



# EXECUTIVE SUMMARY

Cerego is a personalized learning software platform that helps us learn more efficiently and retain that knowledge for longer.

The company's mission is to make people smarter by building a single, generalizable platform for acquiring and demonstrating knowledge and capability. "Generalizable" means that the same system works for individuals learning any subject matter: medical care, principles of aviation, workplace procedures, and more. The platform also provides instructors and managers with performance data and predictive analytics that go far beyond traditional assessments or point-in-time estimates of individual knowledge or capability.

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# CEREGO'S LEARNING ENGINE

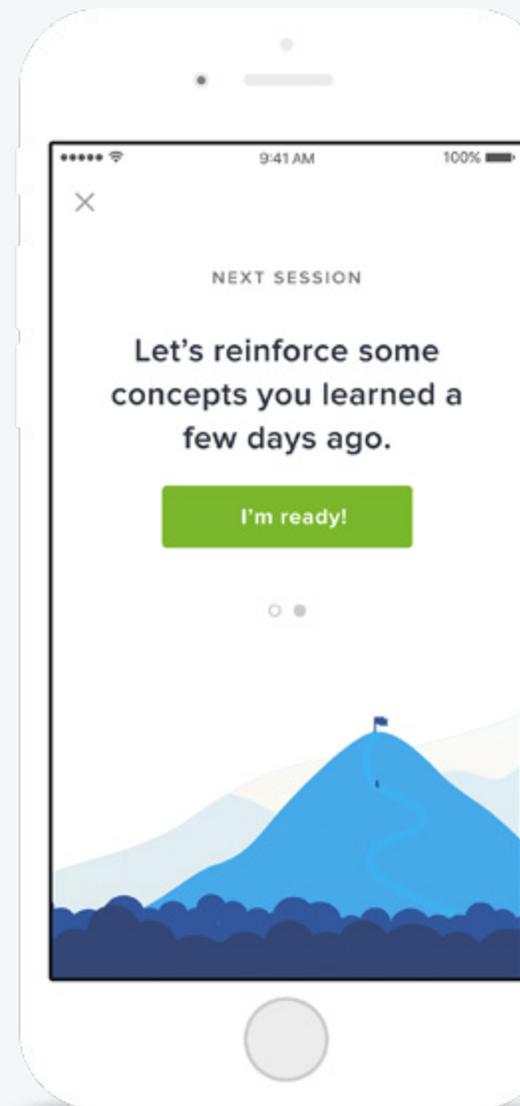
Translating learning  
science into learning  
solutions

Cerego uses proven research from cognitive science and data science to create an optimal schedule to learn and review material—quantifying knowledge and providing the ability to measure what individuals know and what they don't know. The system is constantly adapting and improving the learning experience for each user, and is designed to create durable, flexible knowledge that can be used in the field.

Cerego takes two of the most robust findings in learning science: distributed learning and retrieval practice, and combines them in a learning engine we call **DARPA (Distributed Adaptive Retrieval Practice Algorithm)**. This learning engine keeps track of each user's interactions with the material they are learning and adapts the review schedule to make it available at the moment it is most beneficial for learning.

**Distributed Learning**, one of the most well-studied phenomena in understanding how humans learn, is the observation that spacing out learning across time improves long-term retention compared to studying the same material in a single session, even when total study time is the same. For learners this is not intuitive, meaning there is considerable opportunity to improve outcomes by changing this behavior. While determining the optimal spacing between learning and reviews is difficult for individuals, Cerego leverages machine learning to optimize this interval for every user, and for each item that user is learning.

**Retrieval Practice**, also known as the "testing effect" or "test-enhanced learning" is the observation that actively attempting to recall previously studied material is more effective for long-term retention than spending the same amount of time rereading or re-studying that same material. That is, rather than rereading the relevant chapter, an individual would learn more spending their time attempting to answer practice questions on the subject. This is also not intuitive: most people would naturally re-study the information they are trying to learn (for example by re-reading a crucial chapter of a book before an exam).





**By combining  
these two  
principles into  
a technology  
product, Cerego  
takes learning  
science and  
translates it into  
learning solutions  
in the real world.**



# LEARNING MATERIAL IN CEREGO

Flexible and easy to create

When organizations use Cerego, they create proprietary and custom learning content with the platform's easy-to-use authoring environment. Unlike "adaptive testing" systems that store multiple-choice or other simple assessments, Cerego content is structured in sophisticated ways to support foundational and applied knowledge that is transferable, flexible, and can represent useful information about the world.

Content may take the form of text-based instruction, image-based instruction, step-by-step procedures, pattern recognition exercises, etc. The system uses these pieces of content to create a range of different quiz types that add depth and variation to the review process, helping to build knowledge that is applicable to real-life situations.

**Longitudinal Study**  
5 Steps • 5 Quizzes

**BACK 1**  
An observational rese...

**BACK 2**  
Data is gathered for...

**In case of DGR spillage**  
5 Steps • 5 Quizzes

**STEP 1**  
Call the certified peopl...

**STEP 2**  
Do not touch or step on

**STEP 3**  
Isolate the shipment

**STEP 4**  
Don't attempt to cl...

**STEP 5**  
Avoid skin contact

**Which company had a web accessibility suit filed against them?**

**Poulet**  
4 Quizzes

Chicken

**REGION 1**  
Ribosome

**REGION 2**  
Mitochondria

**REGION 3**  
Cytoplasm

**REGION 4**  
Nucleus

**Identify the poison oak**

**Tim Berners-Lee set up the World Wide Web Consortium (W3C) on October 1, 1994.**  
5 Steps • 5 Quizzes

**A nurse is preparing to administer chlorpromazine 0.55 mg/kg PO to an adolescent who weighs 110 lb.**

Available is chlorpromazine syrup 10 mg/5 mL. How many mL should the nurse administer?

# THE KNOWLEDGE BANK

A common operational picture of user knowledge and ability

The Cerego platform does not just improve how individuals learn using technology. It also helps users become more proficient learners even outside the system, and provides significant benefits to instructors (formal instructors or informal training coordinators). Many of these benefits are delivered through a combination of powerful predictive analytics and visual representations of knowledge and capability.

Cerego's focus on accurately measuring knowledge provides users with a uniquely rich view of their own understanding

of a subject. It also provides instructors and managers with a detailed view of how learners are progressing with course material. Visual dashboards such as the knowledge bank allow users to easily explore their review history, upcoming schedule, item difficulties and more. The Cerego knowledge bank visualizes each memory's current activation and retention for every subject being learned, as well as their upcoming review schedule, promoting ownership and understanding of the learner's progress and the learning strategy being employed.



## The Knowledge Bank

The Cerego platform is designed to support instructors in different contexts. An Admin for a group in Cerego has access to a wide range of tools for viewing and understanding their learners' progress, setting and updating learning goals, and tracking the quality and effectiveness of their content. Crucially, instructor resources (like student resources) are available on-the-go in mobile applications. In some contexts, instructors or managers create their

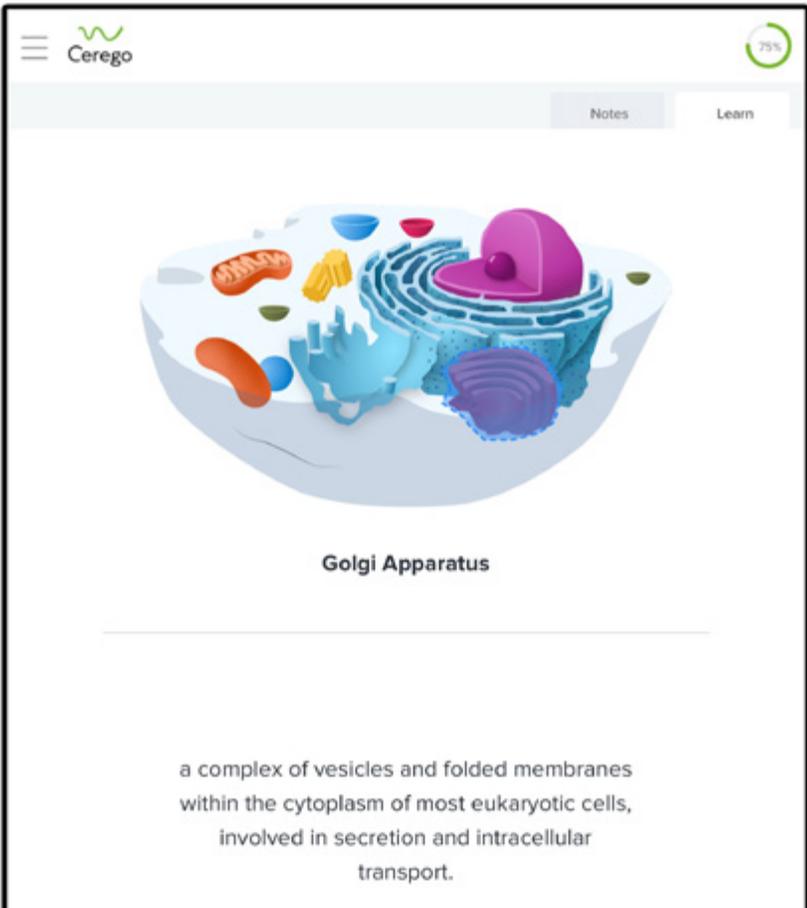
own curriculum on the Cerego platform on-the-fly; in other contexts centralized instructional designers create material that can be used, copied and customized by different managers at different times. While Cerego makes learners incredibly efficient, it also makes instructors (formal or informal) extremely knowledgeable about the capability, and learning patterns their employees, students, or learners have exhibited.

# IMPROVING META- COGNITIVE ABILITY

Cerego helps users become better learners by improving their metacognitive abilities (knowing what they know) and allowing them to use time more efficiently for learning. This is important: since humans have a limited amount of mental resources (and available study time), being able to allocate these resources efficiently plays a large role in how much an individual is able to learn. For example, a learner who recognizes when they have learned some material effectively can move on and direct their attention and resources to learning new or refreshing more difficult material.

A learner without such insight, or who mistakes the fluency of reviewing material they already know well for effective learning, may spend too little time on more difficult, but ultimately more

important and effective reviews of material they know less well. Learning in Cerego is integrated into daily life through mobile apps that allow for genuinely distributed learning, and can be embedded directly into primary source material or supplemented with supporting notes and media for richer learning.



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# RESULTS IN THE FIELD

Cerego conducts research and works alongside third-party researchers to assess and improve the efficacy of the system. We have a wealth of case studies and research material looking at how Cerego improves learning outcomes for our users.

## NYU COLLEGE OF DENTISTRY BOARD PREP

New York University College of Dentistry began using Cerego in the summer of 2015. Approximately 350 students taking review classes for dental board exams in the fall were given the opportunity to supplement their reviews with Cerego content created by the professor.



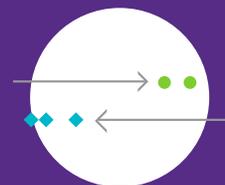
Students studied 424 review items in Cerego, replacing 96 hours of class teaching time (and reducing the professor's in-class teaching by 50%).



Aggregate Board exam results for the students were exceptionally high; 2.6 standard deviations above the national average.



A majority of surveyed students reported that using Cerego to review was worthwhile, by a margin of 58% to 16%.



All 350 students in the review class passed the subsequent Board exams.

**On the strength of these results, NYU adopted an institution-wide Cerego license the following fall and has seen similar results in subsequent years.**



# MAKING KNOWLEDGE STICK

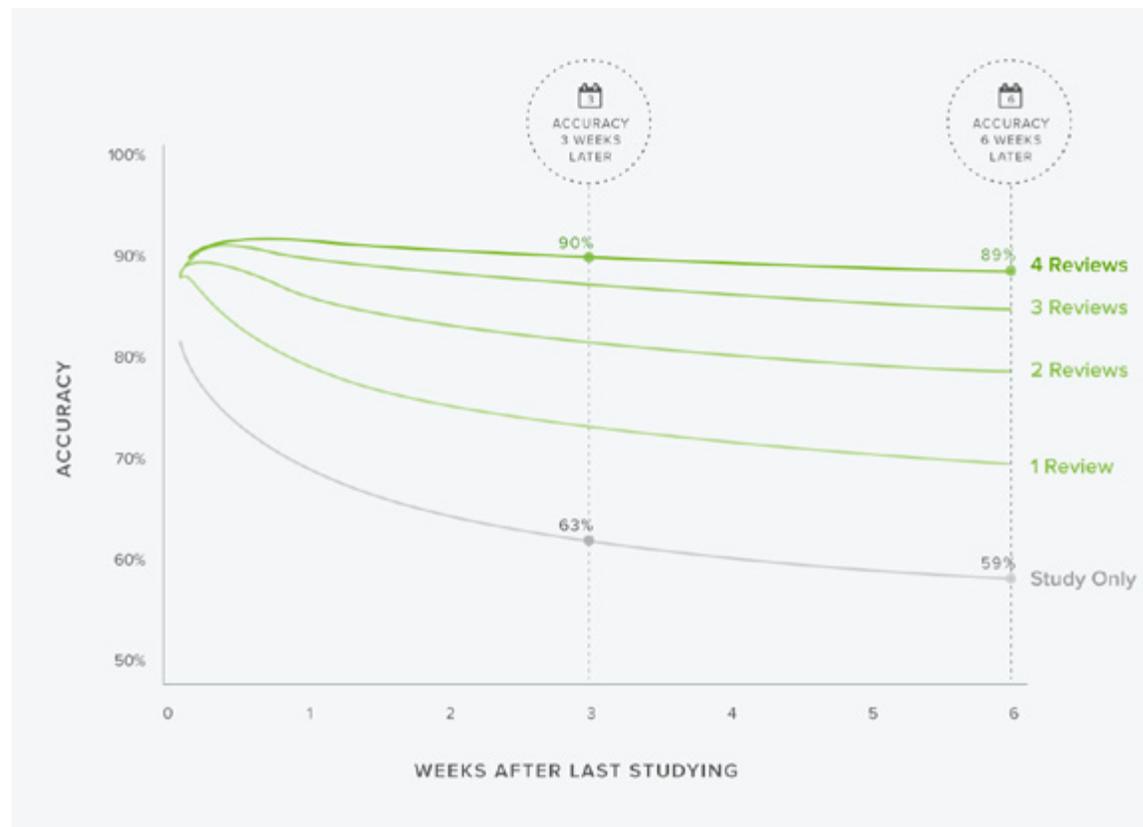
The important thing is not what your test score was last week, but what you know right now. We analyze millions of reviews in our database to track precisely how memories fade and stabilize over time.

This chart, built from millions of interactions in Cerego, shows how memory for new information fades over time - and how reviewing for less than a week can help the knowledge to stick instead.

The ability to remember newly learned material (gray line) drops rapidly from 80% in the first couple of days, to below 60% after a few weeks. Simply studying something new doesn't mean it sticks. On the other hand, just completing a single review a few hours after first

studying something (light green) greatly enhances retention. An immediate 5% improvement in the first day or two grows to a 10% difference a few weeks later. And completing 4 reviews (dark green) takes just 2 minutes per item, but builds a mastery of the material that results in 90% accuracy even weeks later.

The data is clear: following your schedule in Cerego, even just for the first few days, builds mastery for material that sticks around for weeks and months afterward.

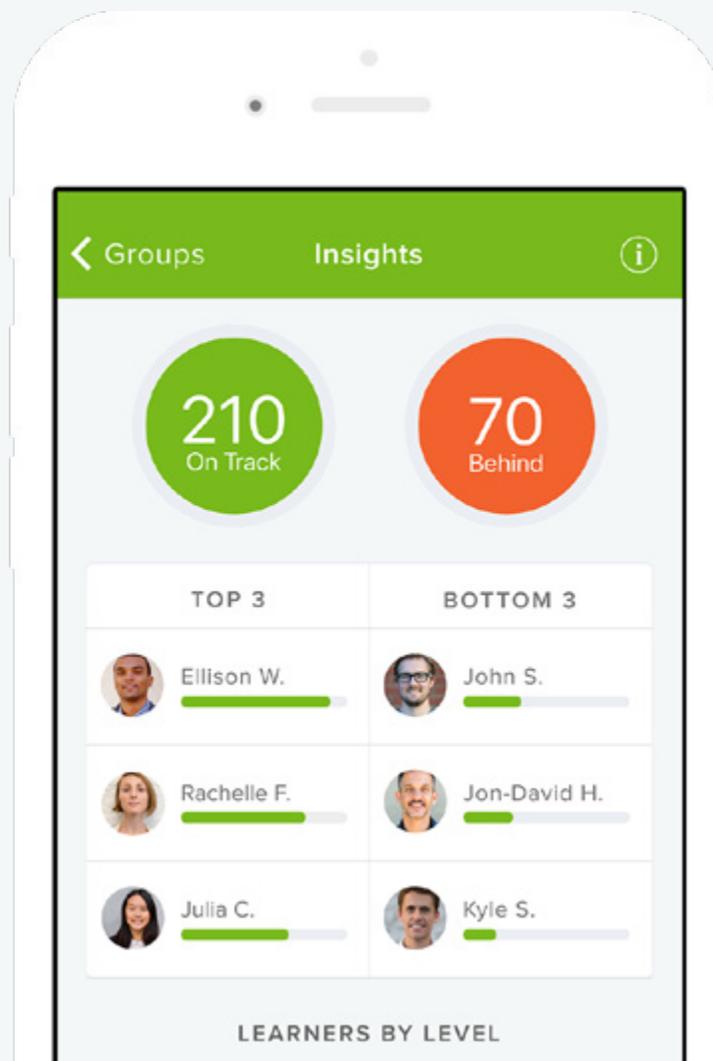


# 2X BETTER WITH MOBILE

Having access to Cerego on a mobile device makes it easier to review - to learn more, and to study in a more effective way. We set out to measure the differences in how our mobile users distributed their study, and the effect this had on their learning. We found that not only did mobile users learn twice as much material through Cerego, but they did so in a more efficient way, through shorter sessions, sticking more closely to their schedule - and showed greater learning gains.

Despite being in the same course with similar requirements, **mobile learners completed more than twice the number of total reviews** (quizzes) than their non-mobile counterparts.

Learn more on our blog:  
[www.cerego.com/blog](http://www.cerego.com/blog)





## FURTHER READING

Further information detailing the architecture, experience, and results from using Cerego can be found at: [cerego.com/whitepaper](http://cerego.com/whitepaper)