The 2018-2023 Global Cognitive Learning Market

Revenues Will More than Double by 2023

Analysis by: Sam S. Adkins
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Table of Contents

Metaari’s Organizational Enterprise Licensing Model ....................... 2
Table of Contents ............................................................................. 3
List of Tables ...................................................................................... 6
List of Figures .................................................................................... 8
About Metaari .................................................................................... 10
About the Analyst .............................................................................. 10
What is Cognitive Learning? Metaari’s Definition of Cognitive
Learning .......................................................................................... 11
  The Foundation of Cognitive Learning is Neuroplasticity .................. 13
  Learning and Behavior Modification are Identical ......................... 14
  Embodied Cognition is Identical to Cognitive Learning .................. 17
The Eight Types of Cognitive Learning Products ............................ 19
Towards a Formal Neuropedagogy: Metaari's Cognitive Learning Pedagogical Framework .................................................. 20
The Demographics are Huge ............................................................ 22
Empirical Evidence on the Effectiveness of Brain Training Products ... 27
Executive Overview: Revenues More than Double by 2023 ....... 31
  The Evolving Business Models ....................................................... 33
  US FDA Approval Raises the Value of Cognitive Learning Products .... 34
Brief Overview of Primary Catalysts Driving the Global Cognitive Learning Market ......................................................... 36
  Leading Indicators: Private Investment in Cognitive Learning Firms Remains Steady ................................................................. 38
  Brain Entrainment: Next-Generation Cognitive Learning Products Alter the Competitive Landscape ................................................ 38
  AI and Cognitive Computing are Game Changers .......................... 39
  Advanced VR-based Cognitive Learning Products Hit the Market .... 40

Over 560 suppliers operating 122 countries are cited in this report to help suppliers identify partners, distributors, and resellers.
Cognitive Learning Games for Children with Special Needs Gain Traction.. 41
Rapid Adoption of Specialized Mental Training Apps for Athletes, First
Responders, and Military Personnel .................................................. 42
What You Will Find in This Report ..................................................... 44
Where are the Buyers? .................................................................. 45
Who is the Buyer? .......................................................................... 47
What are They Buying? ................................................................. 49
Sources of Data on the Global Cognitive Learning Market ............ 51

The 2018-2023 Global Cognitive Learning Market ................. 56

Metaari’s Cognitive Learning Pedagogical Framework ................... 56

The Cognitive Spectrum: Carroll’s Three-Stratum Theory of Intelligence ...... 57
The Response to Intervention (RTI) Model .................................. 61
Applied Behavior Analysis Therapy (ABA) ................................. 63
Cognitive Behavior Therapy (CBT) .............................................. 66
Contingency Management ............................................................. 69
Biofeedback and Sensory Stimulation Technologies .................... 70
Neuromodulation (Brain Stimulation) .......................................... 71
Spaced Repetition ........................................................................ 73
Dual N-Back ................................................................................ 75
Elaborate Encoding ....................................................................... 77

Global Cognitive Learning Demand-side Analysis ..................... 78

Detailed Demand-sided Analysis of the Primary Catalysts Driving the Global
Cognitive Learning Market ............................................................... 78

Steady Investments Made to Cognitive Learning Companies .......... 79
Brain Entrainment: Next-Generation Cognitive Learning Products Alter the Competitive
Landscape ...................................................................................... 82

Brain Trainers for Kids Hit the Market ........................................ 84
Brainwave Entrainment is the Foundation of a New Type of Learning .......................... 86
Biofeedback and Sound and Light Stimulation: Training the Brain with Sensory Stimulation
........................................................................................................... 88

Neuromodulation (Brain Stimulation) Technologies ..................... 95

AI and Cognitive Computing are Game Changers ...................... 101
Cognitive Computing .................................................................... 103
Emotion AI: Emotion Recognition and Sentiment Analysis .......... 103

VR-based Cognitive Learning Products are New Learning Technology Types .... 106
Cognitive Learning Products for Kids with Special Needs Drive the Market .... 111

For more information about this report, email: contact@metaari.com
Metaari’s 2018-2023 Global Cognitive Learning Market

Rapid Adoption of Specialized Mental Training Apps for Athletes, First Responders, and Military Personnel .......................................................... 114

Worldwide Demand-side Analysis by Seven Regions .......................... 121
- Africa .................................................................................. 122
- Asia Pacific ........................................................................... 125
- Eastern Europe ...................................................................... 131
- Latin America ......................................................................... 133
- The Middle East ..................................................................... 136
- North America ......................................................................... 139
- Western Europe ........................................................................ 142

Global Demand-side Analysis by Six Buyer Segments (For All Seven Regions Combined) ................................................................. 148
- Consumers ........................................................................... 149
- PreK-12 Schools ...................................................................... 151
  Solving the 2 Sigma Problem .......................................................... 154
- Tertiary and Higher Education .................................................... 156
- Federal Government Agencies ................................................... 159
- Local, State, Provincial, & Prefecture Agencies ......................... 164
- Corporations and Businesses ...................................................... 167

Global Cognitive Learning Supply-side Analysis by Eight Product Types 171
- Cognitive Fitness Games and Brain Trainers ................................ 173
- Mental Training Apps for Athletes, First Responders, and the Military .... 178
- Cognitive Health and Mental Wellness Apps ................................ 182
  The Wellness Wheel: The Eight Dimensions of Wellness .............. 183
  Emotional Wellness Apps Gaining Traction ........................................ 186
- Mindfulness Online Courses, Mobile Apps, and Online Programs ...... 190
- Cognitive Learning Products for Children with Special Needs .......... 195
- Digital Mental Health Treatment Products ................................... 197
- Digital Addiction Intervention Products and Services .................. 204
- Cognitive Disability Therapy and Rehabilitation Products ............ 207

Index of Suppliers ....................................................................... 214
List of Tables

Table 1 - 2016 World Health Organization (WHO) Global Mental Health Statistics ......................................................... 25

Table 2 - The 122 Countries across the Seven Regions Tracked by Metaari ................................................................. 45

Table 3 - 2018-2023 Global Cognitive Learning Revenue Forecasts (in US$ Millions) ...................................................... 56

Table 4 - 2018-2023 Global Cognitive Learning Revenue Forecasts by Seven Regions (in US$ Millions) ......................... 121

Table 5 - 2018-2023 Cognitive Learning Revenue Forecasts for Africa (in US$ Millions) .................................................. 122

Table 6 - 2018-2023 Cognitive Learning Revenue Forecasts for Asia Pacific (in US$ Millions) ......................................... 125

Table 7 - 2018-2023 Cognitive Learning Revenue Forecasts for Eastern Europe (in US$ Millions) .................................. 131

Table 8 - 2018-2023 Cognitive Learning Revenue Forecasts for Latin America (in US$ Millions) ........................................ 133

Table 9 - 2018-2023 Cognitive Learning Revenue Forecasts for the Middle East (in US$ Millions) ............................... 136

Table 10 - 2018-2023 Cognitive Learning Revenue Forecasts for North America (in US$ Millions) ..................................... 140

Table 11 - 2018-2023 Cognitive Learning Revenue Forecasts for Western Europe (in US$ Millions) ................................. 143

Table 12 - 2018-2023 Global Cognitive Learning Market by Six Buyer Segments (in US$ Millions) ................................. 148

Table 13 - 2018-2023 Global Consumer Cognitive Learning Revenue Forecasts (in US$ Millions) ..................................... 149

Table 14 - 2018-2023 Global PreK-12 Cognitive Learning Revenue Forecasts (in US$ Millions) ....................................... 151
Table 15 - 2018-2023 Global Higher Education Cognitive Learning Revenue Forecasts (in US$ Millions) .......................... 156


Table 17 - 2018-2023 State and Local Government Cognitive Learning Revenue Forecasts (in US$ Millions) .......................... 164

Table 18 - 2018-2023 Corporate Cognitive Learning Revenue Forecasts (in US$ Millions) .......................... 167

Table 19 - 2018-2023 Revenue Forecasts for Eight Types of Digital Cognitive Learning Products (in US$ Millions) .............. 172

Table 20 - 2018-2023 Revenue Forecasts for Cognitive Fitness and Brain Training Games (in US$ Millions) .......................... 173

Table 21 - Top Twenty Best-selling Educational Apps Dominated by Three Educational Game Types (as of January 2019) ................................................................. 176

Table 22 - 2018-2023 Revenue Forecasts for Mental Training Apps for Athletes (in US$ Millions) .......................... 178

Table 23 - 2018-2023 Revenue Forecasts for Cognitive Health and Mental Wellness Apps (in US$ Millions) .......................... 182

Table 24 - 2018-2023 Revenue Forecasts for Mindfulness Online Courses, Mobile Apps, and Online Programs (in US$ Millions) .......................... 190


Table 26 - 2018-2023 Revenue Forecasts for Self-paced Digital Mental Health Treatment Products (in US$ Millions) ....... 198

Table 27 - 2018-2023 Revenue Forecasts for Digital Intervention Products and Services (in US$ Millions) .......................... 204

Table 28 - 2018-2023 Revenue Forecasts for Cognitive Disability Therapeutic and Rehabilitation Software (in US$ Millions) .......................... 208
List of Figures

Figure 1 – Metaari's Defines Cognitive Learning as Neuropedagogy ................................................................. 12

Figure 2 – Reciprocal Learning: Bandura's Social Cognitive Theory ........................................................................... 16

Figure 3 – Domains of Human Embodied Cognition ............................................................................................. 18

Figure 4 – The Eight Cognitive Learning Product Types Grouped in Two Broad Categories ...................................... 19

Figure 5 – Metaari's Cognitive Learning Pedagogical Framework ............................................................................... 21

Figure 6 - Primary Catalysts Driving the 2018-2023 Global Cognitive Learning Market .................................................. 37

Figure 7 – Situated Cognition: Endsley's Model of Situational Awareness ................................................................. 43

Figure 8 – 2018-2023 Cognitive Learning Growth Rates by Seven Regions .............................................................. 46

Figure 9 - 2018-2023 Global Five-year Growth Rates for Digital Cognitive Learning Products by Six Buyer Segments .........48

Figure 10 - 2018-2023 Global Five-year Growth Rates for Cognitive Learning Products by Eight Content Types ............ 50

Figure 11 - Metaari's Actionable Competitive Intelligence Methodology ............................................................... 52

Figure 12 - Carroll’s Three-Stratum Theory of Intelligence ............... 57

Figure 13 – Types of Human Memory ..................................................... 59

Figure 14 - Three-tiered Response to Intervention (RTI) Model ............................................................. 61
Figure 15 - 1997 to 2018 Investments Made to Global Cognitive Learning Companies (in US$ Millions) ......................... 79

Figure 16 - Ten Neuromodulation (Brain Stimulation) Technologies Used in Cognitive Learning Products ..................... 96

Figure 17 – Cognitive Tutors Can Exceed the 2 Sigma Shift ....... 155

Figure 18 - The Wellness Wheel: The Eight Dimensions of Wellness .................................................................................. 183

Figure 19 – Domains of Emotional Intelligence (EQ) ................. 187
About Metaari

Metaari (formerly Ambient Insight) is an ethics-based quantitative market research firm that identifies revenue opportunities for advanced learning technology suppliers.

Metaari publishes quantitative syndicated reports that break out revenues by customer segment (demand-side analysis) and by product category (supply-side analysis). Our forecasts are based on our industry-leading learning technology taxonomy and our Evidence-based Research Methodology (ERM).

We track the learning technology markets in 122 countries. We have a breathtaking view of the international learning technology market. We have the most complete view of the international learning technology market in the industry.

Metaari focusses solely on advanced learning technology research on products that utilize psychometrics, game mechanics, robotics, cognitive computing, artificial intelligence, virtual reality, and augmented reality.

About the Analyst

Sam S. Adkins is the CEO and Chief Researcher at Metaari. Sam has been providing market research on the learning technology industries for over twenty years and has been involved with digital training technology for over thirty-five years. Sam is an expert at identifying revenue opportunities for global learning technology suppliers.
Sam was the co-founder and Chief Research Officer for Ambient Insight between 2004 and 2016 before rebranding the company to Metaari in early 2017. Sam was a business development manager for Microsoft’s Training and Certification group.

During his eight years at Microsoft, he managed the Advanced Knowledge Engineering team that built the world’s first commercial online learning business (The Microsoft Online Learning Institute). Prior to that, he was a Senior Instructional Designer at United Airlines.

Before United Airlines, Sam was the manager of the Instructional Animation and Graphics Lab at AT&T's central computer-based training (CBT) facility for four years.

Sam Adkins and Tyson Greer founded Ambient Insight in 2004. Ambient Insight ceased operations in late 2016 and rebranded as a new company named Metaari that launched in January 2017.

"Ambient Insight has been in operation for twelve years and we have a well-respected brand and a very successful company," comments Adkins. "The global learning technology market has changed dramatically in the last few years and the new advanced learning products coming on the market essentially represent a 'brave new world' in education. We want to be an active part of this new world and launched our new company to focus on these incredible innovations."

What is Cognitive Learning? Metaari's Definition of Cognitive Learning

Oxford Dictionary defines cognition as "the mental action or process of acquiring knowledge and understanding through thought, experience, and the senses." Cognitive science is defined as an interdisciplinary study of the human mind used to characterize the nature of human knowledge.

Cognitive Learning is defined by Metaari as empirical (observable and measurable) neuropedagogy, the intersection of neuroscience, cognitive psychology, and educational theory. Metaari's Cognitive Learning definition is heavily rooted in neuroscience, cognitive science, educational psychology, embodied cognition, and Cognitive Learning Theories (particularly the models of Bloom and Bandura).
In Metaari's taxonomy, the major scientific underpinnings of Cognitive Learning are:

- Educational Neuroscience
- Neuropsychology
- and Educational Psychology

According to London's Centre for Educational Neuroscience, "Educational neuroscience is an emerging scientific field that brings together researchers in cognitive neuroscience, developmental cognitive neuroscience, educational psychology, educational technology, education theory, and other related disciplines to explore the interactions between biological processes and education."

Educational neuroscience is also called neuroeducation or neurodidactics and is a pivotal component of what is now known as neuropedagogy, i.e. Cognitive Learning.

**Figure 1 – Metaari's Defines Cognitive Learning as Neuropedagogy**

Neuropsychology is a "branch of psychology that is concerned with how the brain and the rest of the nervous system influence a person's cognition and behaviors." The science studies the relationship between
neural structures and processes and behavior and cognition. According to ScienceDaily "Neuropsychology is a branch of psychology and neurology that aims to understand how the structure and function of the brain relate to specific psychological processes. It is scientific in its approach and shares an information processing view of the mind with cognitive psychology and cognitive science."

Educational psychology is a branch of psychology that applies theories of human development and psychology to didactics, the science of teaching and learning. In educational psychology, the knowledge acquisition process unfolds in two phases: knowledge transfer to the recipient and hopefully learning transfer (observable and measurable mastery).

All systematic approaches to instructional design incorporate educational psychology. Professionals with formal instructional design credentials have all studied education psychology. Corporate and government instructional designers are well versed in Bloom's Taxonomy. Bloom was an educational psychologist.

The Foundation of Cognitive Learning is Neuroplasticity

The Oxford Dictionary defines neuroplasticity as "The ability of the brain to form and reorganize synaptic connections, especially in response to learning or experience or following injury." The foundation of modern Cognitive Learning theory is the scientific evidence of the brain's plasticity, also known as neuroplasticity.

According to the Canadian researcher Patrice Voss "Neuroplasticity can be viewed as a general umbrella term that refers to the brain’s ability to modify, change, and adapt both structure and function throughout life and in response to experience."

In a 2016 article called "Educational Neuroscience: Challenges and Opportunities", the researcher Ann Neurosci wrote, "Educational neuroscience is an emerging multidisciplinary field wherein the aim is to link basic research in neuroscience, psychology and cognitive science, with educational technology. Neuroplasticity is the key bridging process." She also wrote that "learning to read is one of the most elegant examples of the neuroplasticity of the brain."
Beyond learning to read, the two most prominent examples of neuroplasticity are learning to speak a new language or learning to play a new musical instrument.

- According to the US neuromodulation device maker Helius Medical Technologies, "Research has shown that the process of neuroplasticity underlies all cerebral learning, training, and rehabilitation."

Posit Science is a leading brain training developer and maintains that, "Brain plasticity is the brain's ability to change—physically, functionally, and chemically—throughout life. It is also the basis of our clinically proven Cognitive Learning exercises."

In March 2017, the US Defense Advanced Research Projects Agency (DARPA) funded the $9.85 million Targeted Neuroplasticity Training (TNT) program and is working with seven universities and several Army and Air Force agencies. "TNT research focuses on a specific kind of learning called cognitive skills training. People use cognitive skills to do things like pay attention, process information, do several things at once, detect and understand patterns, remember instructions, and organize information."

- The DARPA TNT program uses a neuromodulation (brain stimulation) method called peripheral nerve stimulation "to enhance learning processes in the brain." The goal of the program is to "develop a noninvasive, user-friendly technology that simultaneously delivers a stimulus, monitors neural response and dramatically accelerates learning."

Halo Neuroscience is a popular Cognitive Learning product used by athletes and military agencies. Their flagship product is Halo Sport, a neuromodulation headset that they claim enables Neuropromising. "Halo Sport is a brain stimulator that increases neuroplasticity."

**Learning and Behavior Modification are Identical**

Cognitive Learning Theory posits that the learning process is based on observable changes in behavior. Learning (knowledge acquisition) is simply an acquisition of a new behavior; a change in behavior.
Cognitive Learning products are designed to change or modify cognitive abilities. Webster's Dictionary defines learning as "a modification of a behavioral tendency by experience. Learning is demonstrated by a change in behavior." **Learning and behavior modification are synonyms, they are identical.**

The identical nature of learning and behavior modification is clearly evident in Bloom's Taxonomy, Gagné's Nine Events of Instruction, and in Robert Mager's work surrounding observable and measurable performance objectives.

These three Instructional Systems Design (ISD) methods are still the foundation of corporate and government training development. The four dominant learning theories (Behavioral, Cognitive, Experiential, and Constructivism) all define knowledge acquisition as a process of cognitive behavior change.

In the revised Bloom's Taxonomy developed in 2001, the researchers Anderson and Krathwohl wrote "A statement of a learning objective contains a verb (an action) and an object (usually a noun). The verb generally refers to actions associated with the intended **cognitive process**. The object generally describes the knowledge students are expected to acquire or construct. **The cognitive process dimension represents a continuum of increasing cognitive complexity.**"

Bloom's Taxonomy has three learning domains: affective, cognitive, and psychomotor. They are the building blocks of Cognitive Learning. The affective domain deals with emotions. Emotion recognition is now a prime component of many Cognitive Learning products. Emotional Intelligence (EQ) is now firmly established in the lexicon. Bloom's cognitive domain deals with knowledge acquisition and the internal manipulation of that knowledge.

The psychomotor domain deals with physical actions but also includes perception and the sense of situational awareness. This domain maps to the relatively new cognitive research paradigm called embodied cognition.

Although it emerged in the early 20th century in the work of pioneers like Jean Piaget, Lev Vygotsky, John Dewey, and Martin Heidegger, it has only been rigorously researched in the last few decades. Due to the inclusion of the psychomotor domain, Bloom's Taxonomy can be categorized as an embodied cognition schema.
Metaari’s definition of Cognitive Learning also draws from the work of Albert Bandura. In his Social Cognitive Theory (Social Learning Theory), there are four non-linear (reciprocal) cognitive processes involved in knowledge acquisition: attention, retention, motor reproduction, and motivation.

The four processes are "contained" within three experiential vectors comprised of the cognitive states of the individual, the environment (including the biological state), and the behavioral conditions at play. Bandura's three experiential vectors map closely to Bloom's three domains.

**Figure 2 – Reciprocal Learning: Bandura's Social Cognitive Theory**

Bandura's model, "posits that people learn from one another, via observation, imitation, and modeling. The theory has often been called a bridge between behaviorist and cognitive learning theories because it encompasses attention, memory, and motivation." Bandura's model is also referred to as observational learning.
Embodied Cognition is Identical to Cognitive Learning

The premise of embodied cognition is that the mind (neural states), body (sensory awareness), and the environment are interactive (reciprocal) components of cognition. It is in direct contrast to the René Descartes' Cartesian Dualism theory that posits a distinct separation between the body (defined as physical) and the mind (defined as non-physical).

- Descartes do not invent dualism. It has been in existence for thousands of years. It maintains that the body and mind are "ontologically distinct substances that causally interact." It is now quite unscientific to claim that the mind is non-physical considering the neural structures and processes that generate states of mind. That said, dualism is still deeply rooted in Western healthcare.

Developmental psychologist Esther Thelen wrote in 2001 that "To say that cognition is embodied means that it arises from bodily interactions with the world. From this point of view, cognition depends on the kinds of experiences that come from having a body with particular perceptual and motor capacities that are inseparably linked and that together form the matrix within which memory, emotion, language, and all other aspects of life are meshed." In other words, embodied cognition is Cognitive Learning.

There are dozens of startups that develop Cognitive Learning using so-called brain entrainment technology, a distinct process of embodied cognition. Brain entrainment is accomplished via biofeedback (output) and/or light and audio sensory stimulation (input). Biosensor devices and wearables are used in most brain entrainment products.

The suppliers that develop these products are identified in this report and an analysis of their product bundles, their pricing models, and their target demographics are also provided.

Many suppliers develop Cognitive Learning products that incorporate neuromodulation (brain stimulation) using electrical or magnetic currents to alter brain waves and cognitive states. There are five types of brain waves and each of them correlate to specific cognitive abilities and states.

They are discussed in detail in the demand-side section. This report identifies ten distinct types of neuromodulation protocols used in
Cognitive Learning products and suppliers that develop them. These suppliers develop quintessential embodied cognition products.

**Figure 3 – Domains of Human Embodied Cognition**

Embodied cognition is a prominent aspect in the virtual reality (VR) experience. The advent of VR has created a renewed interest in experiential learning (situated cognition). Some of the best examples of Cognitive Learning via VR are the new exposure therapy (systematic desensitization) apps on the market. The products have proven quite effective at reducing (and even eradicating) phobias; very distinct cognitive states.

- The American Psychological Association stated in February 2018 that "Even in the early days of virtual reality, researchers quickly recognized that the technology was a great fit for providing exposure therapy. Virtual reality is an excellent tool for exploring basic questions about human perception and cognition."

All of the new VR-based mental training apps for athletes and first responders are virtual experiences designed to alter cognitive states via embodied cognition. The commercial products are based on either sports psychology or situational awareness designed for different demographics.
and both are, by definition, experiential, essentially virtual embodied cognition.

**The Eight Types of Cognitive Learning Products**

In Metaari's taxonomy, Cognitive Learning products are divided into two broad categories: products designed to improve cognitive functions in relatively healthy people and products designed to mitigate cognitive deficiencies or impairments caused by mental health problems, addiction, disability, or traumatic injury.

**Figure 4 – The Eight Cognitive Learning Product Types Grouped in Two Broad Categories**

In relatively healthy people, Cognitive Learning products are designed to improve or enhance perception, working memory, comprehension, emotional states, decision making, fluid intelligence (general problem solving), and reasoning.

In people with cognitive impairments, Cognitive Learning is designed to treat specific impairments like autism, dyslexia, addiction, stress, anxiety, phobia, and dementia. These products are designed to treat a range of cognitive impairments from mild cognitive impairment (MCI) to
severe impairment. The goal is still the same – cognitive behavior change.

This report provides forecasts for eight pedagogically unique product types that fall into these two categories. The buyer demand and the revenues streams for each product type are quite distinct. Calibrating quantitative market forecasts for each product type is a relatively straightforward process.

**Towards a Formal Neuropedagogy: Metaari's Cognitive Learning Pedagogical Framework**

This report includes a detailed description of Metaari's Cognitive Learning Pedagogical Framework. The framework was derived by reverse engineering commercial products. There are outlier products that use other methods, but the ten presented here are the dominant methods used in commercial Cognitive Learning products.

*The framework provides suppliers with a precise method of tapping specific revenue streams and a concise instructional design specification for the development of profitable high-demand Cognitive Learning products.*

Metaari has identified ten schemas that Cognitive Learning developers use to design products derived by analyzing the design of commercial products. The schemas in Metaari’s Cognitive Learning Pedagogical Framework include:

- Carroll’s Three-Stratum Theory of Intelligence
- Response to Intervention (RTI)
- Applied Behavior Analysis (ABA)
- Cognitive Behavior Therapy (CBT)
- Contingency Management
- Biofeedback and Sensory Stimulation Technologies
- Neuromodulation (Brain Stimulation)
- Spaced Recognition
- Dual N-Back
- Elaborate Encoding

These schemas are a combination of cognitive theories, behavioral therapies, sensory input and bio output technologies, brain stimulation, and well-known mnemonic methods. In the detailed analysis of the
framework, developers and products that map to specific schemas are identified.

For example, ABA is widely used in mental therapy and in apps designed to treat autism, dual n-back and Carroll’s Stratum are common design matrices in brain trainers and mental training apps for athletes, and contingency management is the most common method used in addiction intervention. Biofeedback and sensory stimulation are prominent in wellness and mindfulness apps. The framework is a design roadmap for developers. All of the suppliers identified in this report use one or more of the schemas in their products.

Figure 5 – Metaari’s Cognitive Learning Pedagogical Framework

Most of the successful commercial Cognitive Learning products target specific cognitive abilities with well-designed tasks empirically proven to improve those abilities. It is now very difficult to compete in the market without psychometrically-sound feature sets.

One of the most widely accepted models for categorizing cognitive abilities and intellectual processes in cognitive research is Carroll’s Three-Stratum Theory of Intelligence. His classification posits three tiers of cognitive abilities: general intelligence, eight broad cognitive abilities, and dozens of narrow cognitive abilities. All cognitive fitness, brain
training, and mental training apps on the market are designed to improve or enhance one or more of these abilities.

A common behavior modification process used in the PreK-12 schools is the three-tiered model called Response to Intervention, or RTI. It was mandated in the Individuals with Disabilities Education Act (IDEA) that went into effect in the US in 2006. The model is used mostly in schools in North America and in so-called international schools in countries outside the region.

The RTI model was originally developed to provide intervention for students with learning disabilities, but it is now used on a much broader scale and is now being used to identify gifted children as well (known as the fourth tier).

Like the Carroll taxonomy, the RTI model is also an instructional design framework; an instructional design model of very distinct Cognitive Learning products. A detailed discussion of the RTI model is provided in this report. All the educational publishers sell products that map to the model and a description of those products is provided in the detailed analysis of Metaari’s Cognitive Learning Pedagogical Framework.

Cognitive Behavior Therapy (CBT) is being used to treat anxiety and mood disorders. It is touted as the most evidence-backed method with a large body empirical and longitudinal research showing the effectiveness of the method.

Developers are using CBT protocols to design sophisticated Cognitive Learning products. Over one hundred suppliers that develop CBT-based Cognitive Learning are identified in this report. They tend to market their products to particular demographics.

The primary advantage of using a cognitive behavior schema in designing learning products is that the methods (protocols) are standardized. Knowledge transfer is mapped to a standard model. The resulting behavior changes (learning transfer) are observable and can be empirically measured using tools unique to each of the ten schemas.

The Demographics are Huge

Of the eight distinct types of Cognitive Learning products defined by Metaari, four are designed to increase cognitive fitness in relatively
healthy people and four are designed to treat cognitive impairments ranging from mild disorders to clinical disorders. All eight are designed to achieve cognitive behavior modification by altering cognitive states.

The four types of Cognitive Learning products designed to enhance cognitive fitness in relatively healthy people: brain trainers, mental trainers, wellness apps, and mindfulness apps. They can be collectively categorized as cognitive fitness products.

Mindfulness apps are one of the eight Cognitive Learning products forecast in this report. A survey by Fidelity Investments and the National Business Group on Health, found that 22% of employers offer mindfulness and meditation to employees.

- Mindfulness apps are generally based on meditation and yoga techniques. An estimated 36 million people practice yoga in the U.S., up 44% from 2012, and another 80 million Americans will at least try yoga in 2019, according to a survey by the Yoga Journal and the Yoga Alliance.

Second and third-generation brain trainer and brain fitness games in the 2018 market are based on cognitive science, neuropsychology, and brain-based learning theories emerging from educational psychology and educational neuroscience. It is an instructional method that targets the neuro-physiological processes involved in learning and has little in common with traditional instructional design principles. Brain trainers have evolved dramatically since Nintendo introduces the game genre in 2005.

The new cognitive fitness and brain training games are primarily designed for two demographics: the elderly and young children (a recent development). New brain trainers for kids are coming on the market at a rapid pace. They are designed to enhance the developmental stages of children. Mobile brain trainers are popular all over the world. They consistently rank in the the best-selling educational apps in the commercial app stores. The products are now used by billions of people worldwide.

Mental training apps for athletes used to be limited to professional sports teams, a relatively small number of users. Now developers are targeting schools, colleges and individuals with these products. The demographic cohort is quite large. There are over 40 million people in the US alone that participate in some form of organized sport each year.
The demographics for the four types of Cognitive Learning products designed to mitigate mental health issues and cognitive impairment are exponentially more massive.

According to the Center for Disease Control and Prevention, "one in five American children have a diagnosable mental, emotional or behavioral disorder in a given year." The US Department of Health and Human Services (HHS) reports that 7.7% of children in the US between the ages of 3 and 17 have some form of voice, speech, or language disorder. That is five million children. Teenagers were identified as being at the most risk. There are dozens of suppliers identified in this report that develop Cognitive Learning products for kids.

The National Institute of Mental Health (NIMH) reports that, "Our best estimate of the number of adults with any diagnosable mental disorder within the past year is nearly 1 in 5, or roughly 46 million Americans."

- "Although most of these conditions are not disabling, nearly 10 million American adults (1 in 25) have serious functional impairment due to a mental illness, such as a psychotic or serious mood or anxiety disorder.

- Fully 20 percent—1 in 5—of children ages 13-18 (24 million people) currently have and/or previously had a seriously debilitating mental disorder."

- The NIMH reports that, "Anxiety disorders are the most common mental illness in the U.S., affecting 40 million adults in the United States age 18 and older, or 18% of the population."

The A.D.D. Resource Center reports that 12.9% of men and 4.9% of women will be diagnosed with an attention deficit disorder at some points in their lifetimes. The Centers for Disease Control and Prevention (CDC) estimates that 11% of US children aged 4 to 17 suffer from ADHD.

In any given year, 3.6% of US adults aged 18 to 54 (5.2 million people) experience Post-traumatic Stress Disorder (PTSD). PTSD is not limited to military veterans. The disorder is caused by severe psychological or physical trauma.
There are over 40 million adults in the US that have dyslexia. At least 20% of all school age children in the US have dyslexia according to the American Dyslexia Association. That is 11 million children. Cognitive Learning is particularly effective at mitigating the challenges of dyslexia.

The global statistics are staggering. According to the World Health Organization (WHO), there are just under 1.1 billion people on the planet that have some form of mental health issue or cognitive impairment. What is interesting is the difference between countries. Cognitive Learning developers that are successful in some countries may not be as successful in others.

Table 1 - 2016 World Health Organization (WHO) Global Mental Health Statistics

<table>
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<tr>
<th>Disorder</th>
<th>Share of global population with disorder (2016) [difference across countries]</th>
<th>Number of people with the disorder (2016)</th>
<th>Share of males and females with disorder (2016)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any mental or substance use disorder</td>
<td>15.5% [13-22%]</td>
<td>1.1 billion</td>
<td>16% males 15% females</td>
</tr>
<tr>
<td>Depression</td>
<td>4% [2-6%]</td>
<td>268 million</td>
<td>3% males 4.5% females</td>
</tr>
<tr>
<td>Anxiety disorders</td>
<td>4% [2.5-6.5%]</td>
<td>275 million</td>
<td>3% males 4.7% females</td>
</tr>
<tr>
<td>Bipolar disorder</td>
<td>0.6% [0.4-1.5%]</td>
<td>40 million</td>
<td>0.55% males 0.65% females</td>
</tr>
<tr>
<td>Eating disorders (clinical anorexia &amp; bulimia)</td>
<td>0.14% [0.05-0.55%]</td>
<td>10.5 million</td>
<td>0.07% males 0.2% females</td>
</tr>
<tr>
<td>Schizophrenia</td>
<td>0.3% [0.2-0.45%]</td>
<td>21 million</td>
<td>0.29% males 0.28% females</td>
</tr>
<tr>
<td>Alcohol use disorder</td>
<td>1.4% [0.5-5%]</td>
<td>100 million</td>
<td>1.9% males 0.8% females</td>
</tr>
<tr>
<td>Drug use disorder (excluding alcohol)</td>
<td>0.9% [0.4-3.3%]</td>
<td>62 million</td>
<td>1.1% males 0.5% females</td>
</tr>
</tbody>
</table>
According to the US's Center for Disease Control (CDC), just over 1% of people across the planet have an Autism Spectrum Disorder (ASD). That is roughly 80 million people.

According to the Autism Society, over 3.5 million people in the US live with an autism spectrum disorder (ASD). Autism is characterized by "persistent deficits in social communication and interaction across multiple contexts, as well as restricted, repetitive patterns of behavior, interests, or activities. These deficits are present in early childhood, and lead to clinically significant functional impairment."

In recent years, humanoid robots programmed for cognitive therapy have proven to be very effective at treating people with autism, particularly children. There are now companies in the market across the planet that specialize in treating children along the autism spectrum with robots.

- The US has the highest rate of childhood autism in the world at 168 for every 10,000 kids followed by Japan at 161 per 10,000 kids. Canada comes in third with 152 autistic kids per 10,000. The UK and Ireland both have 100 autistic kids for every 10,000 children. Brazil has one of the lowest rates in the world with only 27 kids per 10,000 having autism.

The US Surgeon General released a report in November 2016 that stated that "more than 27 million Americans currently use illicit drugs or misuse prescription meds like painkillers." Addiction intervention products are a unique type of Cognitive Learning product and revenues for the product are broken out in this report. The growth rate for these products is 21.2% and revenues will more than double by 2023.

According to the US Department of Health and Human Services (HHS), people aged 65 and over accounted for 14.5% of the population in 2014, or more than 46 million people. The HHS expects this to grow to 17% by 2020 and to 21.7% of the population by 2040. The number of people aged 60 years or older is expected to rise from 900 million to 2 billion between 2015 and 2050, representing a growth from 12% to 22% of the total global population, according to a recent World Health Organization (WHO) report.

Cognitive Learning products are also being used to mitigate the shortage of mental health professionals in rural areas. A study published in the American Journal of Preventive Medicine and reported in Big Think found that 65% of rural counties in the US don’t have a psychiatrist, 47%
don’t have a psychologist, and a full 81% don’t have a psychiatric nurse practitioner. The shortage of mental health professionals is particularly acute in developing economies.

**Empirical Evidence on the Effectiveness of Brain Training Products**

Researchers and suppliers have a growing body of empirical evidence proving that people who use Cognitive Learning products can condition the brain to improve memory, attention, visual and spatial awareness, auditory processing, linguistic skills, planning skills, and problem solving.

In June 2016, three neuroscientists won the one million dollar 2016 Kavli Prize in Neuroscience. The Kavli Prize is a partnership between the Norwegian Academy of Science and Letters, the Kavli Foundation (US), and The Norwegian Ministry of Education and Research. Michael Merzenich of the University of California, Carla Shatz of Stanford, and Eve Marder of Brandeis were honored for discovering “mechanisms that allow experience and neural activity to remodel brain function.”

- According to the Kavli Foundation, "The Kavli Prize in Neuroscience is awarded for outstanding achievement in advancing our knowledge and understanding of the brain and nervous system, including molecular neuroscience, cellular neuroscience, systems neuroscience, neurogenetics, developmental neuroscience, cognitive neuroscience, computational neuroscience and related facets of the brain and nervous system."

Michael Merzenich is one of the founders of Scientific Learning, a company that develops cognitive intervention products for children. They sell to the schools, directly to parents, and to clinical buyers. Scientific Learning products have been tested in rigorous scientific studies and their site lists hundreds of these studies. "Merzenich has been awarded more than 50 patents and has contributed his software development skills to several therapeutic training programs."

Merzenich is a Professor Emeritus in Neuroscience at the University of California, San Francisco. He is also the Chief Scientific Officer of Posit Science, the developer of the popular BrainHQ product. Their site lists over 100 studies that provide evidence for the effectiveness of their brain
training products. "Our exercises and assessments have been rigorously tested and scientifically proven to be beneficial in more than 100 independent, peer-reviewed research papers published in scientific journals."

In a Japanese study conducted in 2013, the researchers found that playing brain training games does improve cognitive abilities. "To evaluate the transfer effects of the commercial brain training game on cognitive functions, we assessed a broad range of cognitive functions (fluid intelligence, executive functions, working memory, short-term memory, attention, processing speed, visual-spatial ability, and reading ability). The present study showed scientific evidence that the brain training game had the beneficial effects on cognitive functions (executive functions, working memory and processing speed)."

The American Journal of Psychiatry published the results of a study in November 2016 called "Computerized Cognitive Training in Older Adults With Mild Cognitive Impairment or Dementia: A Systematic Review and Meta-Analysis". Dr. Amit Lampit (who led the study) said the results showed brain training could play an important role in helping to prevent dementia.

- "Our research shows that brain training can maintain or even improve cognitive skills among older people at very high risk of cognitive decline - and it's an inexpensive and safe treatment." The research team performed a meta-analysis in which they combined outcomes from 17 randomized clinical trials including nearly 700 participants.

A meta-analysis study published in Neuro-psychology Review in January 2017 called "Enhancing Cognitive Functioning in Healthy Older Adults: a Systematic Review of the Clinical Significance of Commercially Available Computerized Cognitive Training in Preventing Cognitive Decline." The researchers culled empirical studies that included commercial brain training products and then classified them into three levels, with the highest levels indicating empirical evidence of effectiveness.

- Posit Science and CogniFit came in at the highest level and Pearson's Cogmed, Nintendo's Brain Age, and MyBrainTrainer came in at the second-highest level.
In June 2016, MyBrainSolutions released the study results of over 10,000 addiction patients that used their brain health products. Over 350 clinicians participated. "In 2015, data from a patient’s baseline assessment to their follow-up assessment at the end of treatment showed that thinking improved by 18%, emotional functioning improved by 31%, and self-regulation improved by 57."

A study published in Annals of the American Thoracic Society in June 2016 showed that discharged ICU patients that played Posit Science's BrainIQ game over 12 weeks “significant improvement in directly trained assessments of four key cognitive functions: attention, processing speed, memory and executive function. This investigation is the first to our knowledge to evaluate feasibility of a computer gaming approach of cognitive rehabilitation in survivors of non-neuro/non-trauma critical illness.”

In July 2016, the results of the ten-year ACTIVE (Advanced Cognitive Training for Independent and Vital Elderly) study on 2,785 people (65 and older) funded by the National Institutes of Health (NIH) provided empirical evidence for the effectiveness of cognitive training. The study found that older adults’ risk for dementia was reduced by 48 percent over 10 years when they completed 11 or more sessions of brain-training. The scientists say this is the first time a cognitive training intervention has been shown to protect against dementia in a large, randomized, controlled trial.

- People in the ACTIVE study were given exercises along three cognitive domains: memory, reasoning, and speed-of-processing abilities.

- "After 10 years, only the speed-of-processing training had a statistically significant effect on cognition. Participants in this group were 33% less likely than control participants to develop cognitive impairment or dementia."

- The speed-of-processing exercise was a commercial product called Double Decision from Posit Science.

A new brain training game designed by researchers at the University of Cambridge improves users’ concentration, according to new research published in January 2019. Researchers in Cambridge's Behavioural and Mental training app developers are increasingly using augmented reality (AR) and virtual reality (VR) technology in their products, which requires a specific set of developer skills.
Clinical Neuroscience Institute developed and tested a game called Decoder. It is a quintessential attention network training app.

In a study published in the journal Frontiers in Behavioural Neuroscience the researchers reported that "playing Decoder on an iPad for eight hours over one month improves attention and concentration. This form of attention activates a frontal-parietal network in the brain."

The game has now been licensed through Cambridge Enterprise, the technology transfer arm of the University of Cambridge, to commercial brain training developer Peak, who specialize in evidence-based brain training apps.
Executive Overview: Revenues More than Double by 2023

The global growth rate for Cognitive Learning products is 17.8% and revenues will more than double to well over $7 billion by 2023. This report only provides forecasts for content. There are very few (if any) authoring tools on the market designed to create Cognitive Learning. The one exception is the tools used to author Auditory Beat Stimulation (ABS), but most are open source.

Several Cognitive Learning suppliers identified in this report define their products as platforms, but almost all of them are aggregations of packaged content. There is a demand for custom services but it is quite small in terms of revenues. Supplier tend to configure their products for clients rather than customize them. Consequently, this report only provides forecasts for content.

The barriers-to-entry for new Cognitive Learning companies are now quite high as very sophisticated products continue to come on the market. This is even true for the mobile brain trainers. These new products integrate cutting-edge cognitive behavioral theory, psychology, emotion analytics, neurofeedback, affective computing, neuroscience, AI, and biotechnology.

VR is proving effective at treating people with emotional and mental issues. Products are now on the market that can reduce if not eliminate phobia and anxiety. This is particularly true for VR-based exposure therapy (systematic desensitization). People learn to reduce their fears by being exposed to triggers while navigating in a safe virtual environment. This type of Cognitive Learning requires very specialized teams of developers.

Most (if not all) of the intervention and therapeutic products have been developed in partnerships with clinical specialists and those products tend to command high price points. It would be very difficult for a development company without access to clinical expertise to build a commercially viable product of this type.

In December 2018, Apple released their annual “best of” lists and named self-care apps as the top App Store trend of 2018. Apple stated at the time that "This year the best self-care apps put our mental well-being front and center. These innovative apps made self-care more accessible than ever, expanding the practice of wellness around the world."
The new mental training apps for athletes and first responders are based on sports psychology and situational awareness, both highly specialized disciplines. The new mental training app startups are selling very sophisticated products and most are now VR-based products.

Cognitive Learning developers are increasingly using augmented reality (AR) and virtual reality (VR) technology in their products, which requires a specific set of developer skills not found in the development of legacy learning technology products.

The new Cognitive Learning products that utilize artificial intelligence (AI) platforms such as the cognitive computing platform IBM Watson are fundamentally new types of learning technologies that require a completely different set of developer skills compared to legacy learning technology products.

In educational psychology, there are two phases of the learning process; knowledge transfer and learning transfer. Knowledge transfer is the transmission of information and skills to the learner. Learning transfer is the ability of the learner to demonstrate mastery in a real world setting. Next-generation Cognitive Learning products (particularly those based on artificial intelligence and VR) effectively accomplish both phases simultaneously and are dramatically more effective than legacy eLearning products.

The VR-based mental training apps for athletes and the VR-based situational awareness apps for first responders and the military are good examples of products that achieve knowledge transfer and learning transfer (mastery) simultaneously.

This is an evidence-based quantitative report. This report identifies over 560 Cognitive Learning developers competing in the 122 countries tracked by Metaari. The vast majority are startups that have launched in the last 2-3 years. New companies continue to come on the market at a rapid pace.

- This report identifies the Cognitive Learning companies and distributors that operate in specific countries and regions; it identifies the types of products and services they sell, their business and pricing models, and their primary buying segments.
The report provides verbatim marketing messages from most of the companies in this report to show suppliers how their competitors articulate their value proposition. It identifies the investment funding totals for most of the suppliers cited in this report. Developers that have garnered private investment have obviously been successful at quantifying their value proposition.

This report identifies specific buyers by company or organization name and their location providing suppliers with potential sales leads. This provides invaluable insight on the top buyers across the globe, the types of Cognitive Learning products they buy, and the suppliers that are meeting the demand from these buyers.

**The Evolving Business Models**

There are several different business models being used in the Cognitive Learning market including retail pricing, cloud-based subscriptions, and licensing. Some companies sell their products via prescriptions; a practice unique to this type of learning technology.

AttenGo is a "computerized neuro-cognitive training program that enhances cognitive abilities and stimulates brain-wave activity. The results are real. You or your child will feel them immediately." AttenGo is sold on a subscription basis with monthly and annual subscriptions.

A unique Game-based Learning product is developed by Akili Interactive Labs. They have raised $140.9 million in investment since they launched in 2011 including a $13 million in October 2018. "Our cutting-edge cognitive gaming engine enables three separate clinical game versions for remote data-capture, with features designed for extreme patient engagement. Akili Interactive is a prescription digital medicine company combining scientific and clinical rigor with the ingenuity of the tech industry to reinvent medicine."

Omada Health announced in January 2019 that they would launch new programs for customers with depression and anxiety. "The company has entered into a perpetual licensing agreement with Lantern Health, a digital mental health company that shut down its consumer-facing retail commercial operations in August 2018, and will integrate Lantern’s software into its existing infrastructure." Lantern announced a similar licensing deal with Spring Health in February 2019. Essentially, Lantern
reinvented themselves as a B2B company after they failed to achieve traction in the B2C market.

**US FDA Approval Raises the Value of Cognitive Learning Products**

A very new development in the Cognitive Learning market is the granting of US Food and Drug Administration (FDA) approval for products. FDA-approved products must pass rigorous testing and an FDA approval attests to the effectiveness of the product. As of January 2019, eleven Cognitive Learning companies had obtained FDA approval. FDA approval allows suppliers to sell their product via prescription and it is a powerful branding and marketing advantage.

Israel's VRHealth claims to be the world's "first certified virtual reality medical company. All of our Medical Applications are FDA authorized. Our products focus on motor cognitive, physical, psychological, postural ability and pain assessment and treatment." The company develops medical and wellness apps for corporate buyers using AR and VR. They have raised $4 million in investment since they launched in 2016. "VRHealth sells its products to clinics, hospitals and offices for about $2,000 a year. Each headset costs about $900, and the software starts at $100 a month."

In August 2016, the FDA gave ImPACT Applications permission to market the Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT) and ImPACT Pediatric apps. "ImPACT and ImPACT Pediatric are not intended to diagnose concussions or determine appropriate treatments. Instead the devices are meant to test cognitive skills such as word memory, reaction time and word recognition, all of which could be affected by a head injury."

In May 2017, UK's Cambridge Cognition Holdings announced that the FDA granted 501(k) clearance to "to market CANTAB Mobile as a device that can detect early stages of clinically relevant mental impairment in older adults. The Cambridge Neuropsychological Test Automated Battery (CANTAB) was developed initially more than 30 years ago as a group of tests for use in neurologic and psychiatric research. The Paired Associates Learning (PAL) test is one of the tests to detect features of cognitive impairment that could be signs of early Alzheimer's disease."
In October 2017, California's Carrot announced that their app designed to help people quit smoking had obtained FDA approval. Their Pivot product "combines proven, evidence-based strategies with human coaching and a model of behavioral science called self-determination theory to help participants quit for good." They have raised $30.8 million since they launched in 2015 including a $25 million round in October 2018.

In June, 2018, Headspace, perhaps the most popular meditation app in the world, launched their Headspace Health division, "which aims to launch the first prescription meditation app. The company is seeking FDA approval of meditation programs specifically designed to treat a range of chronic diseases. So it's going to be a separate product that's developed in collaboration with patients, physicians, patient advocacy groups."

Switzerland's MindMaze announced that they had won FDA approval for their new MindMotion GO in June 2018. The product is a portable gamified neurorehabilitation product. MindMaze had already obtained FDA approval for their MindMotion PRO in 2017.

Pear Therapeutics says it is “the first prescription digital therapy designed to treat opiate dependence.” Their product is called reSet. The product was developed in cooperation with Sandoz and won US Food and Drug Administration (FDA) approval in late 2018.

Pear's app is a good example of a product designed with contingency management methods, one of the ten design schemas identified by Metaari. The company has garnered $134 million in investment since they launched in 2013 including a $50 million round in January 2018.

Palo Alto Health Sciences is a "digital therapeutic company at the forefront of revolutionizing behavioral healthcare with evidence based, at-home, drug-free solutions. Our product, Freespira, is an FDA-cleared treatment for individuals suffering from panic disorder, panic attacks and other symptoms of panic." Their product is unique in that it includes a sensor that measures breathing rates and CO2 levels. They obtained FDA approval in December 2018.

Akili Interactive Labs has raised $140.9 million since they launched in 2011. Their product is quite sophisticated and on track to get US FDA approval. They develop cognitive games that assess the cognitive states of users. Their game platform is being used in clinical trials for attention.
deficit. "Akili Interactive Labs is a medical device company that makes mobile video games—and not the other way around." Akili garnered $55 million in funding in May 2018 and $13 million in August 2018.

Click Therapeutics signed an astonishing $300 million deal with the Japanese pharmaceutical giant Otsuka in January 2019. "Through cognitive and neurobehavioral mechanisms, Click’s Digital Therapeutics enable change within individuals, and are designed to be used independently or in conjunction with biomedical treatments. Click’s lead prescription program is entering into a multi-center, randomized, controlled, parallel-group, phase III FDA registration trial for the treatment of Major Depressive Disorder in adults."

In April 2019, NeuroSigma was granted FDA approval for their handheld Monarch eTNS devices designed to treat children between the ages of 7 and 12 with ADHD. Monarch is "the first non-drug treatment meant to address attention-deficit hyperactivity disorder approved in the US."

NeuroSigma had already obtained CE (Conformité Européene) Mark of approval in Europe in 2015. The company "develops and commercializes Trigeminal Nerve Stimulation (TNS) for a variety of neurologic and psychiatric disorders." They have raised $13.4 million since they launched in California in 2008.

**Brief Overview of Primary Catalysts Driving the Global Cognitive Learning Market**

This is a brief overview of the catalysts driving the market. A very detailed analysis of these catalysts is provided in the demand-side section.

There are several primary and secondary catalysts driving the global Cognitive Learning market. The market is now in the midst of profound innovation and disruption. New startups are launching advanced products based on virtual reality, augmented reality, emotion intelligence, cognitive science, biofeedback, artificial reality, and neurotechnology like sensory stimulation and neuromodulation (brain stimulation).

New products are hitting the market at a steady rate and venture capital is flowing to these new companies.
The six major catalysts contributing to the growing demand for Cognitive Learning products across the planet include:

- A steady flow of private investments in global Cognitive Learning companies
- The launch of sophisticated next-generation brain entrainment products based on advanced technologies and cutting-edge cognitive engineering coming on the market
- The integration of Artificial Intelligence (AI) and cognitive computing into very sophisticated products
- A growing number of advanced products hitting the market that integrate virtual reality (VR)
- A wide range of new products designed for children with special needs
- The rapid adoption of new specialized brain trainers called mental training apps in sports organizations and military agencies

Combined, these catalysts have created very favorable market conditions for developers of these products, but mostly in the developed economies so far. The competitive landscape is fertile ground for startups that incorporate advanced scientific theories, new technologies, and cognitive...
engineering methods into their products. Capital is readily available to these startups from government agencies, corporate foundations, and private investment firms.

**Leading Indicators: Private Investment in Cognitive Learning Firms Remains Steady**

Private investment activity declined by 10% in 2018 compared to 2017. The funding was still much higher than investments made in 2016 and 2015. Private investment in Cognitive Learning companies surged dramatically starting in 2015. The funding in 2017 was just over $900 million, so a 10% decline is insignificant.

A major investment pattern that appeared in 2015 was the investor interest in next-generation Cognitive Learning (behavior modification) companies based on Cognitive Behavior Therapy (CBT), neuroscience, and artificial intelligence. Investors are gravitating to products with strong science and cognitive engineering foundations.

Just under $3 billion was invested in Cognitive Learning companies across the planet between 2015 and 2018. *This is nearly ten times the funding that went to this type of company for the fourteen-year period between 2000 and 2014.* There were no investments made to this type company prior to 2001.

The companies that have obtained funding and the types of products they are developing are identified in this report. Very few of the 460 companies cited in this report are self-funded.

**Brain Entrainment: Next-Generation Cognitive Learning Products Alter the Competitive Landscape**

There is a flood of next-generation Cognitive Learning products hitting the market known as brain entrainment products. Brain entrainment is a concept that has been around since the early 1800's but commercial Cognitive Learning products and apps incorporating brain entrainment methods (such as light and sound stimulation) are very new to the market and are quickly gaining traction in the consumer segment and in the healthcare verticals.

These new products integrate a range of technologies including emotion analytics, affective computing, biosensors, wearables, neuro-sensors,
attention network training (also called executive attention network), neurofeedback, brain mapping (qEEG), light and sound brainwave entrainment, neuromodulation (brain stimulation), galvanic skin response (GSR), heart rate variability (HRV), cognitive engineering, augmented reality, virtual reality, and, most importantly, artificial intelligence.

Developers are designing Cognitive Learning products with these technologies by mapping standardized cognitive engineering schemas, behavior therapies, neurofeedback and sensory stimulation, brain stimulation, and mnemonic methods into the instructional design. There are ten standardized schemas in Metaari's Cognitive Learning Pedagogical Framework. The schemas were isolated by reverse engineering commercial Cognitive Learning products on the market.

A relatively new trend is the availability of brain trainers, wellness apps, and mindfulness apps designed for relatively healthy children. These apps target developmental stages of very young children. Over a dozen of these new apps are identified in this report.

Biofeedback and sensory stimulation technologies are closely related but differ in "direction". Biofeedback is output and sensory stimulation is input. New Cognitive Learning developers combine both in advanced products and apps.

Advanced Cognitive Learning products are integrating neuromodulation (also called brain stimulation or neurostimulation) technology into their products. Neurostimulation is a "modulation of the central or peripheral nervous system by weak electrical or magnetic impulses with the intent to alter brain waves and cognitive states." It is used to treat people with cognitive disabilities and addictions but also by relatively healthy people to enhance cognitive states like wellness, memory, attention, and problem solving.

A detailed analysis of these next-generation products and their developers is provided in the demand-side section. Hundreds of new products are identified and the developers have all garnered high amounts of funding.

**AI and Cognitive Computing are Game Changers**

The education industry is on the verge of extraordinary innovations in knowledge transfer using cognitive computing and artificial intelligence.
platforms. New AI-based Cognitive Learning products are coming on the market at a rapid pace. The most well-known cognitive computing platform is IBM's cognitive computing platform called Watson.

IBM prefers the term augmented intelligence over artificial intelligence. "At IBM, we are guided by the term 'augmented intelligence' rather than 'artificial intelligence.' It is the critical difference between systems that enhance and scale human expertise rather than those that attempt to replicate all of human intelligence."

The integration of Watson into digital learning content essentially accomplishes the "holy grail" of providing true personalized (adaptive) learning by adapting in real time to a student's cognitive abilities. True personalized learning has long eluded learning technology suppliers despite the claims that their products are adaptive. Artificial intelligence finally provides the technology to achieve personalized learning.

IBM claims that their IBM Watson Education division "is bringing education into the cognitive era. We are transforming the learning experience through personalization. Cognitive solutions that understand, reason and learn help educators gain insights into learning styles, preferences, and aptitude of every student. The results are holistic learning paths, for every learner, through their lifelong learning journey."

Advanced VR-based Cognitive Learning Products Hit the Market

A growing number of companies are integrating VR into their off-the-shelf Cognitive Learning products. New companies continue to bring advanced VR-based products to market and several of these companies are attracting large amounts of investment.

Clinics around the world are now offering VR-based therapy, usually using commercial apps. There are brand new types of cognitive therapy known as virtual reality therapy (VRT), virtual reality immersion therapy (VRIT), and/or virtual reality graded exposure therapy (VRGET).

Researchers from the University of Waterloo announced in March 2019 that VR can help improve an individual’s perception of time. "The ability to estimate the passage of time with precision is fundamental to our ability to interact with the world. VR now convincingly changes our experience of space and time, enabling basic research in perception to
inform our understanding of how the brains of normal, injured, aged and diseased populations work and how they can be treated to perform optimally.”

The University of Cambridge has been deploying VR-based therapy for the UK’s National Health Service (NHS) across 15 facilities as part of their Oxford VR spin out company. "Oxford VR is treating patients in 10 NHS clinics around England while carrying out clinical tests to treat conditions like depression. It’s backed by science. We know what we do works. The potential for large-scale benefits is exciting.” One of the most successful treatment packages developed by the team is designed to treat people with a heights phobia. *More than two-thirds of those treated have reported a total reversal in their fear.* Oxford VR garnered $4.1 million in funding in September 2018 to commercialize the platform.

**Cognitive Learning Games for Children with Special Needs Gain Traction**

There is a wide range of robotic products and mobile educational games designed to help children with special needs. Parents, schools, clinics, and private therapists buy these products.

The US demographic is huge. The US Department of Health and Human Services (HHS) reports that 7.7% of children in the US between the ages of 3 and 17 have some form of voice, speech, or language disorder. That is five million children.

The US Individuals with Disabilities Education Act (IDEA) defines fourteen conditions that are used to identify a "child with a disability." These include autism, deaf-blindness, deafness, developmental delay (DD), emotional disturbance (ED), hearing impairment, orthopedic impairment, special learning disability, speech or language impairment, traumatic brain injury, visual impairment including blindness, and a category called "other health impairment". The other category deals with "limited alertness in school and causes include ADHD, epilepsy, and asthma.

Quite sophisticated cognitive intervention products are now used to treat children with attention deficit, autism, dyslexia, and other cognitive disorders. They are developed by neuroscientists, clinical professionals,
and cognitive therapists and, until recently, tended to be very expensive. They are still used primarily in clinical situations and in the schools, but the developers have started to release cost-effective commercial products in the consumer segment.

Physical robots programmed to provide Cognitive Behavior Therapy (CBT) are now being used all over the world. Children with autism often find it challenging to interact socially with another person. These kids rarely have this problem with robots. Applied Behavior Analysis (ABA) is now a very common method used to treat children with Autism Spectrum Disorder (ASD). There are dozens of these therapeutic robots and therapy apps identified in this report.

Since these products tend to be developed in collaboration with clinical specialists, they command higher price points than the other types of Cognitive Learning products. In January 2019, the mobile app analytics portal App Annie had a list of 600 apps for special needs children across all the mobile OS formats.

**Rapid Adoption of Specialized Mental Training Apps for Athletes, First Responders, and Military Personnel**

Relatively new types of Cognitive Learning products have come on the market in the last two years. These are now commonly referred to as mental training apps. They are gaining rapid adoption in the sports world and in the military and first responder agencies.

Mental training products for athletes are based on sports psychology and products for first responders and the military are usually based on situational awareness (also known as situational intelligence). Both types produce outcomes that can be measured with a high degree of reliability.

Mental training for athletes was provided almost entirely in physical locations until recently. The clients tended to be sports organizations. The legacy providers and a range of new startups are now selling mental training apps directly to users in the commercial app stores. The potential market in the US alone is massive. Over 40 million people participate in some form of organized sports in the US every year. Startups that develop this type of Cognitive Learning product are coming on the market at a rapid rate. The startups are attracting significant amounts of private investment.
Dr. Mica Endsley (President of the cognitive engineering firm SA Technologies) is a pioneer in situational awareness and defines it as "a field of research within cognitive science that entails the perception of elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future." She has also written that the three cognitive processes are not linear. It is interesting that in her model of SA, she nests the three processes with projection containing both comprehension and perception and comprehension containing perception.

**Figure 7 – Situated Cognition: Endsley's Model of Situational Awareness**

In 2015, Endsley wrote "The interest in SA grew quickly from its initial start in aviation to many disparate fields including air traffic control, military operations, transportation, power systems, law enforcement, emergency management, health care, space, transportation, education, mining, and oil and gas operations."

- In a paper called "Situational Awareness Ability and Cognitive Skills Training in a Complex Real-World Task", researcher Kerry O'Brien wrote that "Successful performance in complex dynamic environments depends on domain-dependent factors, such as situational awareness (SA). Underlying SA in a domain are
domain-independent cognitive abilities in perception, memory, attention and executive control.'"

The most sophisticated products coming on the market use VR to immerse the user in safe virtual environments. The participants essentially practice dealing with complex situations, effectively building and enhancing the cognitive skills required to handle real situations. In VR-based Cognitive Learning products, knowledge transfer and learning transfer (mastery) are accomplished simultaneously. Over 60 suppliers that sell these products are identified in this report and they are attracting significant amounts of private investment.

**What You Will Find in This Report**

There are six sections in this report: a brief overview of the global catalysts, a deep-dive of Metaari's Cognitive Learning Pedagogical Framework, a detailed analysis of the catalysts, a demand side-analysis by seven regions, a demand-side forecast for six buying segments, and a supply-side analysis by eight content-defined product types.

This report only provides forecasts for content so the product types are content categories. They are pedagogically distinct and the demand is different for each category. The revenues streams are unique for each content type. This report does not include revenues for cognitive assessment exams and assessment inventories. These are diagnostic products and cannot be considered learning transfer methods. There are platforms on the market that clinical professions use to capture cognitive and behavioral data on patients. The data output is indeed used for decision support but it cannot be categorized as Cognitive Learning.

Despite the direct correlation between cognition and physical pain, this report excludes revenues for products designed to treat chronic pain. Neuromodulation (brain stimulation) is increasingly becoming an alternative to opioid-based treatments.

This report includes a detailed description of Metaari's Cognitive Learning Pedagogical Framework that identifies ten schemas used to design Cognitive Learning products. The schemas are a combination of therapies, neurotechnology protocols, and mnemonic methods. The framework was derived by reverse engineering commercial products. The framework provides suppliers with a product roadmap to tap...
addressable revenue streams for specific types of Cognitive Learning products.

Where are the Buyers?
Metaari tracks the learning technology markets in 122 countries across seven regions. While there can be similarities in buying behavior across countries, they are usually confined to a particular buying segment. In general however, the buying behavior is quite different in each country.

Table 2 - The 122 Countries across the Seven Regions Tracked by Metaari

<table>
<thead>
<tr>
<th>Number of Countries Analyzed in Each Region</th>
<th>Countries Analyzed in this Report by Region</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 Countries in Africa</td>
<td>Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Chad, Côte d'Ivoire (The Ivory Coast), the Democratic Republic of Congo (DRC), Ethiopia, Ghana, Kenya, Madagascar, Malawi, Mali, Mauritania, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, South Africa, Tanzania, Tunisia, Uganda, Zambia, and Zimbabwe</td>
</tr>
<tr>
<td>21 Countries in Asia Pacific</td>
<td>Australia, Bangladesh, Cambodia, China (including Hong Kong and Macao), India, Indonesia, Japan, Laos, Malaysia, Mongolia, Myanmar (Burma), Nepal, New Zealand, Pakistan, the Philippines, Singapore, South Korea, Sri Lanka, Taiwan, Thailand, and Vietnam</td>
</tr>
<tr>
<td>15 Countries in Eastern Europe</td>
<td>Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Georgia, Kazakhstan, Kyrgyzstan, Moldova, the Russian Federation, Serbia, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan</td>
</tr>
<tr>
<td>18 Countries in Latin America</td>
<td>Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, the Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Perú, Uruguay, and Venezuela (Metaari has suspended analyzing Venezuela during the current financial crisis in that country.)</td>
</tr>
<tr>
<td>12 Countries in the Middle East</td>
<td>Bahrain, Egypt, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Turkey, and the United Arab Emirates (UAE) (Metaari has suspended analyzing Yemen during the current political crisis in that country)</td>
</tr>
<tr>
<td>2 Countries in North America</td>
<td>Canada and the United States</td>
</tr>
<tr>
<td>24 Countries in Western Europe</td>
<td>Austria, Belgium, Bulgaria, Croatia, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Lithuania, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Spain, Sweden, Switzerland, and the United Kingdom</td>
</tr>
</tbody>
</table>
This report provides five-year forecasts for Cognitive Learning products for seven regions: Africa, Asia Pacific, Eastern Europe, Latin America, the Middle East, North America, and Western Europe.

The region with the highest growth rate is Africa at 35.4% followed closely by Western Europe at 34.6%. Yet, the revenues in Africa are still quite low and relatively high in Western Europe. Western Europe will account for the third-highest revenues by 2023. The market conditions in these two regions are very different.

**Figure 8 – 2018-2023 Cognitive Learning Growth Rates by Seven Regions**

Africa has the fastest growing middle class demographic on the planet. This means there is a growing amount of discretionary spending in the region.

The growth rate in the Asia Pacific region is a healthy 22.9% driven by strong demand in Japan, South Korea, China, and India. Adoption is just taking off in the developing countries in Asia, particularly in Southeast Asia.

The growth rate in Eastern Europe is a robust 29.0%. The revenues are heavily concentrated in the Russian Federation, Ukraine, and Belarus. The Middle East has a high growth rate of 24.8%. Despite their small population, Israel is the top buying country followed by Turkey. The UAE is adopting Cognitive Learning in their public schools.
Latin America has very high growth rate of 31.8%. Mexico, Colombia, and Brazil account for the majority of revenues, so far. While the demand for Cognitive Learning is growing on Latin America, there are still very few suppliers that have emerged in the region. It is still largely an import market in that region.

North America is the most mature market in the world and was an early adopter of Cognitive Learning products, particularly products for people with special needs and consumer-facing brain trainers. The growth rate is essentially flat at 0.4%.

This masks the fact that North America will account for the highest revenues for Cognitive Learning throughout the forecast period. A flat growth rate that is still in the positive range means that revenues will remain steady over the forecast period. North America is the largest revenue opportunity for global suppliers.

Who is the Buyer?
There are six buying segments identified in this report: consumers, PreK-12 schools, higher education institutions, corporations & businesses, federal government agencies, and state & local government agencies.

The buying behavior in each of the six segments is different yet there are similarities across segments. Both government agencies buy Cognitive Learning products to treat military, public safety employees, and first responders who have cognitive disorders resulting from trauma and injury. Mental training apps based on situational awareness are quite similar in both government segments.

Consumers are the largest buyers in terms of expenditures across the forecast period followed by corporations. The growth rate in the global consumer segment is a healthy 12.6% with the revenues concentrated in Cognitive Learning products for children and intervention products for adults with addiction or mental disorders.

A relatively new trend in the consumer segment is the demand for cognitive games (brain trainers) and mindfulness apps for relatively healthy children.
Suppliers are also starting to port their clinical intervention and therapy products to consumer-friendly apps. Parents with children with special needs now have access to relatively cost-effective products.

Corporations license products directly from suppliers, from wellness firms, and from insurance companies. The largest buyers of mental health, addiction intervention, and cognitive therapy products are inpatient treatment facilities, outpatient facilities, residential treatment facilities, health plan providers, and insurance providers.

The buyer segment with the highest growth rate for Digital Cognitive Learning products is the PreK-12 segment at 27.8%, followed by corporations and state and local agencies at 22.2% and 21%, respectively. Revenues for Cognitive Learning products will more than triple in the PreK-12 segment over the forecast period.

**Figure 9 - 2018-2023 Global Five-year Growth Rates for Digital Cognitive Learning Products by Six Buyer Segments**

The federal government buys a range of Cognitive Training products mostly for military personnel and national mental health programs. The US federal government develops mobile PTSD apps that they provide to military personnel at no charge. The apps are not designed to be used as stand-alone interventions, but rather as part of formal therapy.

For more information about this report, email: contact@metaari.com
The demand in the corporate segment is being driven by the rapid adoption of cognitive health and mental wellness platforms. These products are now being distributed by insurance carriers and providers and increasingly offer mindfulness and intervention features. Corporate healthcare organizations buy all eight types of Cognitive Learning products, but the revenues are concentrated in the four product types used to treat mental health issues.

The buying behavior is very different in the two academic segments. In the PreK-12 segment, most of the products are procured for special education and cognitive remediation. In the higher education segment, revenues are heavily concentrated in sales to medical and healthcare institutions.

Digital Cognitive Behavior Therapy (dCBT) is gaining traction in the institutions as a way to mitigate the shortage of mental health counselors and the dramatic rise in mental health issues in the last five years.

The growth rate in the local & state government agencies is 21.0%. These agencies purchase Cognitive Training products for public safety personnel and first responders. They also purchase products that they distribute free to constituencies.

**What are They Buying?**

Cognitive Learning is a unique type of learning technology in that it is a content story. There are very few tools on the market (if any) that are designed to develop these products.

There is a demand for custom content development services but this usually entails configuring packaged programs and content to meet the needs of organizational buyers. This report only provides forecasts for content.

The growth rate for all eight Cognitive Learning content types combined is 17.8%. There are two basic categories of Cognitive Learning products on the market: products designed to enhance cognitive abilities in relatively healthy people and products designed to mitigate cognitive disabilities. This report identifies eight distinct types of Cognitive Learning products in these two categories.
The products designed to improve cognitive functions in relatively healthy people included in the supply-side section:

- Cognitive Fitness Games and Brain Trainers
- Mental Training Apps for Athletes
- Cognitive Health and Mental Wellness
- Mindfulness Online Courses, Apps, and Online Programs

The products designed to mitigate cognitive deficiencies caused by mental health problems, addiction, disability, or traumatic injury include:

- Products for Children with Special Needs
- Mental Health Treatment Products
- Addiction Intervention Products and Services
- Cognitive Disability Therapy and Rehabilitation Products

Cognitive fitness games and brain trainers have a five-year compound annual growth rate of 3.7%. This is the most mature type of Cognitive Learning product on the market with the first products emerging in 2005. The global market is highly commoditized with developers competing solely on price.

**Learning Products by Eight Content Types**

Flat growth rates are not necessarily negative indicators. Flat growth rates correlate oft steady revenue streams over a forecast period.
The new mental training apps that have recently come on the market have a modest growth rate of 5.4%, which is still quite high for a new product type. These products are mostly mobile and VR-based apps and, while gaining adoption, the demand is localized to specific demographics like professional athletes, first responders, and military personnel. Suppliers are starting to market the products to consumers and this could have an impact on demand. In the US alone, over 40 million people participate in some form of organized sports every year.

Cognitive health and mental wellness apps are gaining rapid adoption in the corporate segments across the planet. The growth rate is quite high for this type of Cognitive Learning product at 18.5% and revenues will more than double over the forecast period. Employers and healthcare providers are increasingly offering health and wellness products as employee benefits.

Cognitive Learning products that are designed for mindfulness are easy to develop and have very low price points. The market is saturated with products and they continue to come on the market. The growth rate for these products is essentially flat at 2.6%. This means that the revenues will remain steady for the forecast period. In the current market, these products are mostly in demand in developed economies.

Cognitive Learning products designed to treat children with special needs have a growth rate of 22.9%, followed by mental health and addiction intervention products at 22.8% and 21.2%, respectively. The growth rate for Cognitive Learning products designed to treat disabilities is 18.3%. These four product types are developed in partnership with cognitive behavior professionals and clinical specialists and command high prices.

These products used to be prohibitively expensive to develop until quite recently and empirical evidence of their effectiveness was lacking at best. Compelling empirical evidence is mounting on the extraordinary effectiveness of these products. While they are primarily purchased by schools and clinical buyers, suppliers are beginning to market the products directly to consumers.

Sources of Data on the Global Cognitive Learning Market

Metaari principals are competitive intelligence experts that have been tracking the global learning technology industry since 1998. We have the
most detailed and comprehensive data on the global learning technology competitive landscape in the industry.

Our primary data sources include our predictive analysis data repository (mapped to our learning technology taxonomy developed in 2005 and updated annually), our Cognitive Learning Pedagogical Framework, and a vast amount of longitudinal data collected since 1998 on over 3,000 suppliers across 122 countries. We have tracked the investments made to learning technology companies since 1998 and publish a whitepaper on global investment patterns every year.

Secondary data sources include: trade agencies, trade associations, financial reports, press releases, news articles, investment disclosures, merger & acquisition (M&A) disclosures, and academic budget statements.

**Figure 11 - Metaari’s Actionable Competitive Intelligence Methodology**

These data are then cross correlated with country-specific variables that include: population, socio-economic factors, technology distribution, broadband penetration, device sales, and education policies. Metaari generates actionable competitive intelligence by mapping the competitive landscape, performing supply-side and demand-side analyses, and by
compiling data from a wide spectrum of information broadly classified as leading and lagging indicators.

The vast majority of information relating to the demographics of the buyers for Cognitive Learning are government agencies and healthcare-related associations.

- In the US, this includes the US Department of Health and Human Services (HHS), the National Institute of Mental Health (NIMH), the Anxiety and Depression Association of America (ADAA), the American Psychological Association (APA), the Centers for Disease Control and Prevention (CDC), the American Dyslexia Association, the Autism Society, the Yoga Journal, and the Yoga Alliance. Canada's Mental Health Association is a good source of information for Canada.

Countries with national healthcare programs like Canada, the UK, the Russian Federation, and China report statistics of mental health and cognitive disabilities in the country. A good source of news and information on neuroscience in the Russian Federation and in Eastern Europe is the Neuronovosti ("Neuro News") portal.

There are non-government agencies that report on the demographics as well including the Worldwide Healthcare Organization (WHO) and the UN. WHO has 194 member countries and publishes an annual on mental health called the Mental Health Atlas broken out by six broad regions: Africa, the Americas, Europe, the Eastern Mediterranean, South-East Asia, and the Western Pacific.

Several international universities publish reports on the mental health issues across the globe. For example, the University of Oxford's Oxford Martin Program on Global Development reports on mental health in their Our World in Data series of reports. In their 2016 series, they reported that 1.1 billion people on the planet have some type of mental disorder.

The Anxiety and Depression Association of America (ADAA) is "an international nonprofit organization dedicated to the prevention, treatment, and cure of anxiety, depressive, obsessive-compulsive, and trauma-related disorders through education, practice, and research." They review apps designed to mitigate these challenges.

The Wellness Council of America (WELCOA) is a good source of information on corporate wellness programs in the US. WELCO "is one
of the nation’s most-respected resources for building high-performing, healthy workplaces. With a 30 year history and more than 5,000 corporate members, WELCOA has an impeccable reputation for helping business and health professionals improve employee well-being and create healthier organizational cultures."

A portal called PsyberGuide "seeks to provide accurate and reliable information about software and apps designed to treat schizophrenia, bipolar disorder, depression, and anxiety disorders." They had reviews of 187 mental health apps as of January 2019. PsyberGuide is funded by One Mind, "a leading non-profit organization supporting collaborative brain research to provide patients who suffer from brain disease and injury better diagnostics and treatment.

- With over 325,000 emerging digital health technologies, and an estimated 15,000 of those designed for mental health, One Mind recognized the lack of advice or guidelines to help people navigate the expanding marketplace of mental health apps. Thus in 2013, One Mind established PsyberGuide to address this growing problem."

The Autism Association of Western Australia is a non-profit funded by government agencies and donations and has a portal that has reviews of dozens of commercial apps and games for children with special needs.

- "All of the apps reviewed on this website have been reviewed by a member of our Therapy team. These therapists come from a range of backgrounds including Speech Pathologists, Occupational Therapists, Psychologists and teachers."

The Cognitive Neuroscience Society (CNS) portal is an excellent source of news on the attest development in cognitive neuroscience. "The Cognitive Neuroscience Society (CNS) is committed to the development of mind and brain research aimed at investigating the psychological, computational, and neuroscientific bases of cognition."

A good source of news and information on behavioral neuroscience is the Frontiers in Behavioral Neuroscience journal. It is "a leading journal in its field, publishing rigorously peer-reviewed research that advances our understanding of the neural mechanisms underlying behavior."

The International Neuromodulation Society (INS) has its headquarters in San Francisco and has regional charter organizations in 23 other
countries. The INS is a good source of news and information on the fast-evolving neuromodulation (brain stimulation) industry. "The International Neuromodulation Society (INS) is a non-profit group of clinicians, scientists and engineers dedicated to the scientific development and awareness of neuromodulation – the alteration of nerve activity through targeted delivery of a stimulus." This report identifies ten neuromodulation protocols used on Cognitive Learning products.

The International Brain Research Organization (IBRO) is headquartered in Paris. "IBRO is the global federation of neuroscience organizations that aims to promote and support neuroscience around the world through training, teaching, collaborative research, outreach and advocacy. More than 90 international, national and regional scientific organizations constitute IBRO’s Governing Council which, together with the five IBRO Regional Committees, address the needs and advance the work of individual scientists and research communities everywhere."