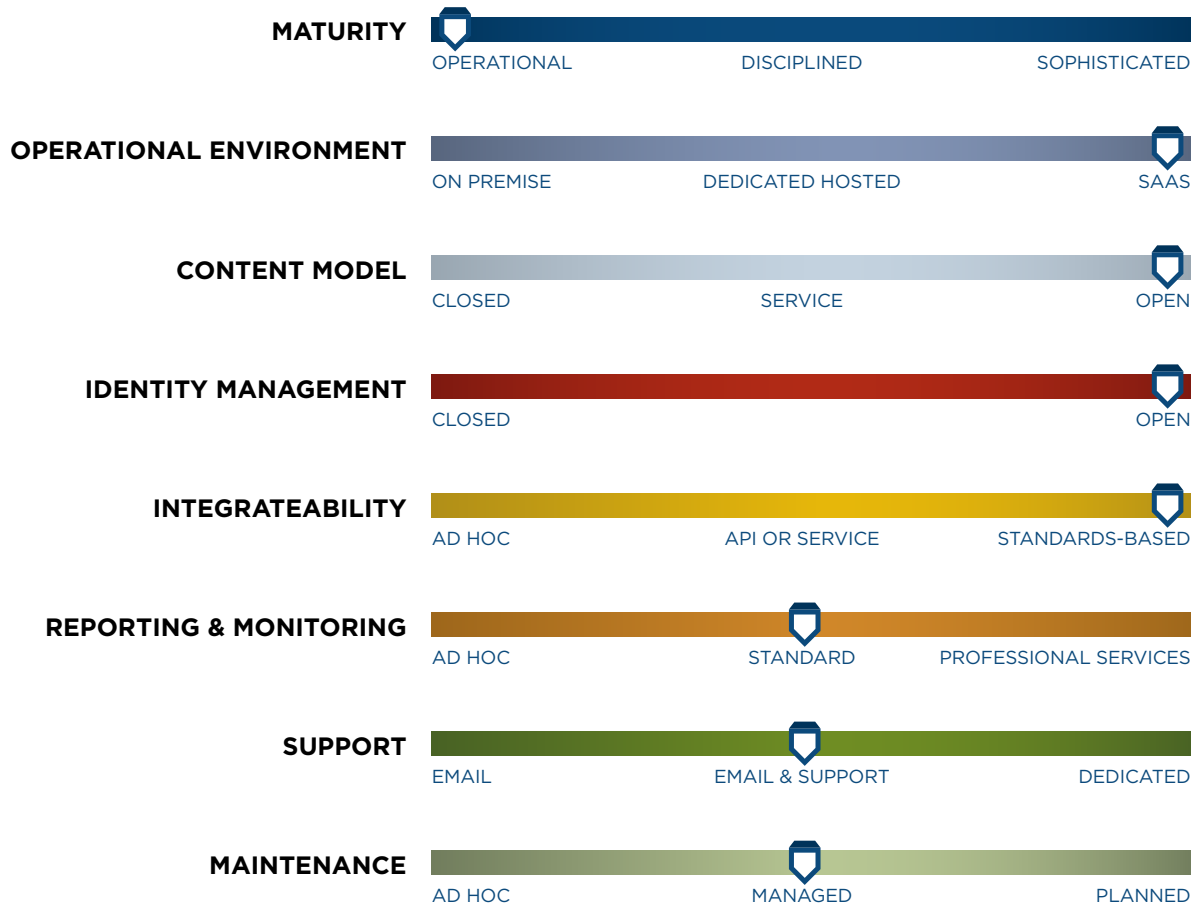
EVIDENCE OF OUTCOMES

J&B Learning is actively working to perform research on outcomes and efficacy but, given the relatively recent launch of its adaptive offerings, is in the beginning stages of those efforts. The Company did acknowledge one large confidential pilot running at a for-profit postsecondary institution supporting several thousand student users per month across two disciplines.

TECHNOLOGY MATURITY

The graphic and commentary below offer insight into core operational and technology attributes that an institution will need to understand relative to adoption of J&B Learning’s solution. More specific descriptions of the options for each attribute are found in Appendix B.

J&B LEARNING’S MATURITY OVERVIEW



MATURITY & OPERATIONAL ENVIRONMENT

J&B Learning has a nascent adaptive offering that has been developed based on its PrepMe acquisition. The Company has made astute product operationalization decisions relative to its technology selections and deployment models.

CONTENT MODEL & INTEROPERABILITY

J&B Learning has adopted an open content model that enables professors and instructors to incorporate content from diverse sources. The solution also offers a tightly-coupled publishing model designed to leverage the enhanced adaptivity of Company-developed content. Additionally, the solution uses IMS-Global's LTI standard for integration into the campus education ecosystem, but currently the Company has focused on integrating the solution into offerings within its own portfolio.

MONITORING, SUPPORT, & CHANGE CONTROL

The PAL model of J&B Learning's adaptive solution offers a direct-to-student model that could produce uneven support demands. However, the Company appears to have made infrastructure decisions that enable a high degree of elasticity to scale to customer demand without changing its infrastructure or development operations.

The platform provides comprehensive reporting and monitoring. J&B Learning provides both level-one email support and level-two help desk/technical support. Service Level Agreements are negotiated in conjunction with institutional adoptions. The Company has also indicated implementation of a mature managed and proactively-executed maintenance and uptime strategy.

PROFILE: LOUDCLOUD SYSTEMS



FOUNDING & FUNDING

2010

LoudCloud has raised \$11 million in equity financing over two rounds of funding.

SOLUTION MODEL

Platform

WEBSITE

www.loudcloudsystems.com

OVERVIEW

LoudCloud Systems (“LoudCloud”) is an entrepreneurial technology and services company started by an executive with extensive experience developing instructional software and learning simulations for education institution and corporate customers. The Company’s initial offering was an LMS paired with a robust analytics module – now called “LoudSight™” – with access to hundreds of data points drawn from major institutional systems (e.g., LMS, SIS, Financial Aid) that enabled institutions and instructors to apply findings directly back into the instructional arena. Today, LoudCloud’s higher education solution is a “learning ecosystem” centered on a learning platform and surrounded by more than 10 distinct modules, including class management, collaborative learning, e-portfolio, and grade book, as well as related deployment, support, and customization services.

The adaptive components in the LoudCloud ecosystem currently reside in two modules. The Company’s e-reader platform, LoudBooks™, includes an adaptive reader technology (ART) that delivers varied content-based learning resources to students. The other module, LoudSight™, draws on learner behavioral data captured through various institutional systems and platforms to deliver predictive analytics and recommendations to instructors and administrators.

LoudCloud targets senior academic and instructional leaders among both higher education and K-12 institutional customers, with a selected number of active engagements today.

BUSINESS MODEL

LoudCloud employs a software license model based on student FTEs as well as a hosted, software as a service subscription model, both in conjunction with varying levels of hosting/deployment, professional services, and customization fees. From a software licensing/subscription perspective, LoudCloud's ecosystem is composed of a series of disaggregated modules, allowing institutions to adopt the fully integrated suite or simply one or two modules to sit within their existing learning platform environment. As a result of this flexibility, the Company takes a customized approach to addressing institutional needs and offers a strong services orientation.

ADAPTIVE CAPABILITIES OVERVIEW

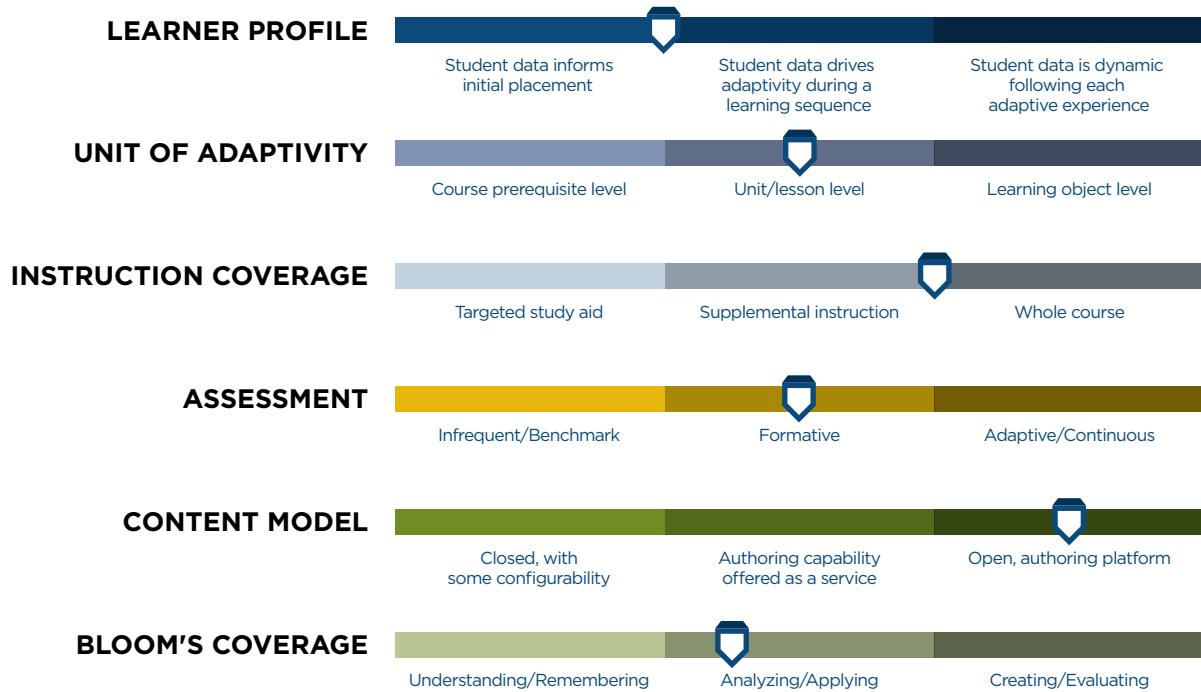
Adaptivity in LoudCloud's solution ecosystem lies primarily in its LoudBooks™ e-reader platform and the application of its LoudSight™ module. Both solutions are still early in their product lifecycle; as such, the breadth and depth of adaptivity continues to evolve as the Company executes against its product roadmap.

LoudBooks™ includes an Adaptive Reader Technology (ART) designed to allow students access to relevant content beyond the core instructional materials in a seamless, integrated fashion. The platform auto parses and extracts keywords – moderated by the instructor or institution – and performs both lexical and semantic analysis to identify complementary, auxiliary resources (e.g., publicly available materials, subscription services the institution has licensed). These resources – which can be text, video, or audio – are brought into the “margin” of the e-reader platform as hyperlinks and ranked based on relevance. These auxiliary resources change dynamically as new, more relevant ones become available. Complementing this dynamic rendering is LoudSight™, an analytical engine that continuously evaluates and classifies learner behavior to facilitate delivery of personalized content based on known learner types.

LoudSight™ is intended to be deployed as a customized dashboard that enables faculty and administrators to differentiate instruction and feedback to students. The system is set up in conjunction with institutional customers, who identify key success parameters for students, instructors, and the institution; once implemented, the system tests the institutional hypotheses regarding which parameters matter most based on the capture and analysis of hundreds of data points. Detailed reporting is available to instructors who can then compare student learning behaviors and performance to course expectations, peer students, and historical student cohorts. The reports can be configured for delivery via a variety of formats, including as push alerts based on pre-determined thresholds. Increasingly, LoudCloud anticipates helping institutions shift from comparative to predictive analysis in their use of the system – i.e., forecasting at-risk behaviors and concerns – and facilitating instructors' ability to adapt to individual students' pathways and experiences.

The graphic below highlights LoudCloud’s platform capabilities across the six attributes in the Taxonomy framework.

LOUDCLOUD’S ADAPTIVE TAXONOMY OVERVIEW



INSTRUCTOR RESOURCES

LoudCloud offers instructors a variety of tools: e-readers, analytics, class management, grade book, notifications, e-portfolio, quizzes, a course builder environment and more. Specific to the LoudSight™ analytics platform, the Company currently offers more than 120 predefined reports informed by more than 500 behavioral data points, such as how much time students have spent on the platform, the number and frequency of posts within the course community, and content resources reviewed in LoudBooks™, among others. Within the LoudBooks™ platform, instructors have the ability to modify the keywords and concepts underpinning the adaptive element of the content sourcing that occurs as an extension of the core instructional materials.

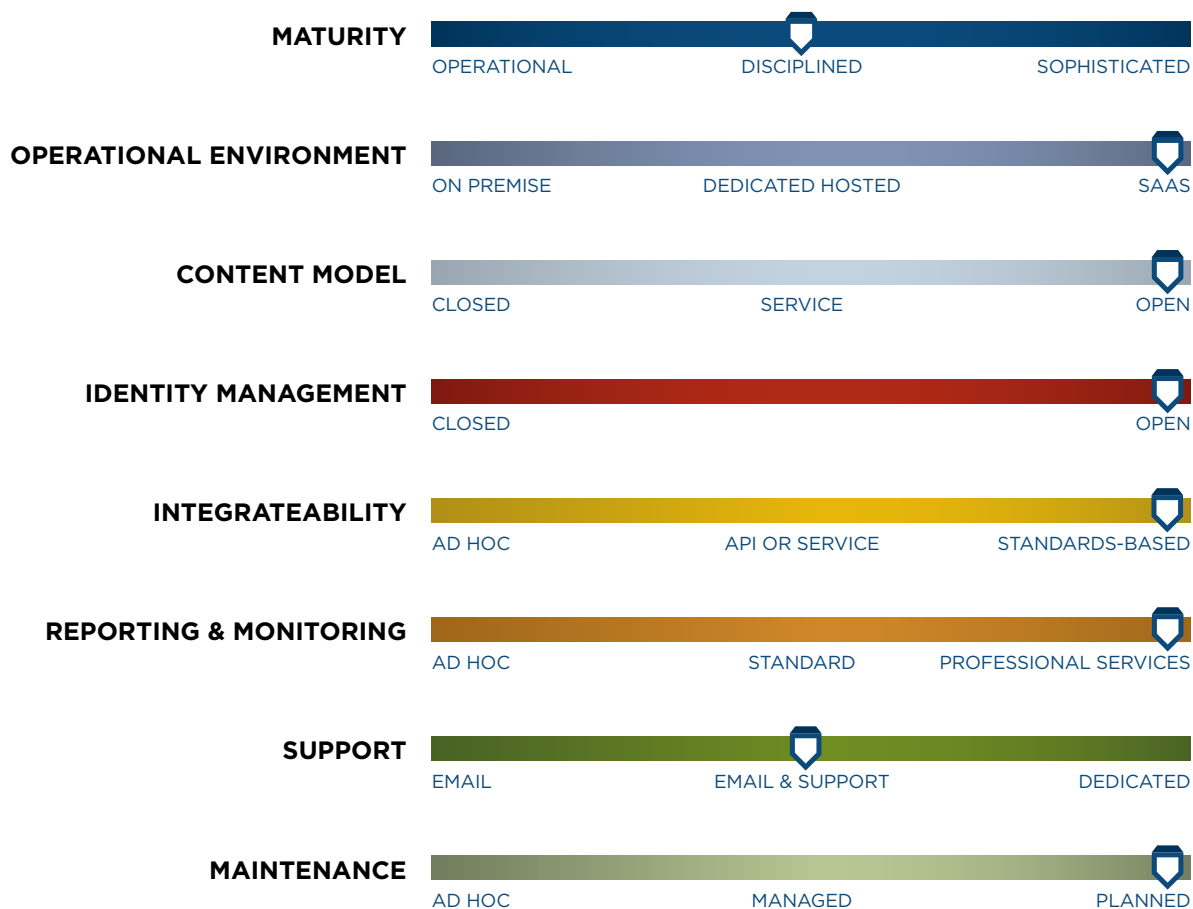
EVIDENCE OF OUTCOMES

LoudCloud remains early in its business lifecycle and relative to institutional implementations of its platform. While the Company has not yet published any research regarding its system’s impact and/or efficacy, case study efforts are underway with two leading partners, Grand Canyon University and Jefferson Country School District (CO).

TECHNOLOGY MATURITY

The graphic and commentary below offer insight into core operational and technology attributes that an institution will need to understand relative to adoption of LoudCloud’s platform. More specific descriptions of the options for each attribute are found in Appendix B.

LOUDCLOUD’S MATURITY OVERVIEW



MATURITY & OPERATIONAL ENVIRONMENT

LoudCloud is a start-up with a comprehensive set of technology and services offerings. Though an emergent player, the Company has made infrastructure decisions that have resulted in maximum flexibility and elasticity, thus ensuring its ability to scale to meet customer demand and potential expectations.

CONTENT MODEL & INTEROPERABILITY

LoudCloud's platform and analytics solution couples the student profile to an open content model. The content needs to be configured for adaptive consumption and correlation, but works based on an ongoing and updating model that takes into account additional interactions throughout the platform and network. The Company has also deployed application programming interfaces via RESTful web. Additionally, selected third-party content repositories have been pre-wired to the platform to facilitate searching and embedding of content items during course authoring.

MONITORING, SUPPORT, & CHANGE CONTROL

LoudCloud's operational environment is composed of a blended solution that incorporates both Amazon Web Services and the Rackspace Cloud to deliver public and private cloud solutions. The Company has implemented a sophisticated deployment and support model for its clients. Moreover, its solution approach has been developed to meet the needs of both K-12 and postsecondary institutional clients.

PROFILE: MCGRAW-HILL EDUCATION - LEARNSMART



FOUNDING & FUNDING

2007

The initial launch of the LearnSmart product was in 2008, although predecessor technology development was started in the late 1990's.

LearnSmart is the adaptive product line for McGraw-Hill Education's ("McGraw-Hill") higher education division. The technology has been funded exclusively by McGraw-Hill via an exclusive development relationship with Area9. In January 2013, the Company announced it had acquired a 20 percent equity stake in Area9.

SOLUTION MODEL

Publisher - Established

WEBSITE

<http://learnsmart.prod.customer.mcgraw-hill.com/>

OVERVIEW

McGraw-Hill Education ("McGraw-Hill") launched its LearnSmart service in 2008 having partnered with Area9, a global software development firm, to initially create a medical simulator product for Latin expressions. The exclusive partnership evolved into the development of LearnSmart, an assessment-driven adaptive homework tool that supported approximately one million new users in 2012 alone. McGraw-Hill has built upon the widespread adoption and use of the LearnSmart product to expand the platform; in January 2013, the Company announced the LearnSmart Advantage suite with four additional offerings: SmartBook, LearnSmart Prep, LearnSmart Labs, and LearnSmart Achieve.²

The initial LearnSmart solution - as well as the newer Advantage suite offerings - are deeply integrated with McGraw-Hill's Connect course management platform. Connect is often the primary starting point for students and instructors when launching adaptive technology from LearnSmart.

LearnSmart has been embedded in over 150 textbook programs spanning more than 30 disciplines including anatomy/physiology, accounting, biology, business, chemistry, communication, and psychology.

2. This profile focuses exclusively on McGraw-Hill's currently adopted LearnSmart solution. With the exception of LearnSmart Achieve, the recently announced LearnSmart Advantage suite adaptive offerings are commercially available.

BUSINESS MODEL

McGraw-Hill offers LearnSmart in its Connect homework manager platform; fees for its use are included in the overall price when a professor and/or institution adopt Connect. LearnSmart is also offered as a stand-alone product with two different price points based on one- or two-semester use. Pricing for the LearnSmart solution – across both models – varies based on the subject area adopted; e.g., LearnSmart is more expensive in a chemistry course than in a sociology one.

McGraw-Hill also established a performance-based fee model in 2012 through its relationship with Western Governors University. The deal involves a flat fee per student for a suite of McGraw-Hill instructional resources and includes a premium fee for each student who uses the materials (e.g., LearnSmart) and passes the course.

The Company also introduced a direct-to-student model for LearnSmart in the summer of 2012.

ADAPTIVE CAPABILITIES OVERVIEW

McGraw-Hill and development partner Area9 have created a proprietary learning-object architecture in the development of LearnSmart. The learning objects are delivered within a platform they refer to as “super adaptive with an individualized approach.” Learning theory employed is primarily constructionist. LearnSmart focuses on covering foundational learning objectives at the bottom of Bloom’s taxonomy; recently launched LearnSmart Advantage suite offerings are positioned to address higher levels of the taxonomy.

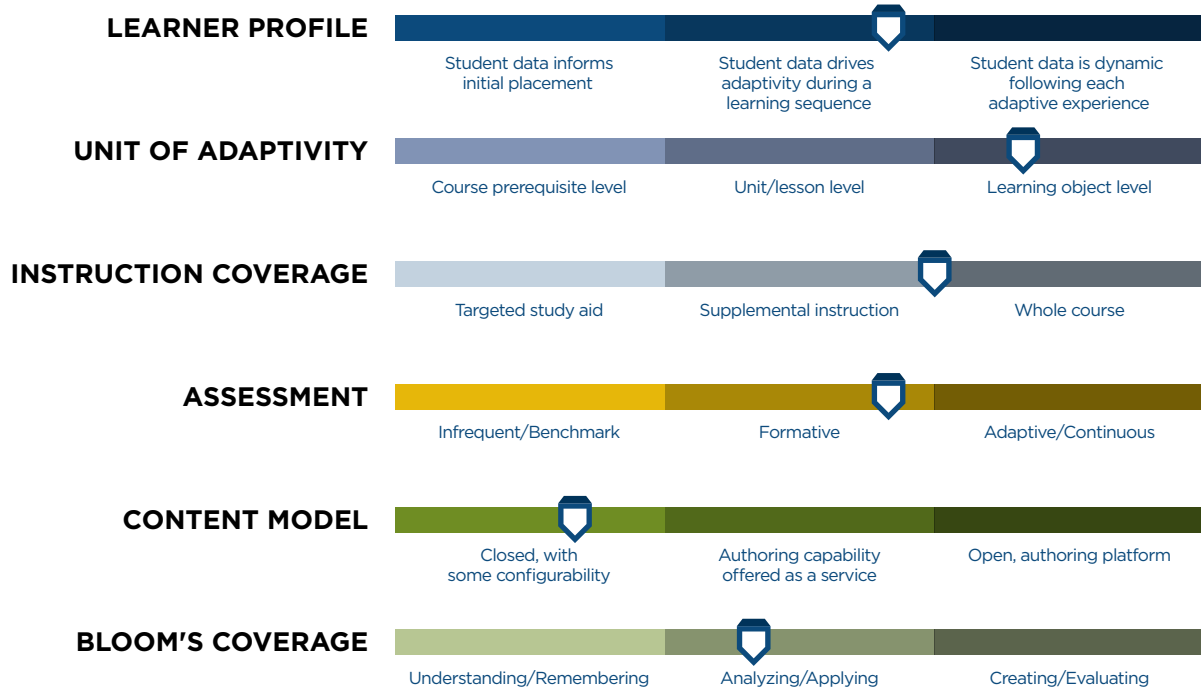
LearnSmart is an interactive study tool that adaptively assesses students’ skill and knowledge levels to track which topics students have mastered and which require further instruction and practice. Based on student progress, the tool then adjusts the learning content based on students’ knowledge strengths and weaknesses, as well as their confidence level around that knowledge.

LearnSmart’s adaptive technology also understands and accounts for memory degradation. It identifies the concepts that students are most likely to forget over the course of the semester – by considering those that they had been weakest in or least confident with – and encourages periodic review by the student. In this way, the tool goes beyond systems that simply help students study for a test or exam, and aims to assist students in achieving true concept learning and retention.

LearnSmart constantly reassesses students’ progress to pinpoint knowledge gaps, adjust objectives, and map out a personally-tailored instructional path.

The graphic below highlights LearnSmart’s solution capabilities across the six attributes in the Taxonomy framework.

LEARNSMART’S ADAPTIVE TAXONOMY OVERVIEW



INSTRUCTOR RESOURCES

LearnSmart’s Instructor Reports, available to faculty using McGraw-Hill Connect, provide real-time information about student and class performance and understanding. Instructors can monitor student activity to identify which students are struggling and deliver assistance to potentially improve performance. LearnSmart Instructor Reports also highlight the concepts and learning objectives that the class as a whole is having difficulty grasping. This information can create value and efficiencies for professors and students along a number of different dimensions.

EVIDENCE OF OUTCOMES

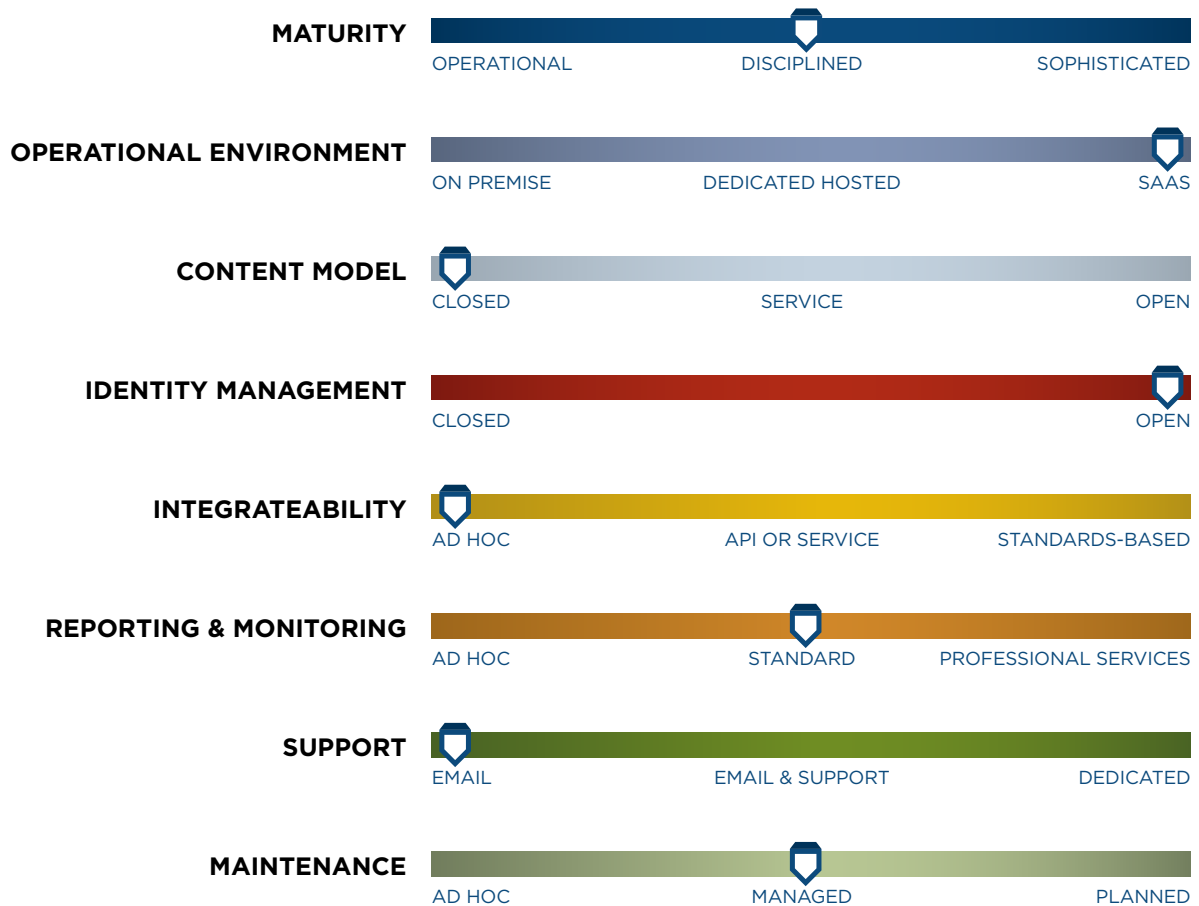
LearnSmart has been evaluated in a number of efficacy and impact studies. Several studies dating back to 2009 across multiple course types and institutional settings have shown favorable results for students using LearnSmart in the areas of pass rates, information retention, and grades. Some of these studies involved McGraw-Hill directly, while others were independent studies.

LearnSmart has been used by tens of thousands of students at institutions of all types. Recent large-scale implementations of LearnSmart – as part of a broader McGraw-Hill digital learning solution – have occurred at the University of Minnesota, Indiana University, and Western Governors University.

TECHNOLOGY MATURITY

The graphic and commentary below offer insight into core operational and technology attributes that an institution will need to understand relative to adoption of LearnSmart’s platform. More specific descriptions of the options for each attribute are found in Appendix B.

LEARNSMART’S MATURITY OVERVIEW



MATURITY & OPERATIONAL ENVIRONMENT

LearnSmart has a more than 15-year history of developing and refining its solution to address the problem of learners' failure to retain information. This development process differs from other solutions' because its foundations are in medical psychology and simulations, rather than following the more common practice of developing solutions as part of a comprehensive learning system. The solution can be independently acquired by students, prescribed by professors/instructors, or adopted institution-wide.

CONTENT MODEL & INTEROPERABILITY

The LearnSmart solution is capable of delivering thousands of courses developed within the McGraw-Hill publishing platform. However, content external to the LearnSmart system cannot be added by professors due to the solution's current content paradigm. LearnSmart has been integrated into Blackboard via a direct integration; beyond this system, integrations have occurred via the McGraw-Hill Campus platform.

MONITORING, SUPPORT, & CHANGE CONTROL

Monitoring and reporting functions are managed using tools within the McGraw-Hill and Area9 data centers. The maintenance and support models are mature and include level-one and level-two support, as well as field consultants who work directly with clients for large campus and institution adoptions.

PROFILE: OPEN LEARNING INITIATIVE



Open Learning Initiative
Carnegie Mellon University

FOUNDING & FUNDING

2002

The Open Learning Initiative received its initial grant from the William and Flora Hewlett Foundation in 2002. Since that time, the Organization has generated more than \$20 million in grant funding.

SOLUTION MODEL

Publisher - Emergent

WEBSITE

<http://oli.cmu.edu>

OVERVIEW

The Open Learning Initiative (OLI), founded by and based at Carnegie Mellon University, may well be one of the oldest and most well-known innovative online course design models in the higher education community. The Organization was initially conceived to marry Carnegie Mellon's deep expertise in technology and learning sciences to determine if the Web could be used to deliver effective instructional models for independent learners. OLI operates as an ongoing research initiative, resulting in a considerable collection of evidence as to the learning efficacy, efficiency, and impact of its courses.

OLI promotes a design-based approach to developing online learning experiences (i.e., courses) that enable adaptivity through inclusion of cognitive tutor models and dashboard-based analytics for instructors and learners. The Organization has designed and developed 23 online courses in which the most appropriate technology resources are applied to support desired learning outcomes and experiences. While many of the technology tools deployed in the courses have been developed at Carnegie Mellon and/or by OLI, the Organization also incorporates functional- and domain-specific resources (e.g., chemistry simulation software, group collaboration platform) from external organizations.

OLI currently offers 18 online courses across several academic disciplines, with an emphasis on the natural sciences (e.g., *Biology, Chemistry, Anatomy and Physiology*), mathematics (e.g., *Logic and Proofs, Probability and Statistics, Statistical Reasoning*), and computer science (e.g., *Media Programming, Principles of Computing*). The offerings are primarily introductory-level courses targeting independent learners; OLI reports that in 2011 it achieved approximately 10,000 enrollments, although more than half a million individuals accessed its open and free courses. More than 100 higher education institutions adopted an OLI course(s) in 2011, with the Organization's largest current institutional effort (supported by a \$4 million grant award) in the community college sector.

BUSINESS MODEL

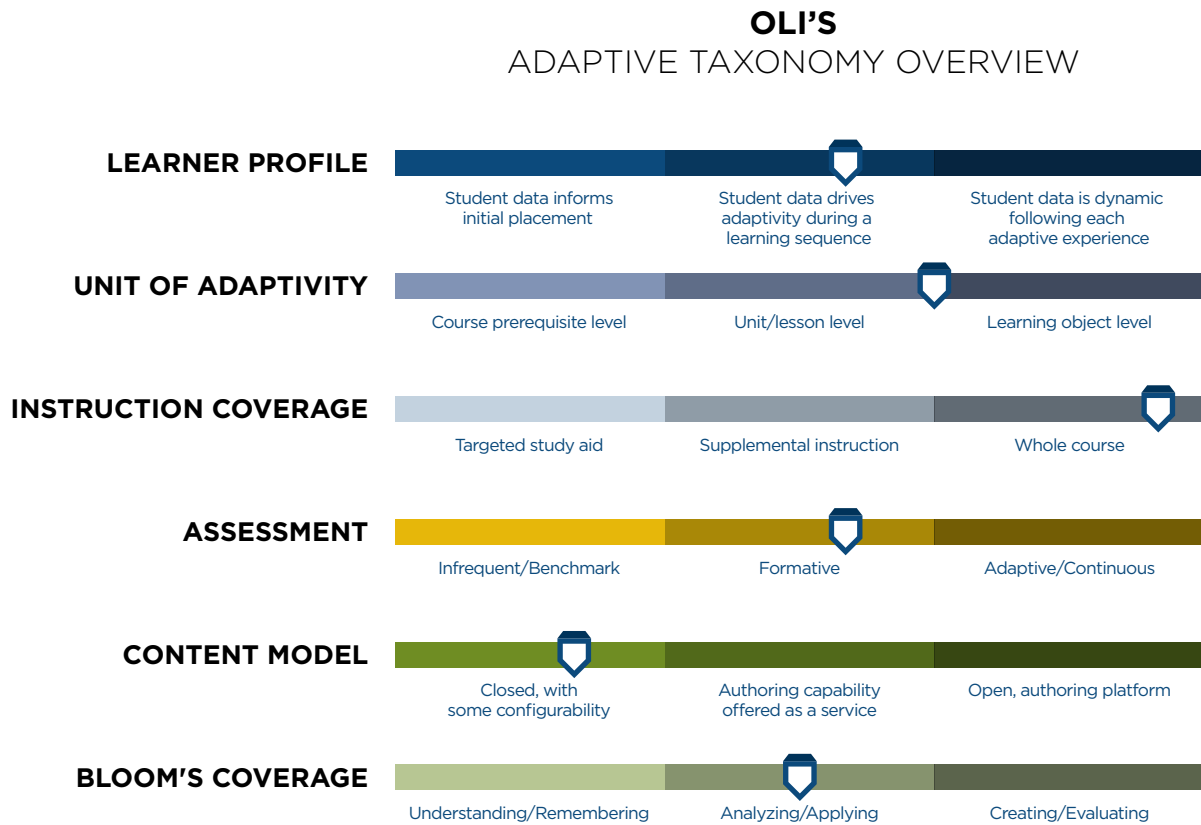
OLI is a nonprofit and receives the vast majority of its funding from a series of foundations, including the Hewlett Foundation, the Bill & Melinda Gates Foundation, the Lumina Foundation, and the National Science Foundation, among others. The Organization provides open and free access to its courses for individual learners, allowing these learners to enroll and complete the fully online, asynchronous instructional program. When used to support classroom instruction, the OLI system provides additional tools, including high-stakes assessments and learning analytics for instructors. For this type of academic use, OLI may charge a student fee of up to \$60 dollars, depending on the course.

ADAPTIVE CAPABILITIES OVERVIEW

Among the core instructional technology tools embedded in the OLI platform is a “mini-tutor” based on a cognitive tutor model. Mini-tutors’ questions of learners focus on specific processes or student-centered measurable learning outcomes and provide targeted feedback and rich hints based on students’ responses as they proceed through various assessments and simulations. Additional content, assistance, and problem-solving opportunities can then be offered based on students’ performance and demonstrated misconceptions. OLI notes, however, that theirs is not a “fully developed cognitive tutor”, as the expense for developing a cognitive tutor is significant. OLI’s research indicates that because student responses are generally within a constrained range, a “lite” cognitive tutor is sufficiently effective, particularly when the potential answer space is deeply informed by faculty domain and teaching expertise. Moreover, OLI reports that unanticipated student misconceptions and answers can be consistently addressed in subsequent course releases.

OLI embeds assessment throughout course activities, capturing data and analytics that inform student mastery levels relative to those set by OLI’s course design teams. In cases where independent learners are enrolled in an OLI course, a dashboard highlighting performance levels is made transparent to students, enabling them to select one of multiple instructional pathways for pursuing – and achieving – mastery. Thus, adaptivity occurs as individual learners make decisions about their own learning progression. In more traditional institutional settings where OLI courses are deployed in a blended learning model, the Learning Dashboard for instructors facilitates personalization in a similar fashion. Instructors are able to assess performance toward objectives at both individual student and broader cohort level, enabling adaptation of instruction at both levels.

The graphic below highlights OLI's solution capabilities across the six attributes in the Taxonomy framework.



INSTRUCTOR RESOURCES

OLI courses were initially intended for independent learners who might or might not be affiliated with an institution; as such, there were limited instructor-oriented tools. However, as OLI pushes more directly into the institutional market and in support of blended online learning models, it has expanded its investment in a new, instructor-focused Learning Dashboard. Instructors also have access to a gradebook. The Organization has also identified instructor professional development to support adoption and implementation of its courses as a key area for additional research investigation.

EVIDENCE OF OUTCOMES

From its inception, OLI's objective has been to validate the learning impact achieved by marrying findings from learning sciences with technology-enabled course models. As such, OLI is a more than 10-year-old research initiative in which the impact and efficacy of its courses have been constantly evaluated and, based on the findings, refined, and/or redesigned.

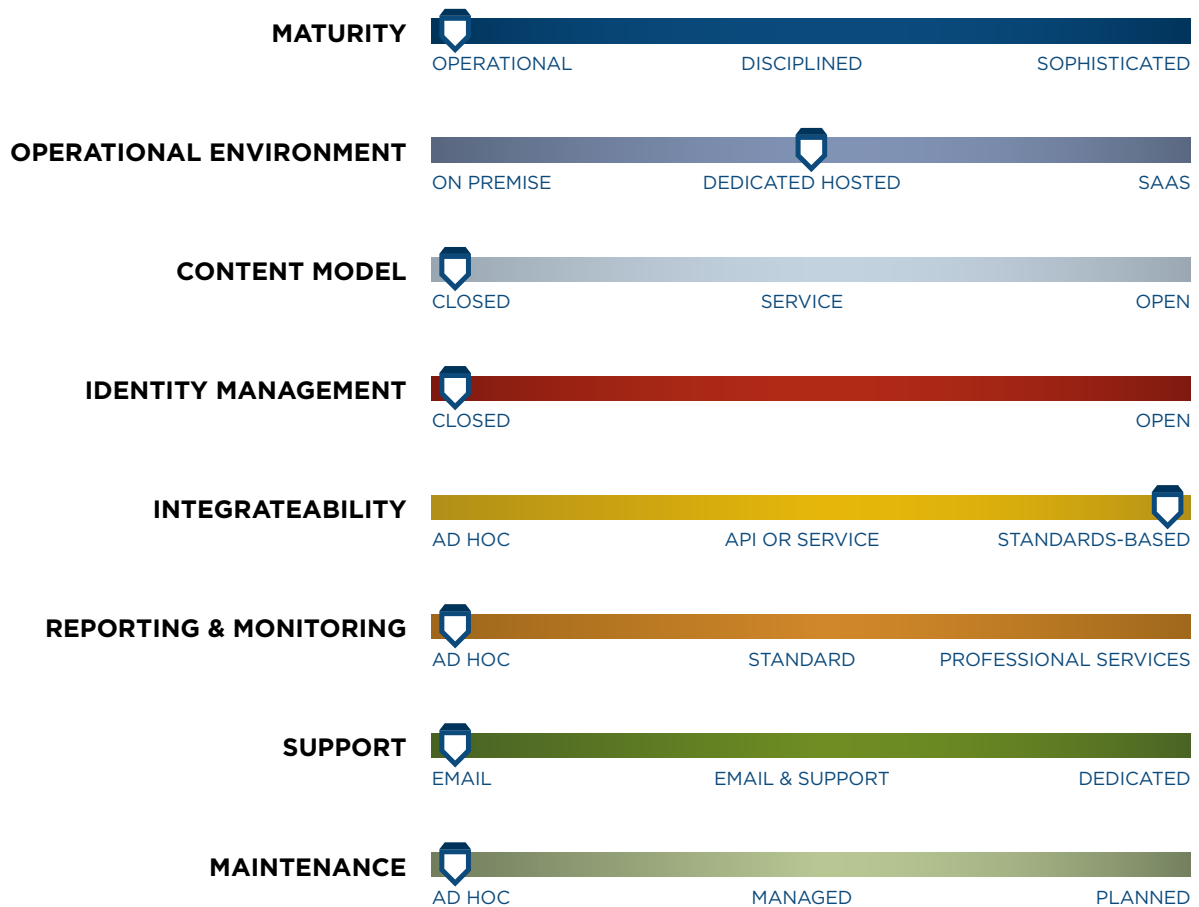
One of the most recent studies, conducted by ITHAKA S+R in 2011, was a randomized control study that focused on OLI's statistics courses at six public universities and included statistically reliable control and treatment groups. When compared to students enrolled in a traditional instructor-led statistics class, the research indicated no difference in learning between the blended (i.e., OLI) and face-to-face groups. Moreover, OLI-enrolled students completed the course 25 percent faster, irrespective of demographics, gender, or Pell-eligible status.

The Organization has made publicly available more than 30 peer-reviewed articles and presentations published since 2003 that demonstrate the impact and lessons learned from its course design methodology and implementation. This list is accessible at <http://oli.cmu.edu/publications>.

TECHNOLOGY MATURITY

The graphic and commentary below offer insight into core operational and technology attributes that an institution will need to understand relative to adoption of OLI's solution. More specific descriptions of the options for each attribute are found in Appendix B.

OLI'S MATURITY OVERVIEW



MATURITY & OPERATIONAL ENVIRONMENT

The Open Learning Initiative represents both a locally deployed solution as well as an open system; that is, any learner who desires to register can do so and can utilize the system's resources. Given OLI's origins and mission, the Organization's courseware solutions are not fully productized in a manner consistent with other commercial applications.

CONTENT MODEL & INTEROPERABILITY

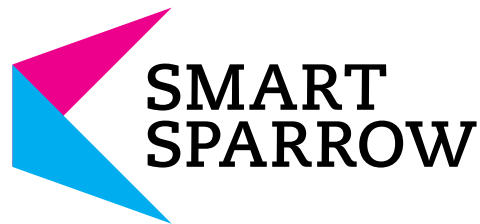
OLI's course design model requires content development be done within the system by the Organization's design teams in order to support and control the content metadata required to drive the adaptivity of the learner experience.

To date, integration of OLI's platform has occurred primarily within Carnegie Mellon University's infrastructure; the Organization does not provide integration with other colleges' and universities' systems in a turnkey fashion. Integration into CMU infrastructure employs a standard single sign-on (SSO) solution, with deeper integration achieved through IMS Global's Learning Tools Interoperability (LTI) standard.

MONITORING, SUPPORT, & CHANGE CONTROL

As a nonprofit, non-commercial entity, OLI's investments in this area are limited to date. The Organization has a help request system built into its platform and a dedicated specialist providing email support.

PROFILE: SMART SPARROW PTY LTD.



FOUNDING & FUNDING

2010

Smart Sparrow was spun out of the Adaptive eLearning Research Group at the University of New South Wales (UNSW) where it had been resident from 2005 to 2010. The Company secured an undisclosed Round A of institutional funding from Australia-based venture capital firms OneVentures and Uniseed in September 2011. The Company has also secured grants in excess of \$5 million (Australian) to fund specific initiatives.

SOLUTION MODEL

Platform

WEBSITE

www.smartsparrow.com

OVERVIEW

Smart Sparrow was launched in late 2010, based on several years of research and development in the Adaptive eLearning Research Group at the University of New South Wales (UNSW), which had been led by company founder and CEO Dror Ben-Naim. The Company's "Adaptive eLearning Platform" (AeLP) enables institutions and individual professors to author interactive, adaptive lessons and tutorials, simulations, and "intelligent" homework solutions with the context of existing courses. Smart Sparrow's approach to deploying adaptive models and tools in postsecondary education focuses on supporting the teacher/professor as the catalyst for facilitating the adoption and use of personalized learning solutions.

Smart Sparrow's AeLP is based on research across various areas including intelligent tutoring systems, educational data mining, cognitive load theory, and Laurillard's Conversational Framework's concept of Reflection and Adaptation.³ The Company's platform is composed of an integrated suite of tools for 1) developing/authoring adaptive online learning content; 2) delivering that content to learners; and 3) analyzing the learners' performance and progress. For individual learners, the Smart Sparrow environment provides a personalized experience: the feedback they receive is adaptive to them specifically as is the sequence of learning activities.

Smart Sparrow's solution has been adopted primarily in Australian-based postsecondary institutions to date. The Company expects to have a presence in all Australian universities by the end of 2013, and also intends to expand into the U.S. market. Smart Sparrow plans to focus on what it terms the "learning by doing" disciplines of science, engineering, medicine, and math, with the least emphasis on math.

3. Laurillard, D. (2002). *Rethinking University Teaching: A Conversational Framework for the Effective Use of Learning Technologies*, Routledge.

BUSINESS MODEL

Smart Sparrow generates revenue through licensing fees for use of its AeLP solution and large professional services projects. Smart Sparrow's AeLP solution is typically priced per academic license (i.e., per author) with some cap on number of students. Academic departments can purchase a group license to support a more broad-based programmatic need, which may also be upgraded to an enterprise license.

The Company also works closely with institutions and/or consortia to develop specific adaptive instructional resources and/or full courseware. As one example, in August 2012, Smart Sparrow secured a \$3.3 million (Australian) grant from Australia's National Broadband Network (NBN) Enabled Educations and Skills Service Program to power a national biomedical education initiative delivered through several Australian medical schools.

ADAPTIVE CAPABILITIES OVERVIEW

Smart Sparrow delivers tools and technologies that allow professors and instructors to integrate adaptive elements into their courses. Smart Sparrow's Adaptive eLearning Platform (AeLP) is primarily deployed as an enabler of adaptive lessons/tutorials within a course; the Company is currently developing an adaptive courseware authoring environment. Smart Sparrow's approach to adaptivity centers on three key principles:

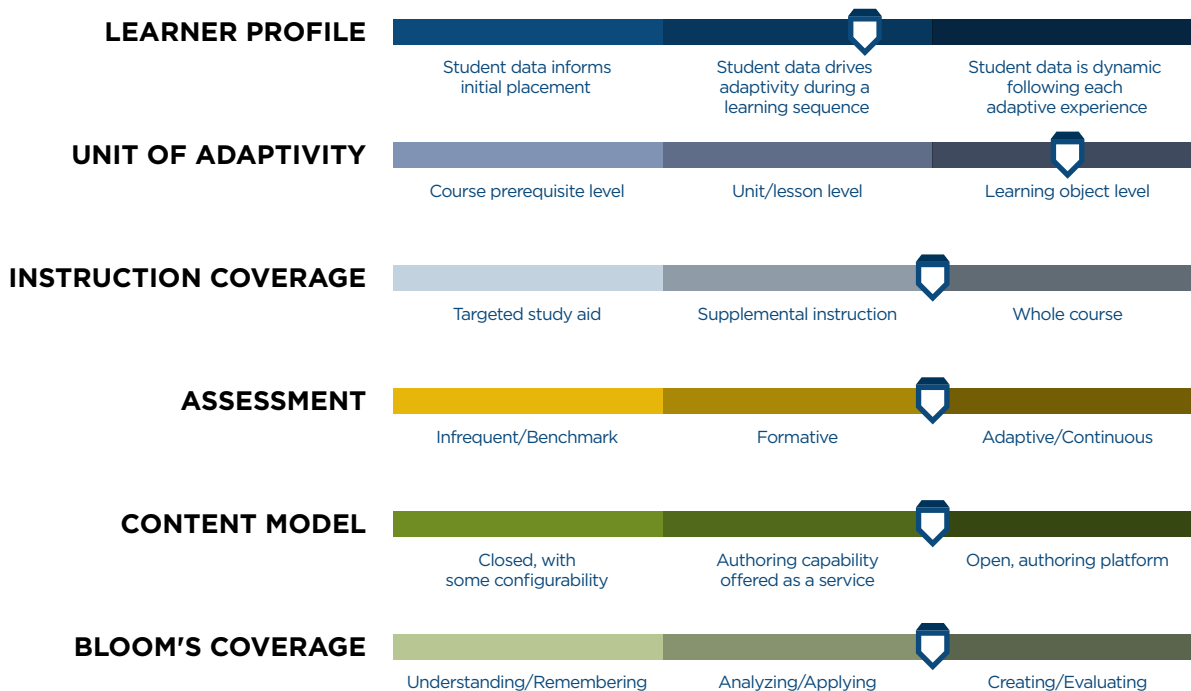
- Promote “learning by doing” with an emphasis on interactive learning experiences
- Make learning as “adaptive and intelligent” as a one-on-one tutorial approach
- Empower educators with an easy-to-use suite of authoring tools, collaboration, and analytics resources

The Company's AeLP delivers personalization and adaptivity to learners and faculty along several dimensions. Both informative and intervention feedback is delivered to learners in response to their interactions with instructional materials and activities in the system. The AeLP delivers adaptive sequencing of a learner's instructional experience based on performance; learners progress at different paces and along different pathways. Finally, a variety of analytics dashboards provided to instructors assist them in evaluating learners' progress and modifying the (virtual) classroom experience.

Within the AeLP, adaptivity is rule-based, and the platform includes a rich authoring tool for adaptive content. The tool features WYSIWYG content authoring capabilities and rule-authoring interfaces with which instructors can “enable” the adaptivity of their content. At the same time, the Company provides a comprehensive set of professional services to assist institutions and consortia in developing adaptive programs and courseware, including pedagogical consultation, curriculum development, content development, software development (interactive, simulations), back-end integration, and student support.

The graphic below highlights Smart Sparrow’s platform capabilities across the six attributes in the Taxonomy framework.

SMART SPARROW'S ADAPTIVE TAXONOMY OVERVIEW



INSTRUCTOR RESOURCES

One of Smart Sparrow’s core principles is to empower professors/instructors in the development and use of adaptive learning resources and courses. The Company describes itself as the “Office” application suite of adaptive learning and aims to provide instructors with easy-to-use online authoring tools and analytics dashboards. Instructors can see detailed reports of their students learning paths and solution attempts, including a Solution Trace Graph™ that visualizes individuals’ learning paths; facilitates comparative analysis across items and activities; and enables interactive review of individual learner and cohort performance.

EVIDENCE OF OUTCOMES

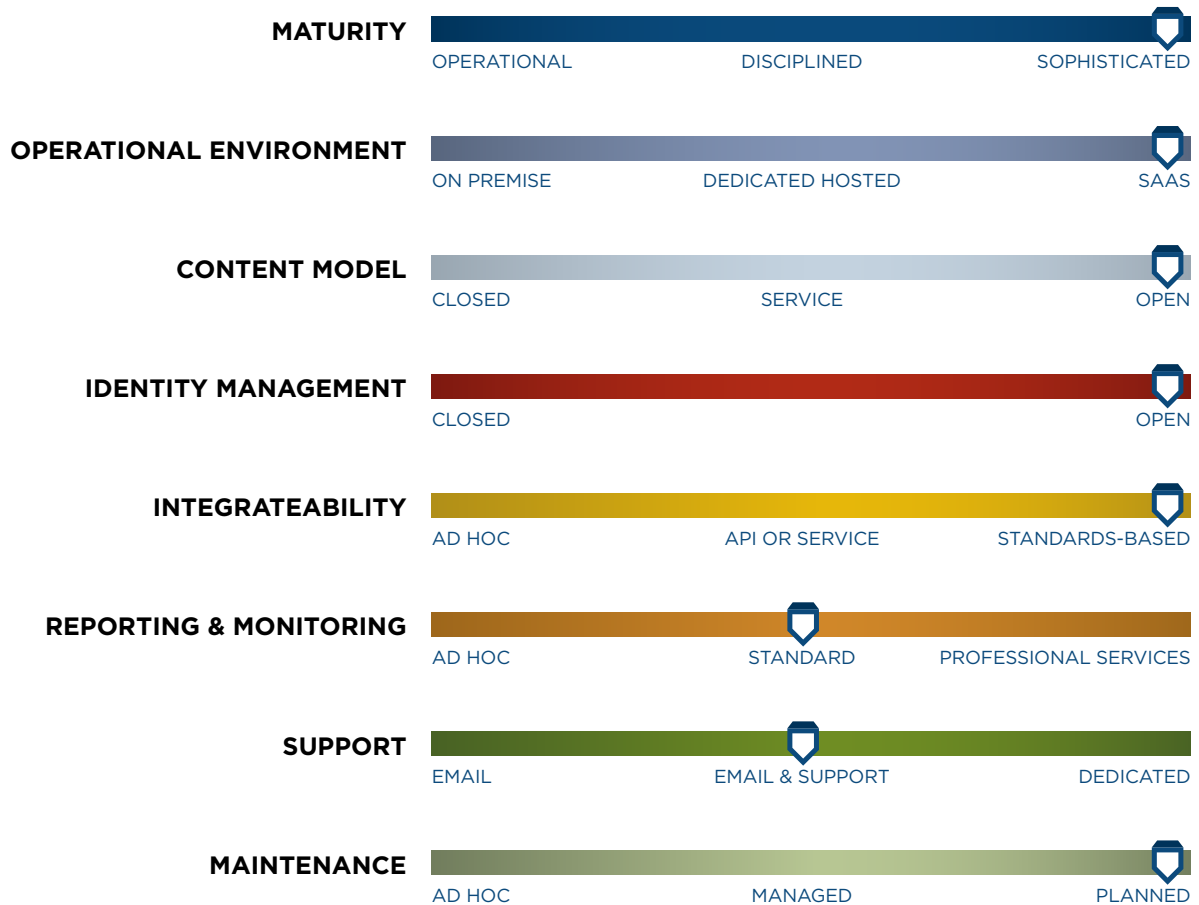
Smart Sparrow makes available on its website numerous published research papers highlighting the impact of adaptive tutorials in medicine and mechanics engineering pilots across multiple institutions. It also encourages those professors adopting and using its AeLP to report out findings and impacts of adaptive learning models in research/academic journals in their disciplines. The Company has also developed language in its existing contracts that both permits and encourages the promotion of outcomes data drawn from class-based and institutional implementations.

In addition, Smart Sparrow hosts on its website brief case studies of several early implementations of its AeLP.

TECHNOLOGY MATURITY

The graphic and commentary below offer insight into core operational and technology attributes that an institution will need to understand relative to adoption of Smart Sparrow's platform. More specific descriptions of the options for each attribute are found in Appendix B.

SMART SPARROW'S MATURITY OVERVIEW



MATURITY & OPERATIONAL ENVIRONMENT

Smart Sparrow has developed and implemented a comprehensive suite of tools enabling its adaptive platform to deliver a rich student and instructor experience. The solution has been developed with higher education as its primary operating model. This early-stage focus has enabled the company to focus on hard-skilled disciplines such as science, engineering, and medicine.

CONTENT MODEL & INTEROPERABILITY

Smart Sparrow's AeLP is an open content model that requires configuration of the adaptive parameters within its publishing and content creation system. Early integrations and interoperability have focused on learning management systems and single sign-on requirements.

MONITORING, SUPPORT, & CHANGE CONTROL

Smart Sparrow's system is operationalized based on various service level agreements, and users and institutions receive level-one, level-two, or dedicated support depending on the engagement parameters. The solution offers industry-standard infrastructure monitoring, enabling integration of its monitoring activities into its support models. The solution has a mature maintenance and deployment model with planned delivery of updates across its client base.

FOCUSING ON THE FUTURE

Establishing effective personalized learning models and environments for learners is by no means a new concept. Ironically, while higher education undertakes much of the scholarship related to learning sciences and effective instructional models, it lags considerably the K-12 and corporate learning markets in its application of the insights developed.

In today's global environment, learning – and lifelong learning – has become one of the most valuable assets in which an individual, organization, or nation-state can invest its resources. Services and solutions from entrepreneurs and innovative businesses are proliferating in response to the resulting increase in market demand, simultaneously challenging the “traditional” models and arbiters of education and learning services. Consequently, the pressures facing colleges and universities today will likely intensify in the years ahead.

Challenging times beget opportunities, and the silver lining for higher education institutions today may be that they are forced to rethink their existing approaches and assumptions. Efforts to innovate, such as the introduction of learning analytics and science-based pedagogy, may drive improvements in and greater transparency around learner success and experience. The potential benefits of these efforts are as enablers of institutional missions and accelerators of institutional effectiveness. Adaptive learning represents one compelling approach that merits consideration from instructors and institutions.

The adaptive learning landscape is a vibrant one, and colleges and universities will increasingly be introduced to new – or new to them – commercially viable solutions for their consideration. While these solutions may all fall under the tag “adaptive learning,” they will likely present a diversity of approaches to adaptivity in support of personalized learning models for students, instructors, and institutions. For institutional decision-makers, understanding organizational context and capabilities will be critical to an effective exploration of this landscape.

In addition, finding the right way to track and observe the proliferation of adaptive learning platforms and publishers (or suppliers in any innovative market segment) will be a valuable skill-set for colleges and universities to nurture. By developing a market – and supplier – point-of-view, customers will more productively navigate the risks and rewards inherent in the promise of an emergent space.

Higher education is at an exciting juncture, one where a future of probabilities and possibilities is still emerging. We encourage you to rigorously explore and evaluate those possibilities on behalf of your communities, your stakeholders, and your students.

APPENDIX A

RESEARCH OVERVIEW AND METHODOLOGY

This paper and *Learning to Adapt: A Case for Accelerating Adaptive Learning in Higher Education* draw on research and analysis conducted by Tyton Partners as part of an engagement for the Bill and Melinda Gates Foundation (the “Foundation”). The analysis underpinning these two papers was developed on behalf of the Foundation’s Personalized Learning Network (PLN), a diverse group of postsecondary institutions and member associations initially convened in May 2012 to identify opportunities for seeding, scaling, and evaluating tech-enabled personalized learning models and solutions. The institutions comprising the PLN support a combined enrollment of more than 700,000 students, while the associations represent over 8.5 million students across more than 630 colleges and universities. A key outgrowth of this effort has been the launch of the [Adaptive Learning Market Acceleration Program](#).

The findings and analysis comprising this paper are based on primary and secondary research conducted between September 2012 and February 2013. Tyton Partners conducted initial interviews with industry experts and investors to gain perspective on the pulse of personalized learning models and solutions in a postsecondary context. An initial supplier scan – with inputs from the Foundation and the PLN – generated more than 70 organizations active in deploying solutions with varying degrees of “personalization” for learners across multiple market segments and models. A subset of this list is highlighted in Appendix D.

We reviewed approximately 40 companies and organizations in detail during October and November 2012; from this group, we prioritized those suppliers that had:

- An adaptive learning solution actively available for higher education institutions as of November 2012
- A solution based on academic research OR efficacy research tied to the solution’s implementation
- Broad applicability related to discipline/subject area coverage and potential use-case scenarios

Ten suppliers were subsequently invited to participate in a series of discussions regarding their solutions and approach to adaptivity; of these organizations, eight elected to participate in a set of in-depth interviews and are profiled in this paper. Each of the organizations invested approximately three-to-five hours of discussion time addressing their:

- Personalized learning approach and model of adaptivity
- Research base, which informed their solution and available outcomes / efficacy data
- Business model and customer experiences
- General perspective on the personalized learning market dynamics

The organizations also completed an RFI regarding various technical specifications and attributes of their solution(s), as well as other selected information. The interviews and RFI response collection occurred between November 2012 and February 2013. This data, in conjunction with publicly available materials, served as the basis for the profiles.

We have sought to develop an objective overview of each supplier's commercially available adaptive learning solutions as of early March 2013. Future solutions and/or enhancements may be referenced, but were not considered for the purposes of the frameworks highlighted (i.e., Taxonomy, Maturity) nor in the body of the supplier profiles.

APPENDIX B

MATURITY FRAMEWORK OVERVIEW

As noted in Appendix A, the profile creation process leveraged inputs gathered throughout the lifecycle of the research process and included the establishment of parameters for categorization of suppliers' product and solution offerings. In addition, Tyton Partners assumed that each profiled solution would be able to scale and that the supplier used standard software industry best practices for the operational management of its software.

For the attributes within the Maturity Framework, the basis of the evaluated criteria is a combination of notes taken from phone-based interviews and the RFI responses. In particular, the RFI responses were used as a key element for contextualizing the solution offerings on elements and variables that were not uncovered during interviews, market scans, or other generally available information. In some cases, there were questions that went unanswered; in these cases the category was evaluated on a whole. If the response was specifically noted as "not applicable," the measurement reflects "N/A." The points on the continuum for each attribute are described below.

OPERATIONAL & TECHNICAL MATURITY (MATURITY)

Operational

The organization has established the product in the marketplace and is able to operationalize the solution for customers. This operationalization is likely customized to each opportunity.

Disciplined

The organization has implemented a disciplined approach to deployment of its products and services. This approach includes discipline in its support model as well as change control and management of the operational environment.

Sophisticated

The organization has established disciplined and repeatable operational processes that enable the consistent on-boarding of additional customers, subject areas, and content. In addition, the organization has the level of technical maturity in its change control and management processes necessary to ensure that undesired changes are not introduced.

PHYSICAL DEPLOYMENT & OPERATIONAL ENVIRONMENT (OPERATIONAL ENVIRONMENT)

On Premise

The solution requires dedicated environments at the customer site.

Dedicated Hosted

This model is the environment approach taken when the known customer base is relatively fixed. This approach is normally considered unsustainable for operational teams to deploy at scale.

SAAS

Software as a service (SAAS), sometimes referred to as “on-demand software,” is a software delivery model in which software and associated data are centrally hosted in the cloud. An advantage of this approach is relatively known, controllable variables affecting the system’s performance. This model, though readily consumable, is relatively new to many higher education institutions and that unfamiliarity may create a barrier to entry.

CONTENT CREATION AND LEARNING OBJECT APPROACH (CONTENT MODEL)

Closed

Content must be authored in the adaptive solutions’ publishing environment. Content created outside the solution cannot typically be added to the environment. This metric is not a qualitative measure, but rather an identification of the solution approach.

Open

Content can be blended between materials created in the environment (i.e., “internal” content) and content drawn and integrated from other sources. This approach enables educators to incorporate external content they feel enhances student learning into the adaptive experience.

IDENTITY MANAGEMENT & SINGLE SIGN ON (SSO) (IDENTITY MANAGEMENT)

Closed

The solution is built with a tightly coupled security model and is not built to integrate into the education enterprise.

Open

The solution leverages an approach that facilitates integration into solutions such as active directory or Lightweight Directory Access Protocol (LDAP).

DEGREE & APPROACH FOR INTEROPERABILITY AND INTEGRATION (INTEGRABILITY)

Ad Hoc

Integration is considered a separate service offering. The system is designed to be standalone and is not developed to enable the extraction, transformations, or loading (ETL) of data.

API or Service

Integration via discrete services enabling controlled and predictable data transfer using application programming interfaces (API), software development kits (SDK) or RESTful web services. These integration components can be independently enhanced along their own software development lifecycle (SDLC).

Standards-Based

Standardized transport protocols (e.g., SIF) and interoperability standards (e.g., SIF, LTI, SCORM) are implemented and used for ETL processes importing and exporting data from the system.

REPORTING & MONITORING

Ad Hoc

Reporting needs to be created for each opportunity. Monitoring is configured on an as-needed basis rather than as part of the standard offering.

Standard

The solution provides a set of standardized reporting components and offerings. Monitoring is integrated into the organization's support model.

Professional Services

The solution can be extended to support additional degrees of customization to facilitate system, application, database, and network monitoring.

TECHNICAL & HELP DESK SUPPORT (SUPPORT)

Email

Support is provided through email only.

Email + Support

Support is provided through email and a call center.

Dedicated

Support is provided by a dedicated support desk staff that is familiar with the customizations and operational environment of the customer.

SOFTWARE & SOLUTION MAINTENANCE (MAINTENANCE)

Ad Hoc

Fixes, patches, or releases to correct software quality issues are deployed as needed via either manual or partially-automated deployments. Customers are notified when these deployments affect their solutions.

Managed

The change control processes are used to ensure that modifications to the adaptive product or system are introduced in a controlled and coordinated manner. This approach reduces the likelihood that unnecessary changes will be introduced into a system without forethought, which may result in introducing faults into the system or undoing changes made by other users of software. Customers are notified when these deployments affect their solutions.

Planned

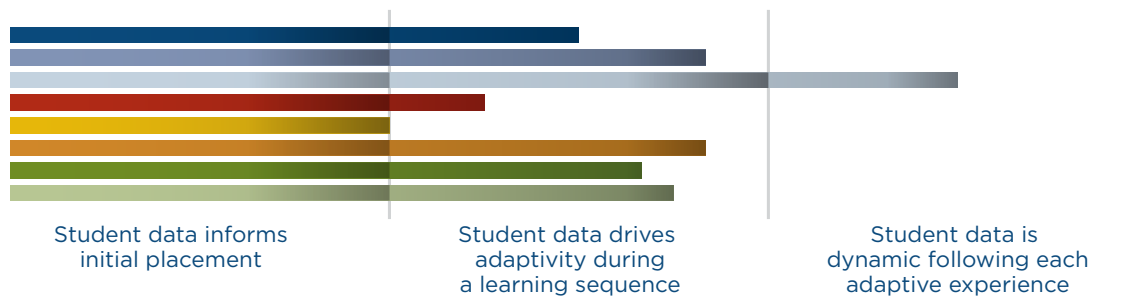
Similar to the managed process above, but also includes a degree of predictability in the scheduled release of these updates. These solutions are mature in that they are nearly bug-free and the deployments normally introduce new features and functionality rather than fixes to software quality issues. Customers are notified when these deployments affect their solutions.

APPENDIX C

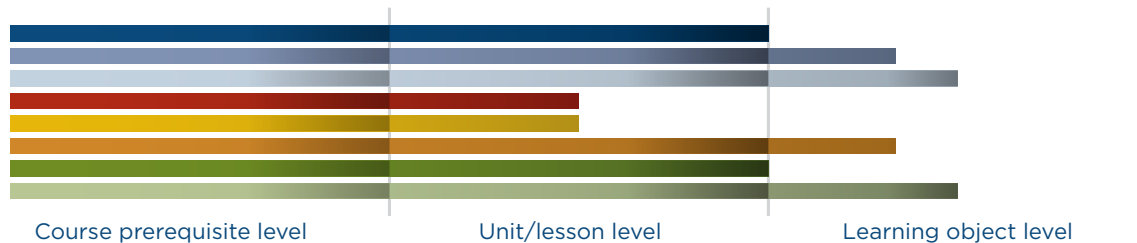
PROFILED SUPPLIERS' ADAPTIVE TAXONOMY OVERVIEW

This graphic offers a comparative view of the profiled suppliers' adaptive learning solutions relative to the attributes highlighted in the Taxonomy lens. The greatest degree of variability lies in suppliers' positioning in the Instruction Coverage and Content Model attributes. Importantly, suppliers are constantly refining and enhancing their solutions; as such, this comparative view represents a point-in-time snapshot, not a defined or fixed product-positioning matrix.

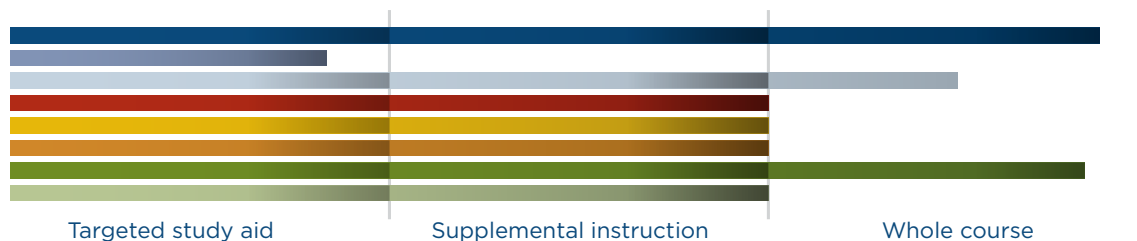
LEARNER PROFILE



UNIT OF ADAPTIVITY

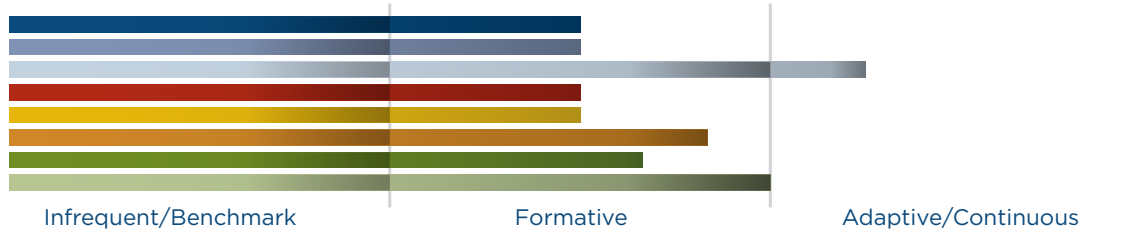


INSTRUCTION COVERAGE

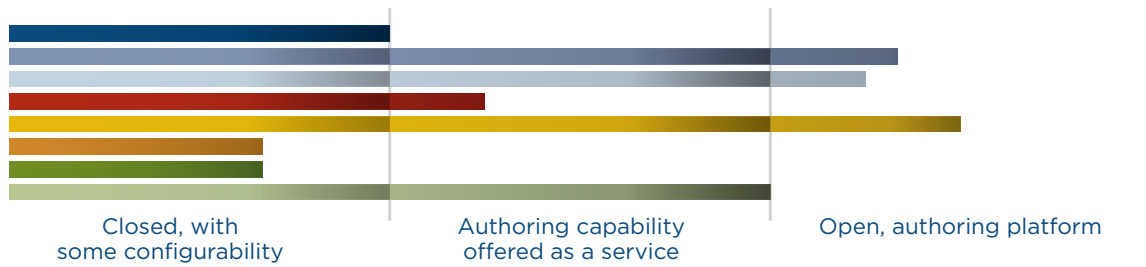


ADAPTIVE TAXONOMY OVERVIEW CONTINUED

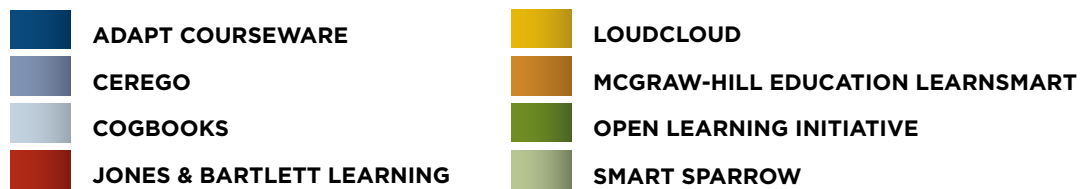
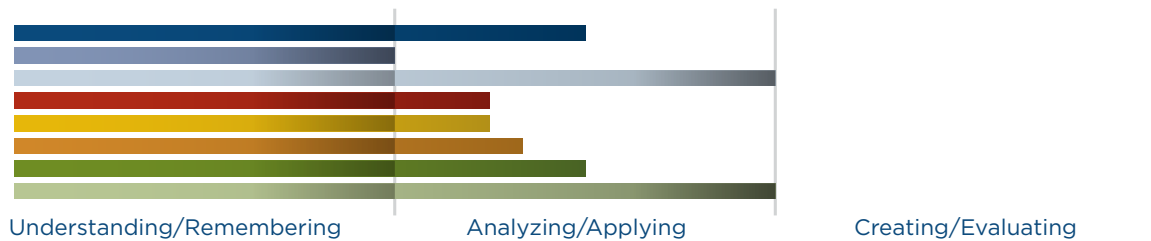
ASSESSMENT



CONTENT MODEL



BLOOM'S COVERAGE



APPENDIX D

ADDITIONAL SUPPLIERS TO WATCH

The table highlights more than 30 companies active in the higher education market that either have adaptive learning capabilities today or may develop them in the future based on their current solution footprint. These companies and organizations are a subset of the initially more than 70 screened by Tyton Partners (see Appendix A) and should not be viewed as a comprehensive nor exhaustive list of current and prospective adaptive learning providers.

COMPANY	MODEL	DESCRIPTION	WEBSITE
2U	Platform	Partners with top-tier universities to deliver selective graduate degree and undergraduate programs online; one element of partnership is 2U-developed technology platforms to facilitate transition to rich online learning environments	www.2u.com
Agilix	Platform	Developer of innovative learning platforms including xLi, an extensible learning infrastructure available to publishers, software developers, and others developing learning applications for education institutions, and Agilix Buzz, a personalized learning system for student-centered, competency-based learning programs	www.agilix.com
ALEKS	Publisher	Developer of a web-based, artificially intelligent assessment and learning system; course products for higher education are available in mathematics, business, science, and behavioral science	www.aleks.com
Altius Education	Platform	Online learning services provider powering Ivy Bridge College; developing Helix, an adaptive learning platform for use by Ivy Bridge students	www.altiused.com
aNewSpring	Platform	Developer of online learning platform with adaptive capabilities, used in K-12, higher education, and corporate learning environments	www.anewspring.com
Blackboard	Platform	Developer of market-leading learning management system and broader suite of learning solutions, including analytics and collaboration platforms	www.blackboard.com
CCKF	Platform	Developer of adaptive learning platform for adoption by publishers, professional associations, and educational institutions	www.cckf-it.com
Cengage	Publisher	Developer of MindTap platform, which offers personalized online learning experience	www.cengage.com/mindtap
CourseLoad	Platform	Developer of platform enabling device- and content source-neutral aggregation and distribution of digital textbooks and course materials	www.courseload.com

COMPANY	MODEL	DESCRIPTION	WEBSITE
Coursera	Platform	Developer of learning platform enabling massive open online courses (MOOCs)	www.coursera.org
Desire2Learn	Platform	Developer of learning management system and broader suite of learning solutions, including predictive analytics and ePortfolio platforms	www.desire2learn.com
EasyGenerator	Platform	Developer of online authoring tool providing a broad suite of capabilities, including personalization of learning paths for individual students	www.easvgenerator.com
edX	Platform	Developer of learning platform enabling massive open online courses (MOOCs)	www.edx.org
GRAPPLE Project	Platform	A European Union-sponsored research and development initiative to create open source adaptive learning software tools and resources that sit on top of existing institutional LMS platforms	www.grapple-project.org
Inkling	Platform	Developer of publishing platform for academic (i.e., textbooks) and trade materials that leverages interactivity enabled by touch-screen tablet devices	www.inkling.com
Instructure	Platform	Developer of learning management system and broader suite of learning solutions	www.instructure.com
John Wiley & Sons	Publisher	Leading academic and trade publisher; its WileyPLUS solution is an online teaching and learning platform based around Wiley digital texts	www.wiley.com
Kenexa	Platform	Broad-based human capital management technology and services business with a portfolio of platform technologies to support enterprise learning initiatives	www.kenexa.com
Knewton	Platform	Developer of adaptive learning platform partnering with education content providers and postsecondary institutions to enable personalized learning models	www.knewton.com
Kno	Platform	Developer of publishing platform for academic materials (i.e., textbooks) that provides interactive features, assessments, and social sharing tools to engage students	www.kno.com
Knowillage	Platform	Developer of an adaptive learning platform that integrates assessment, learning analytics, and content	www.knowillage.com
Knowledge Factor	Platform	Developer of a learning platform enabling personalized learning, with an emphasis on enhancing knowledge acquisition and long-term retention	www.knowledgefactor.com
MindEdge	Publisher	Developer of online courseware that features narrative learning drawing on extended case studies and problem sets	www.mindedge.com

COMPANY	MODEL	DESCRIPTION	WEBSITE
Pearson	Publisher	Leading academic publisher and technology services player; MyLab and Mastering online learning products deliver personalized study paths and an array of instructional resources	www.pearsonmylabandmastering.com
PrepU (Macmillan)	Publisher	Developer of a quizzing engine delivering personalized prep in biology, nursing, and selected AP courses	www.prep-u.com
Quantum Simulations	Publisher	Developer of artificial intelligence tutoring, assessment, and professional development software for accounting, science, and mathematics	www.quantumsimulations.com
Snapwiz	Platform	Developer of a learning platform for publisher partners seeking to deliver adaptive test prep and personalized, enhanced digital textbooks	www.snapwiz.com
Soomo Publishing	Publisher	Developer of webtexts, which are complete, interactive web-based textbook replacements that integrate individual learner analytics	www.soomopublishing.com
StraighterLine	Publisher	Developer of online courses in the sciences, humanities, English, math, business, and languages	www.straighterline.com
ToKToL	Publisher	Developer of adaptive learning test prep resources for courses in mathematics and sciences	www.toktol.com
Toolwire	Publisher	Developer of immersive experiential learning solutions for higher education and corporate training institutions	www.toolwire.com
Udacity	Platform	Developer of learning platform enabling massive open online courses (MOOCs)	www.udacity.com
UniversityNow	Other	Operator of two accredited universities; delivers programs through learning platform enabling individualized instruction, self-paced learning, and collaborative technologies	www.unow.com
VitalSource	Platform	Developer of market-leading e-textbook delivery system in higher education	www.vitalsource.com

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ABOUT TYTON PARTNERS

Tyton Partners, formerly Education Growth Advisors, is the leading provider of investment banking and strategy consulting services to the global knowledge sector. Built on the tenets of insight, connectivity, and tenacity, the evolved advisory services firm leverages in-depth market knowledge and perspective to help organizations pursue solutions that have lasting impact.

Tyton Partners offers a unique spectrum of services that supports companies, organizations, and investors as they navigate the complexities of the education, media, and information markets. Unlike most firms, Tyton Partners understands the intricacies and nuances of these markets and plays an integral role shaping the efforts that drive change within them. The firm's expertise is predicated on its principals' years of experience working across market segments - including preK-12, postsecondary, corporate training, and lifelong learning sectors - and with a diverse array of organizations, from emergent and established, private and publicly traded companies, to non-profit organizations, institutions, and foundations, to private equity and venture capital firms and other investors.

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