The 2018-2023 Worldwide Educational Bot Market: Rapid Adoption in all Six Buying Segments

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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 122 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.

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.

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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 Educational Bots
Metaari's Advanced Learning Technology Taxonomy includes Educational Bots in physical hardware form factors and virtual (software-only) digital bots.

Metaari defines Educational and Training Bots as physical mechanical devices, virtual chatbots, and avatar-based tutors that deliver learning content or behavior modification intervention directly to users. They are essentially learning delivery platforms.

Not all Educational Bots have physical components. There are a range of AI-based virtual Educational Bots sometimes referred to as chatbot tutors, conversational AIs (smart bots), conversational agents, virtual advisors, virtual learning coaches (coaching avatars), tutor bots, and/or edubots. They are commonly referred to as intelligent virtual agents (IVAs). In healthcare the virtual bots are called virtual healthcare advisors (VHA). This report identifies over 80 commercial virtual bot tutors.

Figure 1 –Metaari's Six Types of Commercial Educational Bots

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Metaari's 2018-2023 Worldwide Educational Bot Market

There are at least six distinct types of commercial Educational Bots in the current global market:

- Early childhood learning tutoring robots (smart toys)
- STEM and language learning tutoring bots used in the PreK-12 schools and tertiary institutions
- Information and assistance guide service bots used in public venues, exhibitions, tourist venues, airports, hospitality businesses, retail outlets, government offices, and virtual helpdesks
- Companion elderly care robots designed to improve emotional and cognitive health
- Behavior modification robots designed for Robot-mediated Behavior Intervention (RMBI) therapy for people with special needs
- Self-learning AI-based tutoring robots (both physical and virtual) that can be programmed to provide any type of personalized learning.

A very new type of Educational Bot is an AI-based virtual avatar (sometimes called a visual AI bot) now used in consumer healthcare education, corporate customer service, and IT support helpdesks. These virtual avatars function exactly like the AI-based physical Educational Bots except they do not have physical forms. The key characteristic of all AI-based bots is that they are adaptive and have some capacity for 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 smart AI-based Educational Bots.* They are self-learning "conversational agents" that provide personalized learning to users. There are at least eight categories of conversational AIs that enable personalized learning. They are discussed in the section in this report on Metaari's Artificial Intelligence Array.

The new wave of AI-based chatbots and avatars are covered extensively in this report. All chatbots are informational but the new AI-based bots learn and adapt to individuals. 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 chatbots and avatars have become the new user manuals for technical companies.

Virtual chatbots and avatars are not necessarily cheaper than physical Educational Bot. They still need to be "trained" (programmed) and while suppliers license the platform to clients, they generate most of their revenues by providing services. It can take months if not years to properly train an AI-bot and it can be quite expensive.

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This report does not include reference bot technologies like Siri or Alexa. They do approximate learning technologies in many circumstances, for example, when they provide step-by-step driving directions) but they are not designed to teach. They are essentially voice-activated search engines, smart speakers, and entertainment technologies.

We do not include robots used for telepresence. Telepresence allows a remote user to communicate with other people via a robot that is essentially a video chat device that can be moved by the person controlling the device. The robot is not doing the teaching, the human operating the robot does that. Telepresence robots are common in language instruction in Asia. Remote teachers from other countries tutor individuals and classes via a telepresence robot. Telepresence robots are also used by sick children that "attend" schools via the robots.

There is a type of service robot often referred to as a "concierge robot" used in the hospitality industry. There are two types of concierge robots: those that are basically room service delivery devices and informational and guide robots designed to offer guests information (tourist information, map directions, etc.) and assistance. This report only tracks revenues for the second type since it is an Educational Bot and the first is not.

There is also a type of robot called a Collaborative Robot. These are industrial robots and work in collaboration with humans, hence they are indeed "collaborative" but they are mechanical coworkers, not tutors. This report does not forecast revenues for Collaborative Robots.

**Executive Overview: Rapid Adoption in all Six Buying Segments**

This report analyzes the demand for physical education robots and virtual tutoring bots. The global Educational Bot market has a robust five-year compound annual growth rate (CAGR) of 35.6% and revenues will more than quadruple by 2023. There are eight major catalysts driving the global market and they are analyzed in detail in this report.

The price points for Educational Bots used to be exorbitantly expensive, but a range of sophisticated cost-effective products have come on the market in the last two years. Startups are now attracting significant amounts of private investment. Investors are now interested in bot companies that integrate AI, speech (Natural Language Processing), emotion detection, and facial recognition. Several new companies sell bot products that actually "remember" people they have interacted with in the past.

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Prices are still high for sophisticated physical robots and bots (both physical and virtual) designed for clinical mental health intervention. Yet the prices for robotic components are falling fast, robots can now be rented or leased for short time frames, and licensing prices for conversational AI's (smart virtual chatbots) are declining. Access to cloud-based AI platforms like IBM Watson are based on "pay only for what you use" models. This is now called Artificial Intelligence as a Service (AIaaS) and enables customers to deploy AI without a large investment or exposure to risk.

An interesting business model used by several conversational AI-based chatbot providers is to charge customers by the number of transactions. This is a major business model in the non-educational chatbot market and now being adopted by education suppliers. This makes the products accessible to small and medium sized customers.

Robotics technology is advancing at a rapid pace. Perhaps the most significant innovation is the use of artificial intelligence (AI) in robots. AI-based Educational Bots range from inexpensive smart toys, to sophisticated service robots, to emotionally-aware therapeutic robots. In general, the more sophisticated programmable humanoid physical robots and virtual avatars are still quite expensive. But even these products are falling in price.

According to an August 2018 press release from the Robotics Industry Association (RIA), cloud-based Robots-as-a-Service (RaaS) is a major factor driving down prices. In RaaS business models, the processing and even the robot itself are rented. Many of the physical Educational Bot developers cited in this report offer RaaS options to clients.

Most of the tutoring bots and AI-based virtual teaching avatars are cloud-based products hosted by suppliers and a new term called Bots-as-a-Service (BaaS) is now used to describe virtual bot hosting. All informational and conversational bots are based on basic Question and Answer (Q&A) methods like those commonly used in FAQs.

The primary catalysts driving the market is the high global demand for Educational Bot for young children in the consumer segments and the corporate demand for so-called assistance and service bots (both physical and virtual) across the planet. Educational Bot designed for young children are approaching a mass market phase across the planet.

In general, there are two main categories of Educational Bots: Tutoring and information assistant bots and bots used for clinical Robot-Mediated Behavior Intervention (RMBI). There are physical and virtual products on the market for both categories.

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Figure 2 – Two Broad Categories of Commercial Educational Bots

The physical robots for kids run the gamut from smart toys to advanced robots designed to help children with special needs. A new type of companion tutoring robot designed for elderly cognitive care is also gaining in popularity, particularly in Asia. These Educational Bots are designed for behavior modification, which is a synonym for learning. By definition, all learning is behavior modification.

Virtual tutoring bots range from simple text interfaces and audio interfaces to visual bots that are screen-based 3D avatars. The avatars can be quite sophisticated incorporating AI-based speech recognition, emotion detection, and facial recognition.

Japan’s SoftBank is a global conglomerate known mostly for its mobile business. They diversified into robotics in 2013 with the acquisition of France’s Aldebaran and rebranded it as their SoftBank Robotics division. In 2014, they launched NAO and Pepper robots. Priced in 2018 at around $9,000 and $25,000, respectively, they are two of the most widely used education robots in the world.
By 2018, there were 12,000 Pepper deployed in businesses worldwide and over 15,000 NAO robots in use across the globe. "By August 2018, "More than 15,000 NAO Robots are already in use speaking 20 languages in over 50 countries."

- The NAO robot is now common in the PreK-12 segments and often used for therapy for children with special needs. Both NAO and Pepper are being programmed for educational purposes. Pepper comes with integrated emotional recognition and facial recognition software. Pepper is sold in three configurations: home, enterprise, and education. Of the thirty premium partners profiled on SoftBank's Partner Ecosystem page, twenty-six develop educational solutions.

- According to SoftBank Robotics, "Use cases for the NAO robot include autism intervention therapy, assisted pediatric medical care, STEM robotics programs in schools, assisted living in skilled nursing facilities, digital literacy and maker space programs in public libraries, retail store consumer engagement, retail banking, and hospitality services."

This is an evidence-based quantitative report. This report identifies over 500 Educational Bot developers competing in the 122 countries tracked by Metaari. Some have global distribution reach. Educational distributors across the planet resell Educational Bot in specific countries and regions. For example, SoftBank Robotics has a global partner channel.

Dozens of global distribution agreements are identified in the report. This report identifies the types of bots the global distributors are licensing. Some developers are regional competitors, but most compete at the country level in specific buying segments.

- This report identifies the Educational Bot 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 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 Educational Bots products they buy, and the suppliers that are meeting the demand from these buyers.
The global commercial Educational Bot market is in a state of flux characterized by rapid advancement in technology, exponential innovation, and the avid adoption by all the buying segments. The market conditions are very favorable for suppliers.

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 Educational Bot products and services: retail Educational Bots units, custom development services, and bot authoring tools and components.

**Overview of Catalysts Driving the Global Educational Bot Market**

There are at eight major catalysts driving the global commercial Educational Bot market. They are briefly described in this section and analyzed in great detail in the demand-side analysis section of this report. There are also a range of secondary catalysts such as the advances in 3D printing, biosensors, and neurotechnology that are also discussed throughout this report.

**Figure 3 – Primary Catalysts Driving the Global Commercial Educational Bot Market**

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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 rapid rate. There are significant revenue opportunities for specific types of Educational Bots in particular buying segments, specific verticals (like healthcare), and in specific countries.

**Private Investment Flowing to Educational Bot Startups**

Over $1.3 billion has been invested in Educational Bot companies in 2017 and the first half of 2018. Fifty-eight companies have garnered investments in the eighteen month period. Investors are particularly attracted to healthcare-related bots.

Very few Educational Bot companies raised funding prior to 2017. Only seven companies were funded in 2016 and just three in 2015. Interestingly, despite the widespread use of robots in Japan, most of the investments have gone to companies in the US and China.

The section analyzing the catalyst identifies dozens of Educational Bot companies that have raised funding in the 18-month period and describes the types of bots they make. This provides suppliers with a roadmap for developing products that will attract investment.

The companies that have attracted the highest investments are identified in the section analyzing the primary catalysts in this report and several dozen 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 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 investment analysis in the detailed catalyst section.

**Clinical Use of Bots for Children and Adults with Special Needs**

Cognitive Behavior Therapy (CBT) is a method that provides behavior modification intervention. **Behavior modification is identical to leaning. The two terms are synonymous.** Educational Bots (both physical and virtual) are now in relatively wide use in the treatment of people with special needs. There is a very specific type of therapy based on robots called Robot-mediated Behavior Intervention (RMBI) therapy. Over 25 companies that sell RMBI products and services are included in the detailed analysis of the catalysts.

Kids with autism and other developmental disorders often struggle with social skills. Robots are now proving effective in teaching life skills to these children. They are

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also used in cognitive remediation therapy with adults. New products continue to come on the market to meet the demand. This report identifies over forty of these new therapeutic Educational Bots.

The demographic that can be helped by these robots 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.

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 bots mitigates this problem. The bots can scale to literally millions of people.

According to the World Health Organization (WHO), the array of mental disorders prevalent on the planet include 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.

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There is a growing number of physical robots being marketed as elderly care robots. They are designed to mitigate dementia, loneliness, and anxiety and are by definition behavior modification Educational Bots. For example, Hasbro developed a line of elderly care robots in the shape of cats and dogs under their Joy For All Companion Pet brand in 2015 and 2016.

The Joy For All brand was acquired by a company called Ageless Innovation in May 2018, which was founded by ex-Hasbro employees from the Joy For All group. At the time, the new company stated that they had sold over 100,000 of the robot animals. The robot cat costs $100 and the robot dog costs $120. Many of these products are identified in the analysis of catalysts section of this report.

**Robots That Teach Kids to Code in High Demand Across the Planet**

A very recent trend is the near insatiable demand for smart toy bots 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 kind of robots are attracting significant amounts of venture capital. Twenty-two of the fifty-eight Educational Bot companies that raised fund in 2017 and in the first half of 2018 are selling robots designed to teach kids to code.

*Over seventy Educational Bot developers that sell robots 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. Many are designed for very young children are so-called "screenless" products that use components like physical markers to program the robotic behavior. These are fundamentally new types of Educational Bots.

For example, a robot called Plobot by a company of the same name, is "a cute robot that teaches your kids coding through physical play with no need for computer. It comes with simple command cards to code algorithms, loops, and conditionals."

Poland's Photon Entertainment sells an Educational Robot called Photon designed for young kids. It uses a large floormat with various markings that trigger robot behavior when the children places the robot on the markers. "Photon supports children in developing the basic skills of modern times. It helps them develop creativity, improve their logical thinking abilities, and learn the basics of programming."

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China's UBTECH Robotics launched a new Educational Robot called UnicornBot in October 2018. It is in the shape of a small unicorn and teaches kids to code using the Blockly language. "We use Blockly programming which fits perfectly into our age range for all levels of kids who are interested in coding." Their initial market for the robots is the consumer segment but they are also aggressively entering the US PreK-12 segment. "Our education program is another top priority for our North America office. We launched UBTECH’s education business at the ISTE (International Society of Technology in Education) trade show in June 2018."

**Growing Use of Robot Tutors in the Academic Segments**

Educational Bots used in the PreK-12 schools are almost always physical humanoid robots and tend to fall into two categories: language learning (particularly for young children) tutors and STEM tutors.

Higher education institutions do use physical robots as teaching assistants but are more likely to use virtual avatar-based chatbot tutors; they are now gaining traction across the globe. They are used as student advisors and the most sophisticated virtual tutors are AI-based that provide personalized learning and career advice to students. They are essentially AI-based guidance counselors.

Multilingual smart robots are ideal for teaching foreign languages. The smarter they are, the better they are at offering personalized teaching. The EU-funded L2TOR project in Europe uses a NAO robot from SoftBank Robotics to teach young children foreign languages. The robot teaches English to native speakers of Dutch, German, and Turkish. It also teaches Dutch and German to Turkish-speaking immigrant children.

- "The L2TOR robot’s social behavior is based on how human tutors interact with children, and not only uses verbal communication, but also nonverbal communication, such as gestures and other forms of body language. The robot is able to adaptively respond to children’s actions and engage with them in tutoring interactions."

STEM initiatives around the world are a major catalyst driving the adoption of Educational Bots in the PreK-12 segments. Robots are becoming integral to STEM programs in the schools and the adoption of robots designed to teach children coding mirrors the buying behavior in the consumer segment.

Poland's FLASH Robotics' EMYS is a uniquely shaped language learning robot designed for young children. "EMYS is the most advanced educational robot in the world with a friendly appearance and outstanding interactive capabilities."
product is primarily marketed to the schools, but consumers can purchase the robot for $399. They offer an SDK for third-party developers for $699.

Finland's AI Robots Oy is a 2016 startup that developed a physical tutoring bot called Ovobot. It is designed to teach math to preschool and primary students. "It asks questions and awards points according to how well pupils answer them. The platform also supports personalized learning. Our teaching program is developed in co-operation with Finnish teachers and it follows the Finnish curriculum that is best in the world."

**Consumer Demand for Social Companion Tutoring Robots**

There is a large and growing consumer demand across the planet for "social companion" tutoring robots. Most of the companies meeting this demand are startups and new companies continue to come on the market. There are over thirty of these companies cited in this report.

Hong Kong's Hanson Robotics (developers of the infamous Sophia humanoid robot) sells several physical Education Bots including Zeno and Professor Einstein. Professor Einstein is a small robotic doll in an image of the famous scientist. "We can discuss science, math, the weather, famous people, anything in-between!"

The Professor Einstein robot uses voice recognition and "converses" with children. "Professor Einstein features a Body Camera to see objects in front of him & Motion Sensors to detect the edge of a table where he’s walking. Directional Sound allows him to hear where you are in the room, and turn his head to talk to you." The robot costs the equivalent of $192 in retail outlets across the globe.

- Hanson launched their fourteen-inch 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."

Bosch developed a cooking assistant robot called Mykie. "Mykie listens, answers questions, and projects information and recipes. It keeps track of the household at all times and entertains users. Mykie can be easily operated through voice controls or a touchscreen, and it assists users with recipes through step-by-step videos."

There are now hundreds of smart toys designed for early childhood learning on the market. For example, China's voice-activated YYD ROBO robot for preschoolers tutors young children in counting, vocabulary, English, and pinyin letters (a Roman alphabet form of Mandarin). The robot sings to the kids, and tells jokes and

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children's stories. Their Fairobo edubot is also marketed to preschools and sells for the equivalent of $75.

**The Holy Grail: AI-based Bots Deliver True Personalized Learning**

Personalized learning and adaptive learning have long been the Holy Grail of the training and education industry. Despite vendor claims to the contrary, it has never been achieved until the advent of AI. AI-based Cognitive Learning, Game-based Learning, and Conversational AI Educational Bots (both physical and virtual) are now delivering on the promise and can achieve true personalized learning by adapting to individuals in real time. This is a long-awaited achievement in the training and education industry.

The education and training industry is on the verge of extraordinary innovations in knowledge transfer due to advances in cognitive computing and artificial intelligence platforms. One of the best-known cognitive computing platforms is IBM's Watson and developers are building out advanced learning technology products on top of the cloud-based platform.

Pearson, Apple, Blackboard, Scholastic, Sesame Street, Edmodo (now owned by China's NetDragon) and Houghton Mifflin Harcourt are building new educational products on Watson.

Other 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.

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 self-learning Educational Bots. The most sophisticated bots in the current market integrate one or more of these technologies and are fundamentally different from the so-called "scripted" bots that are programmed to do rote tasks.

It should be noted that AI-based Educational Bots and virtual avatars need to be "trained". This is 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 now on the market particularly in industries like banking, healthcare, STEM, and cybersecurity. That said, there are very few AI models that can perform adequately right out of the box.

For example, it took Credit Suisse eighteen months to bring their IPsoft Amelia virtual customer service agent to an 87% proficiency rate. Despite extensive programming prior to launching Amelia in late 2016, it could only accurately answer 13% of customer inquiries at launch. A detailed analysis of the challenges involved with training AI-based Educational Bots and virtual avatars is included in the section in this report analyzing the primary catalysts. There is now a cottage industry of suppliers who train AI-based robots and virtual avatars. These new service providers have a range of business models and they are identified in this report.

**Rapid Uptake of Assistance, Support, and Information Bots**

Corporate lobbies, government building lobbies, courtrooms, airports, hotels, train stations, retail outlets, and shopping malls are now using Educational Bots (both physical and virtual) to provide information assistance and customer service to people in those venues. In general, they are called service robots.

They are referred to as hospitality robots in the hotel and restaurant industries and retail robots in the retail sector. They are called social assistive robots (SARs) and Virtual Healthcare Advisors (VHAs) in the healthcare sector. The new AI-based avatars are sometimes referred to as intelligent digital humans or digital workers.

SoftBank Robotics’ Pepper robot is the most well-known physical service robot and now in use at over 2,500 sites in Japan. Pepper is starting to be used outside of Japan. It is used in Manhattan’s HSBC bank lobby and "engages shoppers of all ages at Westfield shopping centers in California." In October 2018, the company stated that they had sold over 12,000 units since it went on sale in 2014.

In the Saturn chain of electronics superstores in Germany, a robot named “Paul” greets customers and "asks how it can be of service, and shows them to the appropriate departments or product displays depending on their interests. During the trek through the store, Paul is able to point the customer to special offers or entertain them with jokes. *Paul can detect people’s emotions, gender, and can engage in context-aware speech interaction.*"

Service robots are moving into the retail outlets public spaces in greater numbers. Fellow Robots’ NAVii robot, aka LoweBot, is deployed at Lowe’s home
improvement superstores to help shoppers locate products more easily and help employees maintain inventory. "Users can either verbally state which items they want, or they can type them in on an interactive keyboard."

Japan has a growing number of so-called robot hotels and amusement parks with robotic staff that speak English, Chinese, Korean, or Japanese. The travel agency H.I.S. opened the first robot hotel called Henn-na in 2015. H.I.S opened six new robot hotels in Tokyo and three in Osaka Prefecture. They plan to open 100 more robot hotels, including some overseas.

It should be noted that humans are still employed at these hotels (and required by Japanese law), but the staff headcount is quite low compared to traditional hotels. In March 2018, H.I.S. announced that they would replace a third of their staff with customer service robots at the large Huis Ten Bosch amusement park by 2021. The park employs 1,200 people.

Adoption of Robot Guides in Museums, Exhibitions, and Tourist Sites
There is a new genre of physical Educational Bots called guide robots. They are used to provide information and educational content to people in museums, exhibitions, and tourism sites. The most intelligent are equipped with AI, facial recognition, and emotion detection.

Dozens of museums across the globe now use robots as tour guides including the Musée de la Grande Guerre just outside of Paris, the American Museum of Natural History in New York, the Mob Museum in Las Vegas, and the Canada Science and Technology Museum in Ottawa. The Smithsonian in Washington, D.C. started using 30 Pepper robots in 2018 as tour guides in seven of their facilities. They intend to deploy over 100 Peppers in all 19 of their facilities.

Sharp's tiny RoBoHoN is an AI-based talking "companion robot" that is relatively expensive ($1,230) and only available in Japan. Tourists can rent the small robot in Tokyo's Haneda airport for $12 a day. The robot only speaks Japanese and has GPS. It "points out" places of interest as a tourists explore Tokyo. It is essentially a wide-area conversational tour guide.

- "The robot is voice-controlled and can make calls, read messages, and emails out loud, auto-type dictated replies, click selfies and group photographs, double as a talking alarm clock, as well as display images, videos, and maps onto walls and other surfaces."

Robo Garage Co in Japan develops 16 robots that are quite similar to the RoBoHoN. The company is led by Tomotaka Takahashi who "creates, designs, and invents..."
unique and original humanoids (Ropid, FT, Chroino, Neon). His passion for the cutting edge in robotics brings him into collaborations with other leaders in the field, Researchers, and corporations."

The Art Gallery of Western Australia claims to have deployed the first robotic gallery guide called Aggie; it was first deployed in the gallery in 2016. Aggie was manufactured by France's Aldebaran (now owned by Japan's SoftBank Robotics) and runs on operating software developed by a Belgium company called QBMT.

Aggie was programmed with content by Smartbots, a robotics firm in Perth. Aggie provided art classes to kids as well. Aggie "worked" in the gallery for a year and is now touring the outback. Aggie has gone on a sabbatical art research tour of the outback regions and is expected to return for occasional special events to check up on young visitors."

**What You Will Find in This Report**

There are four sections in this report: an overview of the global market conditions, an analysis of the major catalysts driving the market, a demand side-analysis, and a supply-side analysis. The analysis of the catalysts provides a detailed discussion of the major catalysts driving the global market.

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

Metaari uses standard exchange rate and inflation/deflation variables in our predictive analysis and the impact of these fluctuations are baked into the annual forecasts.

Metaari temporarily suspends tracking the learning technology market in countries undergoing severe socioeconomic challenges and restarts the monitoring once the conditions stabilize.

We have done this in the past for countries like Egypt and the Côte d'Ivoire (The Ivory Coast), but restarted the tracking when the conditions normalized in those countries. We are currently suspending tracking in Venezuela and Yemen.

**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

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

Table 1 - 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>
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This report provides five-year forecasts for Educational Bot products for seven regions: Africa, Asia Pacific, Eastern Europe, Latin America, the Middle East, North America, and Western Europe.

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The region with the highest growth rate is Latin America at 44.7%, followed by Africa and the Middle East at 42.5% and 41.7%, respectively. The growth rate in Western Europe is also quite high at 37.0%. The revenues in each of these regions tend to be concentrated in just a handful of countries.

**Figure 4 – 2018-2023 Commercial Educational Bot Growth Rates by Seven Regions**

The Asia Pacific region has the "lowest" growth rate at 25.4%, which is still quite high. Asia Pacific is an early adopter of commercial Educational Bots and is the most mature market on the planet with widespread use in South Korea, Japan, and now China. Revenues in Asia will more than triple over the forecast period. A detailed analysis of the dynamics and catalysts of the Educational Bot markets in South Korea, Japan, and China are included in the Asia Pacific regional section.

The growth rate in Eastern Europe is 35.6% with revenue heavily concentrated in the Russian Federation, Belarus, Ukraine, and Georgia. Revenues for commercial Education Bots in Eastern Europe will more than quadruple over the forecast period. The growth rate in North America is a healthy 33.6% and revenues will also quadruple over the forecast period.
The revenues for Educational Bots are heavily concentrated in the Asia Pacific region and Western Europe over the forecast period. In the 2018 market, Latin America was the fourth largest buying region after Asia, Western Europe, and North America. By 2023, Latin America will be the third largest buying region after Asia and Western Europe. Western Europe will account for the highest revenues by 2023.

In the 2018 market, South Korea was the top buying country of commercial Educational Bots in the world. China will be the top buying country in the world by 2023. Japan is unique in that they are the only country in the world (so far) that makes extensive use of physical robots to mitigate severe labor shortages. Robots are increasingly being used in their elderly care facilities. "Senior care facilities across Japan are testing out robots that deliver an assortment of social and physical health care and the government-backed initiative has been met with positive reviews by elderly residents." Japan has the most extensive adoption of physical social companion robots anywhere in the world.

**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 Educational Bots are concentrated in the consumer and corporate segments throughout the forecast period, but the buying behavior is very different in each segment. Corporations tend to use Conversational AI bots (both physical and virtual) and consumers prefer physical bots, particularly smart toy bots designed to teach children. The corporate segment has a robust growth rate of 33.5% and the consumer segment has a healthy growth rate of 28.7%. A detailed analysis of all the buying segments is included in the demand-side section of this report.

The PreK-12 segment has the highest growth rate for commercial Educational Bots at a breathtaking 50.1%. This is being driven in large part by the rapid adoption of physical robots in rural Chinese preschools that are experiencing a pronounced teacher shortage. It is also being driven by the growing use of Educational Bots used to teach children with special needs in the earlier grades. This is a global trend.

The most viable way to compete in the PreK-12 segment is via educational distributors. The schools tend to buy from distributors even if they can buy directly from companies. Countries with centralized national education agencies either buy directly from companies or hire "primary" contractors to manage procurement. China is a good example of a country with a central national education agency. The agency uses state-owned China Telecom to manage their PreK-12 procurements.

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The growth rates in the local/state government segments across the planet are very high at 41.6%, followed by higher education at 39.8%. Local and state government agencies are deploying physical Educational Bots in public sector locations like municipal airports and train stations: they are now used in all the major international sporting events. South Korea deployed over 85 robots at the 2018 Winter Olympics including dozens of voice-activated informational robots that spoke Korean, English, Chinese, and Japanese. Tokyo has already stated deploying informational robots in the airports and railway stations ahead of the 2020 Tokyo Games.

All government buyers across local, state, and federal agencies are adopting virtual interactive Conversational AI bots at a rapid rate. Yet, the agencies use the bots 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.

**Figure 5 – 2018-2023 Global Commercial Educational Bot Market by Six Buyer Segments**

Federal government agencies across the globe are increasingly deploying commercial physical Educational Bots for use in government offices and nationally-owned airports. An interesting trend is the rapid adoption of informational robots used to disseminate legal information to citizens in the courthouses. So far, this is a
unique trend heavily concentrated in China. The growth rate in the federal government segment is 37.3% and revenues will more than quadruple by 2023.

Revenues for Educational Bots in the tertiary and higher education segments are still relatively low compared to the other segments but the growth rate is quite healthy at 39.8%. An interesting trend in this segment is the growing use of virtual conversation bots (AI-based chatbots) for student counseling, mental health interventions, and online course "assistants".

**What are They Buying?**

This report forecasts revenues for three types of commercial Educational Bot products and services: retail physical bots (both physical and virtual) sold by unit or by rentals for physical bots and licenses and subscriptions for software-based bots, custom Educational Bot development services, and authoring tools and platforms designed to program Educational Bots.

**Figure 6 - 2018-2023 Global Educational Bot Growth Rates by Three Products and Services**

The growth rate for custom services is a robust 43.1%. 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.

The revenues are heavily concentrated in the retail Educational Bot unit product type. Suppliers sell and lease out physical robots and sell software licenses and subscriptions to virtual interactive Conversational AI bot apps and platforms. The growth rate is a healthy 32.4%. The price ranges for retail Educational Bots (physical or virtual) span a wide spectrum ranging from a few hundred dollars for consumer robots to over $20,000 (or more) designed for people with special needs. Robots used in public exhibition, hospitality, and transportation venues can range in price from $30,000-$80,000.

The new virtual AI-based avatar robots are all custom trained by the suppliers and this can cost up to a half a million dollars and take months to program. Most clinical therapeutic bots (both physical and virtual) are still quite expensive as they require both programmers and clinical specialists to train the bots.

Over 500 Educational Bot companies are identified in this report. The report identifies the type of bots they make 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.

The growth rate for Educational Bot authoring and coding tools is very high at 55.7%. The revenues are still quite low as these tools are very new to the market. Most of the major Educational Bot suppliers provide SDKs as part of their licenses and some have fee-based developer programs. They are modifying their retail robots to be programmable in a concentrated effort to grow their service revenues. Very few Educational Bots are "out-of-the-box" ready when first purchased.

Most Educational Bots have to be "trained" before they can be instructionally effective. This is now a lucrative revenue opportunity for suppliers. The growth rate for custom development services is very high at 43.1% and revenues for custom services will grow over six times over the forecast period.

Suppliers customize their own branded bots but there is now a cottage industry of third-party developers that train and customize general-purpose bots like the NAO and Pepper robots from SoftBank Robotics. Many developers across the globe specialize in training general-purpose bots for academic tutoring, information guidance, and language learning.

The more sophisticated an AI-based bot is, the more training it requires and this can generate a great deal of revenues for service providers. For example, New Zealand's Soul Machines develops very realistic AI virtual bots. As of October 2018, they had

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Metaari's 2018-2023 Worldwide Educational Bot Market

sold over 15 of the bots. On average, they charge up to half a million dollars to customize and train the bots for clients.

**Sources of Data on the Global Educational Bot 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 serious game 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 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, game and Mixed Reality news portals, and academic budget statements.

**Figure 7 - Metaari's Actionable Competitive Intelligence Methodology**

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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.

There are dozens of online portals that track the global robotics industry and they do touch on Educational Bots:

- **The Robot Report** "covers general robotics, industrial robots, robot events, FIRST, RoboCup, VEX, AI for robots, robot software, robot hacks, robot reviews, LEGO Mindstorms NXT, and mobile robots. The Robot Report reports on space, military, industrial, agricultural, commercial and medical robot news. This robot news portal also focuses on robotic products and projects, including news from China, Japan, Korea, Europe, Israel, the US and around the world."

- Robhub "is a Swiss-based online platform that brings together leading communicators in robotics research, start-ups, business, and education from around the world."

- The Robotics Business Review "delivers actionable business intelligence to a global robotics, artificial intelligence and unmanned systems ecosystem through market leading digital media products and live events."

- Robotics Tomorrow is an "Online Robotics Trade Magazine: Industrial Automation, Robots and Unmanned Vehicles."

- Simplebotics "is an independent blog that covers the future of robotics. From robot vacuums to delivery drones to self-driving vehicles, we have you covered on what’s new in the industry."

- A portal called Robotic Gizmos has an education section and has over 300 product articles on Educational Bots. The vast majority are products designed for young children.

- Asian Robotics Review is an online publication "offering news, analysis, research and opinion on the global technology and business issues of robotics, robotics-driven automation, and artificial intelligence (AI) as it applies to Asia (East Asia, Southeast Asia, Asia Pacific, and India)."

The IEEE organization has rolled out a massive reference catalog of commercial robotic products. In September 2018, they stated that “Over the past year, we’ve been creating a massive portal for everything robotics, built around a fun and unique..."
dynamic catalog. You can see it right now at Robots.ieee.org. There you’ll find a vast zoo of humanoids, drones, exoskeletons, quadrupeds, and other kinds of automatons, each with its own profile, with photos, videos, curious facts, and technical specifications."

Robotics trade associations are good sources of information on robotics in general and Educational Bots (that they categorize as a type of service robot). Some of the major robotics trade organizations across the planet include:

- The Robotic Industries Association
- ASSOCIATION ESPANOLA DE ROBOTICA in Spain
- The African Robotics Network (AFRON)
- British Automation & Robotics Association (BARA)
- The China Robot Industry Alliance
- Danish Industrial Robot Association (DIRA)
- International Federation of Robotics (IFR) in Germany
- VDMA Robotics + Automation in Germany
- Japan Robot Association (JARA) in Japan
- The Robotics Society of Japan (RSJ)
- Malaysia Robotics and Automation Interest Group (myRAig)
- ÖGART Austrian Society for Automation and Robotics
- Russian Association of Robotics
- Siri Italian Association of Robotics
- Swedish Industrial Robot Association (SWIRA)
- Taiwan Automation Intelligence and Robotics Association (TAIROA)
- The Korea Association of Robot Industry (KAR)

Silicon Valley Robotics (SVR) "supports the innovation and commercialization of robotics technologies. We host the Silicon Valley Robot Block Party, networking

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events, investor forums, a directory, jobs board and provide additional services and information for members, including an annual global robotics startup competition and reports on aspects of the emerging robotics industry.”

- Silicon Valley Robotics is a not-for-profit coalition of robotics companies and startups, representing the robotics cluster of northern California. Silicon Valley Robotics was launched in 2010 by a network of robotics companies in the greater Bay Area including current sponsoring members, Jabil, Fetch Robotics, Toyota Research Institute, SoftBank Robotics, Mayfield Robotics, EandM Engineering, SICK Sensor Intelligence, and Harmonic Drive.”

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 dozen Education Robot companies that recently garnered private investment are identified in the analysis of the catalysts section.

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