The 2019-2024 Global AI-based Learning Market: Learning in the Bright Air

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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 educational game framework.

We track the learning technology markets in 126 countries. 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, neuroscience, 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.
Metaari's 2019-2024 Global AI-based Learning Market

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."
Metaari’s Definition of AI-based Learning

Metaari’s Advanced Learning Technology Taxonomy defines AI-based Learning as education and training products that enable personalized learning via Natural Language Processing, Machine Learning, and Deep Learning.

A very new type of AI-based Learning is an AI-based virtual avatars (sometimes called visual AI avatars) now used in consumer healthcare education, corporate customer service, and IT support helpdesks. These virtual avatars function exactly like the AI-based physical Educational Avatars except they do not have physical forms.

The key characteristic of all AI-based avatars is that they are adaptive and have some capacity of self-learning. They are now considered a major component of what is known as Conversational AI, a specialized form of Natural Language Processing (NLP).

Conversational AIs are the foundation of the most sophisticated AI-based Learning products on the market today. They are self-learning "conversational agents" that provide personalized learning to users via text, audio, video, and Mixed Reality (AR/VR). These agents can be virtual or "housed" in a physical form factor like a robot, smart toy, or even a stuffed animal.

Metaari defines seven types of pedagogically-defined education and training Conversational AIs in our Classification of Education and Training Conversational AIs diagram. Each are based on a unique pedagogy and all of them enable personalized learning. They are discussed in the section describing Metaari’s Artificial Intelligence Array.

It is a well-known fact in the IT industry that over half of all technical support calls to the helpdesk do not involve technical issues at all. The problem is the user who is either using the technology wrong or does not know how to use it correctly. In those instances, the tech support person ends up being an instructor. It is no surprise that virtual avatars have become the new user manuals for technical companies. They are the quintessential problem-solving Conversational AIs on the market today.

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Executive Overview: The Holy Grail is Achieved

The five-year compound annual growth rate (CAGR) for the global AI-based Learning market is a robust 28.4% and revenues will reach nearly $4 billion by 2024. There is now rapid adoption in all six buying segments tracked by Metaari. The demand is high, the barriers-to-entry are dropping dramatically for developers, and startups are coming on the market at a rapid rate.

Over the last three years, an average of 300 AI-based Learning startups launched every year. A massive amount private investment funding is flowing into these startups. Consolidation is underway with the major learning companies acquiring AI-based Learning startups at a steady rate. These trends have accelerated in 2019.

The flood of startups entering the market will reach a saturation point where consolidation will increase. It is significant that very large companies are now buying AI-based Learning companies essentially "buying their way in" and validating the market. The following is a short list of recent acquisition activity in the AI-based Learning industry:

- EdCast, which calls itself the "Netflix of Knowledge", bought the AI-based Learning firm Sociative in June 2017
- Chegg acquired Berlin's Cogeon for $27.7 million in October 2017. Cogeon's flagship product is MATH 42, an AI-based math learning app designed for high school students
- Verint acquired Next IT in late 2017
- Conversica acquired the Chilean AI startup Intelligens.ai in January 2018
- South Africa's Onsite purchased a controlling stake in VJ Robotics, an AI-based Learning developer for the academic segment, in February 2018
- Reliance in India spent $180 million to take a controlling stake in Embibe in April 2018
- India's iNurture acquired Bangalore's KRACKiN in May 2018. KRACKiN developed an "AI-based methodology to help graduates measure their employability, discover skill gaps, and enhance their skills through a personalized learning assistant."

Over 940 suppliers operating in 126 countries are cited in this report to help international suppliers identify local partners, distributors, resellers, and potential merger and acquisition (M&A) targets.
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- Chegg bought WriteLab, an AI-based writing tutor, for $15 million in May 2018
- Follet bought Fishtree in July 2018. They sell an AI-based Learning platform to the two academic segments
- South Korea's Daekyo (one of the largest education companies in Asia) acquired New York's Knowre in August 2018. "Knowre’s revolutionary technology identifies individual student learning gaps and fills those gaps through algorithmically generated curricula and interactive, scaffolded support."
- Barnes & Noble Education bought PaperRater.com in August 2018. PaperRater's platform includes "an AI-based auto-grading scoring system to help students improve multiple facets of their writing."
- Turnitin, the company best known for its plagiarism-detection tools, acquired California's Gradescope, "a developer of AI-assisted grading technology" in October 2018
  - Turnitin was acquired by a company called Advance Publications in March 2019 for an astonishing $1.75 billion purchase price
- The standardized exam publisher ACT purchased Canada's MGHL Consulting in September 2018. MGHL developed an AI-based Automatic Item Generator (AIG) that can generate test items without the intervention of a human.
- VitalSource acquired Acrobatiq, an adaptive learning platform that spun out of Carnegie Mellon University’s Open Learning Initiative in September 2018
- Houghton Mifflin Harcourt (HMH) acquired an AI-based Learning startup called Waggle in January 2019
- BYJU’s claims to be India’s largest edtech company. They bought US-based Osmo in January 2019 for $120 million. Osmo builds learning games for kids on their proprietary Reflective Artificial Intelligence platform
- Australia's The Simulation Group was acquired by Boston Consulting Group in February 2019
- Besomebody an Ohio training firm, acquired Montréal's Pixelbug Technologies, a Mixed Reality Learning developer in February 2019. Pixel was founded in Dubai in 2012.

TAL Education is the largest online education provider in China and an early adopter of AI-based Learning. They acquired Israel's Ready4 test prep company in February 2019. "Ready4 has developed a cutting-edge consumer mobile prep platform that delivers high-quality, AI-powered live and on demand test prep courses."

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Further proof of validation of the AI-based Learning market is the establishment of formal AI groups inside education companies. Pearson is the largest education publisher in the world in terms of revenue and is building AI-based Learning on IBM and Microsoft’s AI platforms. Pearson hired Milena Marinova, an AI expert from Intel, to run their new artificial intelligence (AI) and personalized learning group in July 2018. This was the first dedicated AI-based Learning department formed by an educational publisher.

- In December 2018, Course Hero followed suit by hiring Preetham Vishwanatha as Vice President of their new Artificial Intelligence and Machine Learning group. Course Hero is "an online learning platform where members can access over 20 million course-specific study resources contributed by a community of students and educators."

- China's Squirrel AI Learning from the YiXue Education Group has the distinction of being a native AI-based Learning company and raised the highest amount of private investment in 2018 at $150 million. In late 2018, they announced that Professor Tom Mitchell, "the global luminary on machine learning" and Dean of School of Computer Science at Carnegie Mellon University (CMU was hired to be Squirrel AI's Chief AI Officer.

Effectively, AI-based Learning is now a mainstream learning product in developed economies and rapidly gaining adoption in developing economies, particularly in countries in Southeast Asia, like Thailand and Vietnam.

The consumer demand for educational AI products designed for early childhood learning (particularly for children with special needs) is very high in every developed economy. The corporate segment is adopting Conversational AI coaches and AI knowledge management platforms at a rapid pace and the healthcare vertical is a thriving hub of AI-based Learning innovation.

The integration of artificial intelligence (AI) into digital learning experiences essentially accomplishes the "holy grail" of providing true personalized learning that adapts in real time to an individual user's cognitive abilities. Personalized learning has long eluded learning technology suppliers despite the claims to the contrary. Artificial intelligence finally provides the technology to achieve true personalized learning. This is a long-awaited

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achievement in the training and education industry. *True digital personalized learning was not possible before the advent of AI.*

The global AI-based Learning market is in a state of flux characterized by exponential innovation and the rapid adoption in all the buying segments. Current AI technology is still in a nascent phase but evolving fast. Perhaps the most significant innovations related to learning are the use of facial and speech recognition, emotion detection, sentiment analysis, and conversational artificial intelligence. The advances in AI-based chatbot technology (particularly Conversational AI's) are major backdrops in the current market. Conversational AIs are at the core of the more sophisticated AI-based Learning products in the current market. The market conditions are very favorable for AI-based Learning suppliers.

One of the best-known cognitive computing platforms is IBM's Watson and developers are building out advanced learning technology products on top of Watson's cloud-based platform. Pearson, Apple, Blackboard, Scholastic, Sesame Street, Edmodo (now owned by China's NetDragon) and Houghton Mifflin Harcourt are selling new educational products built on Watson.

- Pearson and IBM jointly developed the IBM Watson Tutor "originally developed for Pearson’s use with college students. It is a chatbot that allows questions to be posed in text, with responses delivered in various formats, including media or video."

- In June 2018, an executive in the IBM Watson Education division stated in the press that "Our goal is to use AI to improve learning outcomes and to personalize content for learners."

Other AI-based Learning developers that integrate IBM Watson include Blupears, Cognitoys, ThoughtFocus, Tencent, and Circadence. They develop fundamentally different products. Blupears is an early childhood learning app. Cognitoys develops physical robots (smart toys) that teach kids to code. ThoughtFocus develops virtual teaching assistants for the higher education segment. Tencent develops tutoring bots for consumers and Circadence develops virtual assistants used in corporate cybersecurity training. There are now hundreds of suppliers developing learning products on Watson.

Watson is not the only AI platform being used for AI-based Learning. Pearson launched their Longman Welcome to English curriculum in Asia in February

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Metaari's 2019-2024 Global AI-based Learning Market

2018 on Microsoft's AI. Cerego's adaptive learning platform runs on Amazon's AI and Montessorium's popular apps for young kids integrate Google's TensorFlow AI.

AI-tutors and coaches are gaining traction in all the buying segments. Virtual tutoring avatars range from simple text interfaces and audio interfaces to visual virtual avatars and physical robotic tutors. The avatars can be quite sophisticated incorporating AI-based speech recognition, emotion detection, facial recognition, and most importantly, Conversational AI. **Conversational AI is at the core of AI-based Learning.**

This is an evidence-based quantitative report. This report identifies over 940 AI-based Learning developers competing in the 126 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. The barriers-to-entry are now quite low since developers can connect to commercial cloud-based AI engines from companies like Microsoft, Google, and IBM. Rapid authoring tools are now on the market and there are dozens of commercial marketplaces selling so called pretrained AI models, tools, chatbot templates, and data. Development costs are dropping fast and it is now possible to get to market very quickly.

- This report identifies the AI-based 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 AI-based Learning products they buy, and the suppliers that are meeting the demand from these buyers.

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There are four sections in this report: an overview of the current market, a detailed analysis of the catalysts driving the market, a demand-side analysis, and a supply-side analysis. The demand-side analysis provides revenue forecasts for six buying segments for all regions combined. The supply-side analysis provides five-year revenue breakouts for three types of commercial AI-based Learning products and services: retail pretrained packaged AI-based Learning units, custom development services, and AI-based Learning authoring tools and platforms.

**Overview of the Primary Catalysts Driving the Global AI-based Learning Market**

There are eight major catalysts driving the global AI-based Learning Market. They are briefly described in this section and analyzed in great detail in the demand-side analysis section of this report. The major catalysts include:

- The pedagogical breakthrough in achieving true personalized learning
- The spike in private investment going to AI-based Learning startups
- The extraordinary innovations being made in the healthcare verticals across the globe
- The growing use of clinical AIs for therapy (for both physical and mental conditions)
- The increase in the use of intelligent tutors in both academic segments
- The high demand for AI-based Learning in the corporate segments in the developed economies
- The barriers-to-entry are now quite low and developers are now able to get products to market very quickly

There are also a range of secondary catalysts such as national development policies and industry trade initiatives. AI technology is evolving very rapidly driven by advances in robotics, quantum computing, cognitive science, and neuroscience. For example, the neural networks in Deep Learning are modeled on brain science and the more scientists learning about the brain, the more sophisticated the neural networks become.

There are over two dozen countries with formal AI development policies as of early 2019. These countries are developing R&D roadmaps and funding commercial AI projects and research. Some countries are investing significant amounts of money into their domestic AI industries. These countries are
creating favorable conditions for all AI developers including AI-based Learning providers.

AI industry trade associations can be found in every developed country in the world. These organizations actively promote skills development and research. Many have dedicated special interest groups (SIGs) for education. Their members often collaborate with universities to promote AI program expansion, skills development, and cutting-edge research.

New commercial marketplaces that sell AI components are rapidly driving down costs and are strong secondary catalysts lowering the barriers-to entry very quickly. There are now online marketplaces with relatively inexpensive pretrained AI models, tools, platforms, intelligent bot templates, and smart learning algorithms (behaviors) that can dramatically reduce costs and accelerate the development of products.

**Figure 1 – Primary Catalysts Driving the Global AI-based Learning Market**

Developers no longer have to build their AI-based Learning from scratch. They can now easily assemble their products from commercially available components.
Combined, these primary and secondary catalysts are fueling very favorable market conditions for suppliers. The barriers-to-entry are falling fast and new startups are coming on the market at a very rapid rate. At the current pace of startup activity, there will be well over 3,000 AI-based Learning companies in the market within two years.

There are significant revenue opportunities for specific types of AI-based Learning products in particular buying segments, specific verticals (like healthcare), and in specific countries. The revenues are particularly lucrative in the healthcare verticals and in the early childhood learning markets.

Yet the demand is now growing in all six buying segments analyzed in this report. The higher education segment has the highest growth rate, followed by the two government segments. All the buying segments have five-year compound annual growth rates (CAGRs) over 30%.

**Barriers-to-Entry are Now Quite Low**

The barriers-to-entry are now quite low since developers can connect to commercial cloud-based AI engines from companies like Microsoft, Google, and IBM. While some larger edtech companies still opt to create their own AI engines in house (still very expensive and time consuming), the smaller companies can get to market quickly by using the commercial platforms. *They are renting their AI backbone.*

Inexpensive Conversational AI rapid authoring tools and so-called pretrained AI models are now being sold in online AI marketplaces. IBM, Microsoft, Google, and Amazon all operate online marketplaces that distribute premade AI models, algorithms, bot templates, Conversational AIs, and "agent behaviors".

Yet, the large technology companies are not the only ones selling AI components: dozens of startups have come on the market in the last year to meet the demand for the premade AI assets. Startups continue to come on the market at a rapid rate to compete in the new "AI Marketplace" business. There are dozens of these marketplaces identified in this report that includes analysis of their catalog and business models.
Low-code and no-code AI development tools continue to come on the market. Most of the Conversational AI chatbot platforms on the market do not require coding skills. A Conversational AI bot can be created in minutes with the Microsoft Bot Framework by simply uploading a FAQ. Dozens of these tools are identified in the supply-side analysis.

The most common pricing model for AI-based components is "pay-as-you go". Developers pay only for what they use, making it very easy for small startups to grow their business organically with low overhead costs.

AI-based Learning developers are now able to get products to market very quickly by assembling commercial components. It is no longer necessary to code AI in house. The barriers-to-entry are dropping fast and startups are flooding the market to meet the demand for AI-based Learning. The demand is now quite high in all six of the buying segments in the developed economies. Startups tend to focus on specific buying segments or verticals.

The Holy Grail: AI-based Learning Delivers True Personalized Learning at Scale

The education and training industry is on the verge of extraordinary innovations in knowledge transfer due to advances in cognitive computing and artificial intelligence. AI enables digital personalized learning at scale, a long-awaited goal of training and education professionals.

Despite claims to the contrary, true digital personalized learning via technology was never possible before the advent of AI. AI-based Learning developers that integrate the IBM Watson include Cognitoys, Citizens Financial Group, ThoughtFocus, Tencent, and Circadence. They develop fundamentally different products. Cognitoys develops physical robots (smart toys) that teach coding to kids.

- Citizens Financial Group is a bank that developed a chatbot called MyCa (My Career) designed as a career coach for employees. ThoughtFocus develops virtual assistants for the higher education segment. Tencent develops tutoring bots for consumers and Circadence develops virtual assistants used in cybersecurity training. There are now hundreds of suppliers developing learning products on Watson.
Speech recognition, facial recognition, emotion detection, and Natural Language Processing (NLP) based on Machine Learning are all major catalysts driving innovation in the development of AI-based Learning products. The most sophisticated products in the current market integrate one or more of these technologies and are fundamentally different from legacy learning products. *Conversational AI is a subset of Natural Language Processing and is the foundation of AI-based Learning products.*

It should be noted that except for pretrained packaged retail products, most AI-based virtual and physical educational and training avatars need to be "trained". This essentially entails programming them with the data they need to teach subject domains and assist people with very specific information. This has proven to be challenging and the learning curve can be steep. It is usually expensive and time consuming. "Packaged” pre-trained AI models are just beginning to hit the market particularly in industries like banking, healthcare, STEM, and cybersecurity. That said, there are very few AI models that can be perform adequately right out of the box.

*Solving the 2 Sigma Problem*

Benjamin Bloom is a household name in the training and education industry. He made two invaluable contributions to the industry: Bloom's Taxonomy and the famous 2 sigma study. AI-based Learning is having a dramatic impact on what he called "the 2 sigma problem."

In his seminal 1984 study, Bloom and two of his doctoral students compared the effectiveness of learning transfer achieved by groups of students being taught in a traditional classroom setting, using so-called Mastery Learning, or being tutored by grad students in small cohorts of one to three children. "Most striking were the differences in final achievement measures under the three conditions," wrote Bloom. "Using the standard deviation (sigma) of the control (conventional) class, it was typically found that the average student under tutoring was about two standard deviations above the average of the control class (the average tutored student was above 98% of the students in the control class)." This is the infamous 2 sigma, or two standard deviations of achievement compared to conventional classroom instruction.
Bloom also wrote that “The tutoring process demonstrates that most of the students have the potential to reach this high level of learning. I believe an important task of research and instruction is to seek ways of accomplishing this under more practical and realistic conditions than the one-to-one tutoring, which is too costly for most societies to bear on a large scale. This is the 2 sigma problem.”

AI-based Learning has proven to be quite effective at one-to-one personalized instruction and is tremendously scalable. Properly designed AI-based Learning categorically solves the 2 sigma problem.

**Figure 2 – Cognitive Tutors Can Exceed the 2 Sigma Shift**

Intelligent Tutoring Systems (ITS) have been used by the US military for decades. All the US federal ITS implementations include comprehensive statistical analysis of mastery outcomes.
The Floodgates are Open: Private Investment Flowing to AI-based Learning Startups

The massive amounts of investments being made to AI-based Learning is clear evidence of the booming market. Over $4.7 billion was invested in AI-based Learning companies in 2017 and 2018. The highest amount in 2018 was the $150 million invested in China's Squirrel AI Learning from the Yixue Group. They sell AI-based Learning products designed for the PreK-12 segment. Their CEO is an outspoken advocate of AI-based Learning to the point of maintaining it is better suited for instruction than human teachers, a very controversial opinion in a country that places a high value on teachers.

Very few AI-based Learning companies raised funding prior to 2017. Only seven companies were funded in 2016 and just one in 2015. There was no investment in this type of company prior to 2015. Interestingly, despite the widespread use of avatars in Japan, most of the investments have gone to companies in the US and China.

The companies that have attracted the highest investments are identified in the section analyzing the primary catalysts in this report and hundreds more are identified throughout the body of the report. One major focus of investors in the last two years is the interest in companies selling AI-based virtual healthcare assistants and advisors (VHA). Dozens of these companies have come on the market just in the last few years. These companies, a description of their products, and their funding totals are analyzed in the detailed catalyst section.

Assistance Intelligence: Innovations in AIs in the Healthcare Sector are Major Catalysts for AI-based Learning

Innovations in AIs used in the healthcare sector are driving the adoption of AI-based Learning across the globe. Adoption varies from country to country. For example, there is a severe healthcare worker shortage in China and companies are developing sophisticated AIs to create a "virtual workforce".

Startups catering to the healthcare vertical are coming on the market at a rapid rate and garnering significant amounts of private investment. Over 80 of these startups are identified in this report and the analysis also includes funding totals.

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AIs are used in five major ways in healthcare: pathology, analytics, diagnosis, etiology (causation) and treatment (therapy). This includes both mental and physical conditions. Diagnostic and therapeutic Conversational AIs are two of the seven main categories of Conversational AI's discussed in this report. AI is rapidly becoming integral with clinical decision support technology.

A growing range of commercial diagnostic products called symptom checkers are coming on the market; they are designed for consumers. The products diagnose conditions by essentially having a conversation with the consumer. The clinical version of this AI technology is often referred to as patient triage.

In January 2019, Apple and Aetna announce their new personalized mobile healthcare coach called Attain. "The science behind the Attain app is the usage of analytics and machine learning, which will offer more personalized recommendations to users. Users will be provided personalized daily and weekly activity goals based on age, gender and weight. There are four key components to the program: achieve activity goals, sustain everyday health, receive personalized health notifications for key health moments and earn rewards."

In February 2019, Microsoft launched the commercial version of their Microsoft Healthcare Bot, "a tool that allows healthcare organizations to create their own AI-powered chatbots and virtual assistants." The Microsoft Healthcare Bot was first introduced in 2017 as a research project. Its features include "healthcare intelligence, information about conditions, medications, and procedures, medical content and terminology, and a built-in symptom checker."

Use of Therapeutic AIs for People with Special Needs
Cognitive Behavior Therapy (CBT) is a method that provides behavior modification intervention. Behavior modification is identical to learning. The two terms are synonymous. Educational Avatars (both physical and virtual) are now in relatively wide use in the treatment of people with special needs.

Kids with autism and other developmental disorders often struggle with social skills. AI-based Learning products are now proving effective in teaching life skills to these children. They are also used in cognitive remediation therapy with adults. New products continue to come on the market to meet the
Metaari’s 2019-2024 Global AI-based Learning Market

demand. This report identifies over forty of these new therapeutic AI-based Learning products.

The demographics that can be helped by these bots are 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.

According to the Autism Society, over 3.5 million people in the US live with an autism spectrum disorder. 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."

According to the National Institute of Mental Health (NIMH), "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."

- According to the Anxiety and Depression Association of America (ADAA) "Anxiety disorders develop from a complex set of risk factors, including genetics, brain chemistry, personality, and life events."

The US is confronting a critical shortfall in psychiatrists and other mental health specialists. "Nearly 40% of Americans live in areas designated by the federal government as having a shortage of mental health professionals; more than 60% of US counties are without a single psychiatrist within their borders." The use of therapy avatars mitigates this problem. The avatars can scale to literally millions of people.

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The World Health Organization (WHO) tracks an array of mental disorders including depression, bipolar affective disorder, schizophrenia, psychoses, dementia, intellectual disabilities, and developmental disorders including autism. Depression alone affects more than 300 million people according to the WHO.

**AI-based Coding Tutors and Tutoring Robots for Kids**
A very recent trend is the near insatiable demand for smart toy robots that are designed to teach kids to code. This is a trend found in most developed economies. Several suppliers have global distribution agreements and now have international reach.

There is a boom in demand for these products and new startups are coming on the market to meet the demand. Companies that sell these kinds of robots are attracting significant amounts of venture capital.

*Over seventy developers that sell bots and avatars designed to teach kids coding are cited in this report.* Many of these products are quite innovative, integrating AI, facial and voice recognition, and emotion recognition.

Hanson Robotics, the developer of the infamous Sophie humanoid robot, launched their Little Sophia robot for children in January 2019. "Little Sophia can walk, talk, sing, play games and, like her big sister, even tell jokes! She is a programmable, educational companion for kids, that will inspire children to learn about coding, AI, science, technology, engineering and math through a safe, interactive, human-robot experience."

**Growing Use of Intelligent Tutors in the Academic Segments**
Conversational AIs used in the PreK-12 schools are mostly used for two subject domains: language learning (particularly for young children) and STEM. The schools use both physical Educational Robots and virtual tutors.

Over 60 of these companies selling these products to the PreK-12 segments are included in this report including startups that have launched native AI-based Learning platforms in the last two years.
The major publishers like Houghton Mifflin Harcourt (HMH) and McGraw-Hill are acquiring AI-based Learning companies. The leading global educational publisher Pearson has developed commercial AI-based Learning products on IBM Watson and Microsoft Machine Learning. There are now dozens of global educational publishers that are selling commercial AI-based Learning products that run on AI platforms from Google, Amazon, Microsoft, and/or IBM.

Higher education institutions use virtual avatar-based chatbot tutors, counselors, and advisors. They are used to supplement the institution's human staff, particularly in the mental health programs. The most sophisticated AI-based virtual tutors provide personalized learning and career advice to students. Over 40 AI-based Learning companies serving the higher education market are included in this report.

- A company called myKlovr claims to have developed the first AI-based digital college counselor. "It recognizes the potential of AI and uses its capabilities in order to achieve its mission of helping students accomplish their post-secondary education dreams. MyKlovr is a virtual counselor for college bound students. We utilize artificial intelligence and data science to provide you with personalized college counseling and the very best tools and resources to help you fully prepare for the college admissions process."

Over a hundred developers that cater to the academic segments are identified in this report. The report describes their products, their business models, and the countries where they compete. The startups are attracting private investment and this report identifies the funding amounts for each startup.

Uptake of AI-based Learning in the Corporations and Government Agencies

Corporate lobbies, government and corporate run airports, first responder organizations, hotels, hospitals, train stations, retail outlets, and shopping malls are now using AI-based Learning products for customer analysis, personalized internal training, security and crime intervention, and targeted informational product guides.

The new AI-based advisory avatars are sometimes referred to as intelligent digital humans or digital workers. Several vendors in this report refer to their
avatars as digital employees. They are called Virtual Healthcare Advisors (VHAs) in the healthcare sector.

AI has reinvented several legacy enterprise applications including business intelligence, business process management, data analytics and visualization, knowledge graphing, knowledge management, and decision support. Extraordinary new products are coming on the market.

The US military has long used intelligent tutors that enable personized learning but they were prohibitively expensive to develop and maintain until recently. Now commercial AI-based Learning products are gaining traction in both government agencies and corporate verticals.

Governments are deploying Conversational AI avatars at a rapid rate across the planet. They are using them for two primary purposes: citizen information and tourism promotion. The agencies also use them for employee support. Some agencies develop their own avatars internally but most hire outside developers to create the avatars. This is now a lucrative revenue opportunity for custom development service providers.

What You Will Find in This Report
There are four sections in this report: a brief overview of the global market conditions, a detailed analysis of the major catalysts driving the market, a demand side-analysis, and a supply-side analysis. The deep-dive analysis of the catalysts provides a detailed discussion of the trends driving the global market.

The demand-side analysis breaks out five-year revenue forecasts for seven international regions and by six buying segments. The supply-side analysis provides revenue forecasts for three products and services: retail packaged products (both physical robots and virtual avatars), custom development services, and authoring tools and platforms.

Where are the Buyers?
Metaari tracks the learning technology markets in 126 countries across seven regions. There can be similarities in buying behavior across countries, but they

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are usually confined to a particular buying segment. In general however, the buying behavior is quite different in each country.

Table 1 - The 126 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, Peru, 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, the United Arab Emirates (UAE), and Yemen (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>28 Countries in Western Europe</td>
<td>Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, 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 AI-based Learning products for seven regions: Africa, Asia Pacific, Eastern Europe, Latin America, the Middle East, North America, and Western Europe.

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Metaari’s 2019-2024 Global AI-based Learning Market

In the 2019 market, revenues for AI-based Learning are heavily concentrated in North America and the Asia Pacific. In 2019, North America accounted for 29% of all revenues followed by Asia Pacific at 20%. This will pivot by 2024 with Asia Pacific generating 26% of all revenues and North America falling to 16%.

Western Europe has the highest growth rate for AI-based Learning at a breathtaking 42.5%, followed by the Asia Pacific region and the Middle East at 36.7% and 34.3%, respectively. Eastern Europe also has a high growth rate at 33.2% with revenues heavily concentrated in the Russian Federation.

Latin America has a robust growth rate of 30.2%. Africa has a healthy growth rate of 28.4% with revenues concentrated in just four countries. North America has a modest growth rate of 9.8%, but accounted for the highest revenues in the 2019 market. The US was the top buying country in 2019 but China will be the top buyer by 2024.

Figure 3 – 2019-2024 AI-based 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.
Who are the Buyers?
There are six buying segments analyzed in this report: consumers, PreK-12 schools, tertiary & higher education institutions, federal government agencies, provincial/state/prefecture & local government agencies, and corporations & businesses.

The revenues for commercial AI-based Learning products are heavily concentrated in the PreK-12 and corporate segments throughout the forecast period, but the buying behavior is very different in each segment. The PreK-12 segment is now an avid buyer of personalized learning content, particularly for children with special needs. AI-based Learning products tend to be concentrated in language learning and STEM domains.

Figure 4 – 2019-2024 Global AI-based Learning Market by Six Buyer Segments

Corporations are adopting Conversational AIs for both consumer education and for employee training. The healthcare vertical is a primary innovation hub.
for AI-based Learning, particularly AI-based performance and decision support.

The highest growth rate is in the global higher education and tertiary segment. In the current market, Conversational AIs are being deployed as virtual advisors and mental health therapists. Intelligent tutors are just beginning to be integrated with digital courseware. Pearson is the market leader in the higher education space with commercial products running on IBM Watson's AI platform.

Revenues for educational AI-based avatars in the tertiary and higher education segments are still relatively low compared to the other segments. An interesting trend in this segment is the growing use of virtual conversation avatars (AI-based chat avatars) for student counseling, mental health interventions, and online course "assistants".

The federal government segments across the planet have the second-highest growth rate at 33.2% but the buying behavior is quite different in each country. Federal government agencies across the globe are increasingly deploying AI-based Learning products for use in government offices and nationally-owned airports.

State and local government also deploy AI-based Learning and the buying behavior is different in each country as well. For example, the state and municipal courthouses in China are adopting AI-based Learning at a steady rate to provide legal advice to citizens, particularly in rural areas with low numbers of legal professionals.

All government buyers across local, state, and federal agencies are adopting virtual interactive Conversational AIs at a rapid rate. Yet, the agencies use the products for different purposes depending on the level of jurisdiction of the agency. An analysis of that buying behavior is included in the demand-side analysis of this report.

The growth rate in the worldwide consumer segment appears to be low at 15.1% but this is only in comparison to the very high growth rates in the other segments. Products designed for consumers tend to have much lower price points than products designed for the organizational segments. Smart educational toys that use AI can be purchased for under $500.

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Corporations have a strong growth rate for AI-based Learning at 29.0%. Revenues for AI-based Learning products are heavily concentrated in the corporate segments throughout the forecast period.

**What are They Buying?**

This report forecasts revenues for three types of commercial AI-based products and services: pretrained retail packaged content and models sold or licensed by the unit, custom development services, and authoring tools and platforms.

The major buyers of custom development services are corporations and government agencies. Corporate-facing custom developers tend to specialize in specific industry verticals. Government-facing developers tend to be very specialized and market to particular agencies.

**Figure 5 - 2019-2024 Global AI-based Learning Growth Rates by Three Products and Services**

![Bar Chart showing growth rates for Pretrained Packaged Content, Custom Development Services, and Authoring Tools and Platforms]
The revenues are heavily concentrated in custom development services, which also have the highest growth rate of 32.6%. Except for pretrained packaged content, most AI-based Learning products have to be trained and there is now a cottage industry of companies that specialize in training AIs for customers. Suppliers customize their own branded AIs but there is now a cottage industry of third-party developers that train and customize general-purpose AIs. Many developers across the globe specialize in training general-purpose avatars for academic tutoring, information guidance, and language learning.

The new virtual AI-based Learning robots and avatars are usually custom trained by the suppliers and this can be expensive. Most clinical therapeutic AIs are still quite expensive as they require both programmers and clinical specialists to training the avatars. The report identifies six major factors driving the demand for AI-based Learning. There are two major concentrations of demand for custom AI-based Learning services: programming physical robots and training Conversational AI's.

The more sophisticated an AI-based Learning product is, the more training it requires and this is now a major source of revenue for service providers. For example, New Zealand's Soul Machines develops very realistic AI virtual avatars. As of October 2018, they had sold over 15 of the avatars. On average, they charge up to half a million dollars to customize and train the avatars for clients.

The growth rate for AI-based Learning authoring tools and platforms is a healthy 22.6%. The revenues are still quite low as these tools are very new to the market. Most of the major AI-based Learning suppliers provide SDKs as part of their licenses and some have fee-based developer programs. There are now AI-based Learning tools and platforms that are "out-of-the-box" ready at purchase.

There are seven major catalysts driving the demand for AI-based Learning tools and platforms and they are discussed in great detail in the supply-side section. Essentially, AI has reinvented legacy knowledge management (KM) and knowledge graphing. The advent of AI-based KM has caused a resurgence in demand for the product type. Knowledge management platforms have been rebranded as insight engines. Next-generation AI-based geospatial technology is now commonly known as location intelligence.
Tool vendors are actively lowering the barriers-to-entry for startups and established companies alike. Low and no-code tools, component marketplaces, and cloud-based AI platforms are coming on the market at a rapid rate and prices are falling fast. This explains the amazing number of AI-based Learning startups coming on the market at such a high rate.

That said, the growth rate for pretrained AI-based Learning products like smart toys designed to teach languages or used for early childhood learning is 23.5% and revenues will near $1 billion by the end of the forecast period. Educational smart toys have reached a mass market threshold across the globe. There are eight market trends driving the global demand for packaged products and they are described in the supply-side section.

Over 940 AI-based Learning companies are identified in this report. The report identifies the type of AI-based Learning products they sell and the prices they charge for their products and services. It also identifies the companies that have garnered private investment in the last two years.

Sources of Data on the Global AI-based 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 AI-based Learning 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 various pedagogical frameworks, and a vast amount of longitudinal data collected since 1998 on over 3,000 suppliers across 126 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, game and Mixed Reality news portals, and academic budget statements.
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.

Investment activity is a good source of competitive intelligence for the global learning technology industry. Companies and investors often report annual revenues at the time of funding. Metaari considers investment activity as a leading indicator. Over a thirty AI-based Learning companies that recently garnered private investment are identified in the analysis of the catalysts.

There are two AI-based Learning companies that went public in 2018 and 2019. China's Liulishuo went public on the New York Stock Exchange under the ticker of LAIX in September 2018. Sweden's Artificial Solutions started trading on the Nasdaq First North exchange in March 2019. Their financial
Metaari’s 2019-2024 Global AI-based Learning Market

Statements provide invaluable insight into the Asia and Nordic markets, respectively.

Pearson, McGraw-Hill, Houghton Mifflin Harcourt are major global education publishers and they all have AI-based Learning products in their portfolios. Their discussion about those products in the financial statements are also valuable sources of market data. Rosetta Stone is also publicly traded and is still the market leader in digital language learning; they sell AI-based Learning products as well.

There are dozens of online portals that track the trends and innovations in the global AI industry. They track the general AI industry but can be searched to ferret our AI-based Learning information. Portals include:

- A comprehensive portal that tracks thousands of AI companies in Welcome.AI. They have a dedicated education category. The site has profiles for hundreds of AI-based Learning startups.

- A site called H+ (H Plus) is a portal that aggregates news on AI and AR as well as a range of cutting-edge technologies. The site is an invaluable source of data on the national AI policies being implemented in countries across the globe. By the end of 2018, the site had detailed information on AI policies (including funding) for 24 countries.

- The AI Time Journal is an online AI news portal published in Estonia. The site provides extensive data on the latest developments in AI. "The mission of AI Time Journal is to divulge knowledge and information about changes, advancements and opportunities brought by Artificial Intelligence."

- Canada's BetaKit portal focuses on startups and publishes a weekly newsletter called Thee AI Times "a weekly newsletter covering the biggest AI, machine learning, big data, and automation news from around the globe."

- An excellent source of general information and news about AI is the online portal AI Business that launched in 2014, "AI Business is the world’s first and foremost content portal for artificial intelligence and its real-world applications in enterprise and the business world. From breaking news to in-depth interviews and features, our content is
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designed to break down the implications of AI in all of its forms." One of their industry categories is Education.

- AI Trends is another portal with current info on the AI industry. "As one of the most visited website networks on the Internet on the topic of the business and technology of artificial intelligence, AI Trends attracts a highly engaged and dedicated audience of business decision makers across the entire artificial intelligence ecosystem."

- An excellent source of information and news on the use of AI in healthcare is the AI in Healthcare portal: The site tracks startups and investments to AI-based healthcare companies.

The AI Index is an annual report on the global AI industry and has been published twice, so far. The report has very granular information by region and country. "The AI Index is an effort to track, collate, distill and visualize data relating to artificial intelligence. It aspires to be a comprehensive resource of data and analysis for policymakers, researchers, executives, journalists and the general public to develop intuitions about the complex field of AI." The 2018 version was published in December 2018 and has 94 pages.

- The AI Index includes several formal metrics used to measure the industry trends. "The Derivative Measures section investigates relationships between trends. We also show an exploratory measure, the AI Vibrancy Index, which combines trends across academia and industry to quantify the liveliness of AI as a field. The Technical Performance metrics capture changes in AI performance over time. For example, we measure the quality of question answering and the speed at which computers can be trained to detect objects. We introduce a new qualitative metric this year: Recent Government Initiatives. This is a simplified overview of recent government investments in artificial intelligence."

A good source of up-to-date information on artificial intelligence innovation is the Association for the Advancement of Artificial Intelligence (AAAI). It is essentially a global association with over 4,000 members. "Founded in 1979, the Association for the Advancement of Artificial Intelligence (AAAI) (formerly the American Association for Artificial Intelligence) is a nonprofit scientific society devoted to advancing the scientific understanding of the mechanisms underlying thought and intelligent behavior and their

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embodiment in machines. AAAI aims to promote research in, and responsible use of, artificial intelligence."

- AAAI also aims to increase public understanding of artificial intelligence, improve the teaching and training of AI practitioners, and provide guidance for research planners and funders concerning the importance and potential of current AI developments and future directions.

- "If you want to learn more about artificial intelligence or keep up to date with AI from the news, publications and conferences, visit the AI Topics site (an official publication of the AAAI). It uses AI technology to power new information discovery."

There are AI associations in all of the developed countries and starting to appear in the developing economies, particularly Southeast Asia. These associations provide invaluable information on the market conditions and technology developments in those specific countries and regions. Associations that Metaari tracks include:

- Argentine Society for Informatics and Operations Research (SADIO)
- Grupo de Interés en Inteligencia Artificial
- Austria's Österreichische Gesellschaft für AI
- Brazil's Sociedade Brasileira de Computação
- Bulgarian Artificial Intelligence Association
- Canadian Artificial Intelligence Association / Association pour l'intelligence artificielle au Canada
- Chile's Sociedad Chilena de Ciencia de la Computación
- Chinese Association for Artificial Intelligence
- The Czech Republic's Česká společnost pro kybernetiku a informatiku
- Danish Artificial Intelligence Society

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- The Dominican Republic's Sociedad Dominicana de Inteligencia Artificial
- Finnish Artificial Intelligence Society FAIS
- Association Française pour l'Intelligence Artificielle
- Germany's Fachbereich Künstliche Intelligenz der Gesellschaft für Informatik
- Greece's Hellenic Artificial Intelligence Society
- The Hong Kong Society of Artificial Intelligence and Robotics (HKSAIR)
- Hungary's Neumann János Számítógéptudományi Társaság
- Special Interest Group on Artificial Intelligence, Computer Society of India
- Artificial Intelligence Association of Ireland
- Israeli Association for Artificial Intelligence
- Associazione Italiana per l'Intelligenza Artificiale
- Japanese Society for Artificial Intelligence
- Latvia's Automatikas Nacionala Organizacija
- Lithuania's Lietuvos Kompiuterininkų Sajunga
- Sociedad Mexicana de Inteligencia Artificial
- Norwegian Artificial Intelligence Society
- Associação Portuguesa para a Inteligência Artificial
- Romanian Association for Artificial Intelligence
- Russian Association for Artificial Intelligence

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The Slovak Republic's Slovenská spolocnost pre kybernetiku a informatiku pri Slovenskej akadémii vied

Slovakia's Slovensko drustvo za umetno inteligenco

The Asociación Española para la Inteligencia Artificial in Spain

Swedish Artificial Intelligence Society

Swiss Group for Artificial Intelligence and Cognitive Science

Taiwanese Association for AI

Ukraine's Association of Developers and Users of Intelligent Systems

The UK's Society for the Study of Artificial Intelligence and Simulation of Behavior

The British Computer Society, Specialist Group on Artificial Intelligence

Singularity Institute of Artificial Intelligence in the US

There are state, municipal, and regional AI trade associations across the planet. Regional associations include:

- The European Coordinating Committee on AI (ECCAI)
- The European Neural Network Society
- Nordic.AI that has a large (and growing) database of AI developers operating in the region.
- Belgium-Netherlands-Luxembourg Association for Artificial Intelligence
- The Associació Catalana d'Inteligència Artificial in the Catalonia region of Spain

Finally, the Partnership on AI (PAI) is a global consortium of AI companies that publishes information and news on AI. PAI "was established to study and
formulate best practices on AI technologies, to advance the public’s understanding of AI, and to serve as an open platform for discussion and engagement about AI and its influences on people and society."

As of January 2019, the consortium had just over 80 members across thirteen countries. China's internet giant Baidu became the first Chinese company to join the consortium in October 2018. According to PAI, "A promising area of AI is the design of systems that augment the perception, cognition, and problem-solving abilities of people."