AI & Universities

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Foreword

We live in interesting times – during an extraordinary business / societal inflection of epic proportions.

ChatGPT momentum and metrics (including the trifecta of users / usage / monetization) are unprecedented. The amount of investment in and focus on Artificial Intelligence from the most valuable companies in the world is unparalleled, and other capital is also rushing in.

These companies are competing for the next generation of computing. Most are still led by founders who have a habit of being the displacers, not the displaced. And yet regulators (in America and Europe) are focused on reining in Big Tech just when these companies are experiencing their biggest competitive threats in years / decades AND when global state-driven competition is vicious.

This is a critical time for industry, government and higher education to work together. We have the chance to leverage our advantages and augment freedom and democracy, not diminish them. This is the time to step back – to understand the global dynamics and risks at work – and to determine how we can best grow / use artificial intelligence for the good of our country and the world. We are in an intelligence arms race for hearts, minds, and power. For the sake of democratic values, it's crucial for those who uphold these principles to lead not lose.

Actions taken in the next five years will be consequential. It's important for higher education to take a leadership role, in combination with industry and government. The ramp in artificial intelligence – which leverages the history of learning for learning – affects all forms of learning, teaching, understanding, and decision making. This should be the best of times…

Our first-pass observations on these topics follow. We begin with an overview, followed by thoughts on the unprecedented ramp in AI usage and the magnitude of investment in AI from America's leading global technology companies. Then we explore ways that this rapidly changing AI landscape may drive transformations in higher education. We hope these add to the discussion.

AI & Universities – Will Masters of Learning Master New Learnings?

Mary Meeker

AI is developing at an epic pace. America is the global leader, and our entrepreneurial and capitalist system has fostered that leadership. That advantage is the envy of the world, as evinced by the business world's voting mechanism – public company market capitalization. Fourteen of the seventeen global companies that carry a value greater than $500B are headquartered in America, one is in Saudi Arabia (Aramco @ #6), one is in Taiwan (TSMC @ #8), and one is in Denmark (Novo Nordisk at #12).

Global Public Market Capitalization Leaders >$500B = 14 of 17 USA-Based

Rank 2024	Company	Headquarters	Focus	Market Cap Value ($B)
1	Microsoft	USA	Tech / Software / AI	$3,321B
2	Apple	USA	Tech / Hardware / AI	3,229
3	NVIDIA	USA	Tech / Semiconductors / AI	3,038
4	Alphabet (Google)	USA	Tech / Internet / AI	2,258
5	Amazon	USA	Tech / Retail / AI	2,011
6	Saudi Aramco	Saudi Arabia	Energy	1,788
7	Meta (Facebook)	USA	Tech / Internet / AI	1,278
8	TSMC	Taiwan	Tech / Semiconductors / AI	901
9	Berkshire Hathaway	USA	Financial Services	878
10	Eli Lilly	USA	Healthcare	815
11	Broadcom	USA	Tech / Semiconductors / AI	747
12	Novo Nordisk	Denmark	Healthcare	643
13	Tesla	USA	Automotive / AI	631
14	JP Morgan Chase	USA	Financial Services	581
15	Walmart	USA	Retail	545
16	Visa	USA	Financial Services	537
17	Exxon Mobil	USA	Energy	516

Source: Company data, S&P CapitalIQ as of 6/28/24

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The top five most highly valued global public companies are American technology companies – Microsoft, Apple, NVIDIA, Alphabet (Google), and Amazon. In spite of their already formidable size and influence, these companies are fighting like crazy for leadership in AI as their core businesses come under assault from one another…and from global competitors (including state actors)…and from entrepreneurs few have heard of (yet).

At the same time, domestic and geopolitical uncertainty make it critical to determine how we maximize the benefits of AI and minimize the risks. The way we manage this megatrend will define what America looks like in the decades to come. Business plays a key role here…as does government (in moderation)…as does higher education.

American institutions of higher learning have been bastions of technological progress…will that be the case with AI? Rice University Chief Investment Officer Allison Thacker recently asked BOND partner Jay Simons and me to share thoughts on AI – and its potential impact on universities. American universities emerged as the world's gold standard beginning in the 1950s. Owing in large part to the GI Bill, Vannevar Bush and the NSF, and space race funding, many universities came to exemplify intellectual freedom, democracy, and the promise of the American dream of achieving "success and prosperity through hard work, determination, and initiative" (Oxford English Dictionary).

Thanks to mobile phone supercomputers and information transparency, however, methods of learning and research (for all ages) have changed radically. Any learner with Internet access can get a master class on nearly any topic – at a frequency / duration that suits their needs and in ways that significantly improve proficiency. Educational institutions are hard at work looking for the best ways to optimize for these changes.

In the wake of ChatGPT and the AI explosion, we have likely reached a generational, fast and furious change across education. At their essence, AI and connected technology devices provide multimodal personalized output that can help users quickly get information and develop skills on their own terms. Tools that provide real-time feedback on engagement and skill development will continue to improve, enhancing the evolution of pattern recognition. AI will increasingly take over many rudimentary tasks, and the ways teachers teach, and their students learn will evolve.

In many ways, AI can be an all-purpose education tool that many have imagined but have never had. Sal Khan, Khan Academy Founder / CEO, noted in his new book "Brave New Words: How AI Will Revolutionize Education," in the chapter "Rise of the AI Tutor" that "educators have known for millennia that one-on-one instruction – tutoring that works with students at their own time and pace – is the best way for people to learn. It is what Alexander the Great had with his teacher, Aristotle. If Alexander was having trouble with a concept, I can imagine Aristotle slowing down for him...the goal was a "mastery of learning."

The university of the future will not look like the university of today. Some, like Georgia Tech, MIT and Arizona State, have rapidly expanded their digital footprints well beyond their physical plant, in part, to drive economies of scale. Lifelong learning may also be a key part of the future – note that some universities have an affiliation with senior living. As the world continues to flatten and get more competitive (thank you Tom Friedman, 2005), universities will find that AI can be a market share tailwind or a headwind – some will rise to the occasion, others will not.

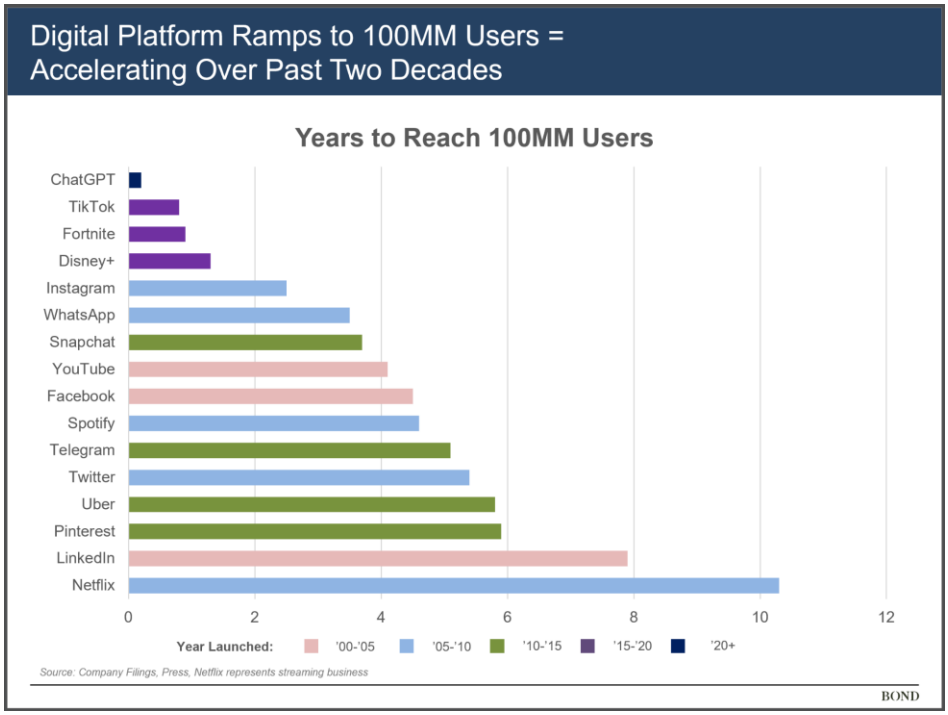
This is the best of times for motivated learners and a consequential time for regulators and leaders to engage in the transformation of pedagogy, working with (not against) our AI leaders. It's a critical time to embrace America's leadership in AI and reimagine the education system in ways that advance curricular flexibility, promote critical thinking, common sense, grit, creativity and soft skills, and optimize for student (and future worker) success, intellectual freedom, and American values.

AI Usage & Spending Ramping at Historic Rates

The advance of AI should drive the fastest and biggest transformations, disruptions, and platform shifts in technology ever seen. While it might seem like an overnight success, the AI crescendo has been building for decades – in the late 1990s with the likes of NVIDIA's graphics processing units (GPUs) and Google's search compilations, in the 2000s with Netflix and Amazon recommendations, X (Twitter) social compilations and Facebook feed prioritization, and in the 2010s with (among others) Amazon Alexa, Tesla Autopilot, Google Transformers, and OpenAI's GPT-2 launch.

For most, though, the inflection point came with the sudden success of OpenAI's ChatGPT launch in November 2022. This was AI's "iPhone Moment"…

- **Fastest User Ramp Ever (for Standalone Product) –** ChatGPT took five days to secure 1MM users vs. Apple iPhone at seventy-four days vs. Facebook at ten months vs. America Online (AOL) at two years…It took ChatGPT just a few months to secure 100MM users vs. nine months for TikTok and thirty months for Instagram.
- **Fastest Software Revenue Ramp Ever –** OpenAI hit a ~$2B revenue run-rate in the first full year post-launch of ChatGPT.



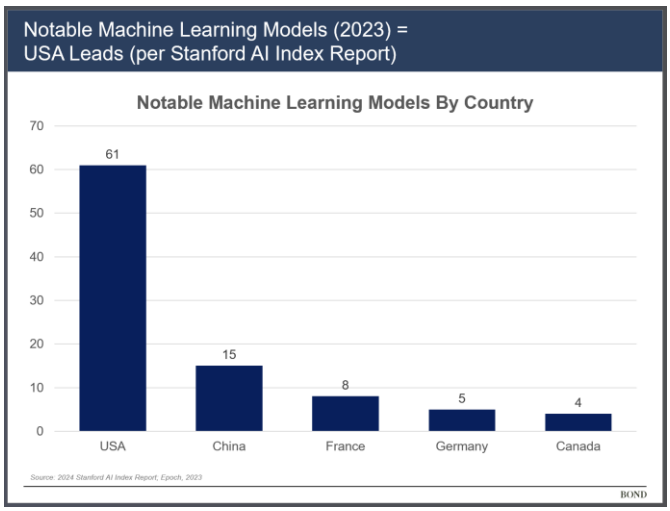
The rise of AI is only set to increase, fueled by technological advancements, major investments, widespread consumer and business adoption, and an increasingly competitive landscape. We are at the beginning of a new supercycle where…

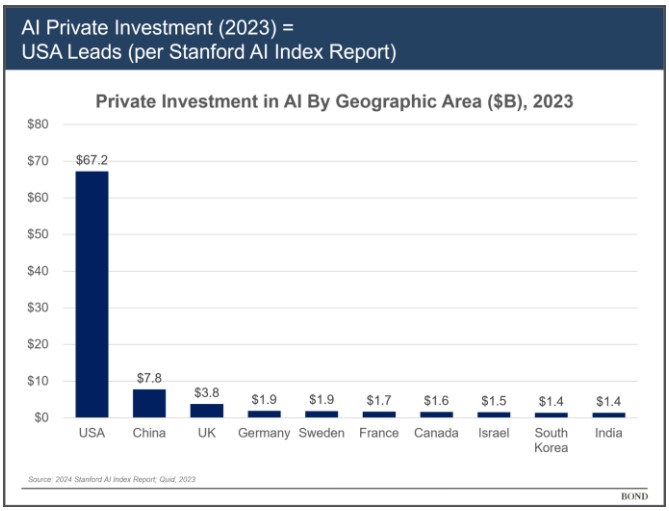
We have access to more data than ever before, and we're in the early stages of making this accessible, useful, and pattern-recognizable. ChatGPT jolted in as the easy-to-use front-end AI access tool for consumers and professionals. Largely trained on Internet data, Large Language Models (LLMs) benefit from the roughly 5 billion global Internet users who have driven an acceleration in the volume of accessible data. International Data Corporation (IDC) estimates that 163 Zettabytes of data will be created and replicated in 2024, up 80x since 2010. This process was supercharged by massive amounts of new compute power coming online – it will become more efficient over time.

The ramp, scope, and scale of technology competition is also different this time. Six companies with market capitalizations above $1 trillion are aggressively attacking the AI opportunity today. Microsoft, Apple, NVIDIA, Alphabet (Google), Amazon, and Meta (Facebook) are fighting for leadership and rapid adoption. Five of these companies have the X-factor of founder involvement – none of them want to be unseated like the incumbents they unseated. There's also Elon Musk, with Tesla at ~$630B market cap and private companies including SpaceX / Starlink at ~$180B, xAI at ~$24B, Boring Company at ~$6B, and X (Twitter), playing on themes of AI and with rich datasets for LLMs. We have never seen competition on this scale before…not to mention venture capital dollars piling in, too.

We are in a global AI arms race, and the stakes are exceptionally high. Five years ago, many would have said China was winning in AI. Since November 2022, however, the animal spirits of capitalism have been unleashed in abundant focus and investment. Many would now put America in the lead, thanks to entrepreneurship, capital, and most of all, rapid consumer and business adoption (see charts below, from Stanford's 2024 AI Index Report). The consequent volume of queries and data helps cement that leadership. Consumers and businesses are aggressively using foundation models, and that in turn makes models more performant.

This cycle of innovation and adoption is set to emerge faster than ever before. In sum, investor speculation is fierce, and Schumpeter's creative destruction is alive and well. History has shown over the past ~6 decades that each new computing cycle happens ~2x faster than the prior cycle (as measured by time to 50% USA household adoption). What's more, each new computing cycle is also ~5-10x bigger (as measured by devices and users over time). In other words, strap in!





Recent AI Data Points from the Big Six

- **Microsoft** – CQ1 revenue of $62B accelerated to 17% Y/Y growth (constant currency) vs. 16% Q/Q with a sizable contribution coming from AI services. In addition, accelerating capex spending of +79% Y/Y to $14B, is an AI investment tell. Microsoft is aggressively aligning capital to prepare for customer demand for their cloud and AI services, and is partnering with top talent from across the industry, including the likes of OpenAI and Inflection AI.

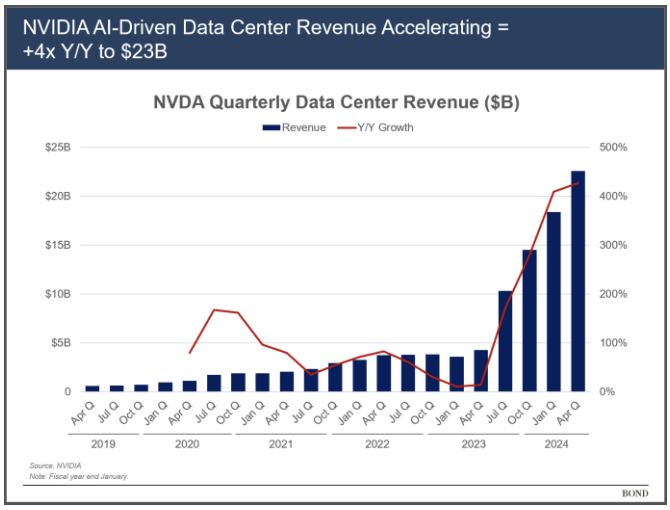
- **Apple** – spanning >2.2B connected devices and its operating system, Apple is collecting one of the world's most wide-ranging datasets. At WWDC 2024, Apple announced a suite of new AI features and a partnership with OpenAI to bring ChatGPT integration to Siri and other first-party apps.

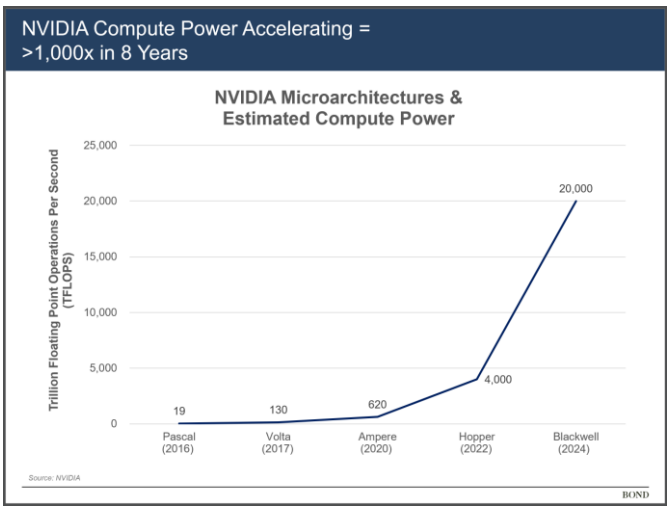
- **NVIDIA –** April quarter data center platform (data processing / training / inference) revenue of $23B accelerated to 427% Y/Y vs. +409% Q/Q! NVIDIA's platform powers several hundred million computers and over 5 million developers, and its newest microarchitecture, Blackwell, has over 1,000x the compute power relative to a decade ago. In a related observation, data center supply growth is robust with total domestic primary market supply growing 26% Y/Y and supply under construction growing 46% Y/Y, per CBRE**.**

- **Alphabet (Google)** – indicated in April that its new AI models and algorithms are >100x more efficient than 18 months earlier. Like Microsoft, Google supported accelerating capex (+91% Y/Y to $12B) in Q1. Google has the ability to leverage foundation models to augment search experiences and attempt to maintain market share. >60% of funded GenAI startups and ~90% of GenAI unicorns use Google Cloud, the company's computing platform (Alphabet, CQ1).

- **Amazon** – invested $4B in Anthropic, arguably the most formidable foundation model challenger to OpenAI. Anthropic uses Amazon AWS as its primary cloud provider and offers Claude (its native LLM) on Amazon's Bedrock managed services. Bedrock has amassed >20K customers building GenAI applications, including the likes of Pfizer, Korea Telecom, NYSE, and Salesforce.

- **Meta (Facebook)** – Meta's latest open-source LLM, Llama 3 8B Instruct, has been downloaded an impressive ~3MM times on Hugging Face since launch in mid-April. Recently raised its 2024E capex forecast to $35-40B implying ~30-48% Y/Y growth vs. -13% in 2023 as it continues to accelerate AI infrastructure investments. Has ability to leverage leading-edge models and features to service its 3B+ daily active users, offering new features such as chat embedded across a family of apps and AI characters with personalities mirroring the likeness of Naomi Osaka, Dwyane Wade, and MrBeast, among other celebrities (Meta).





AI's Impact on Higher Education Will be Significant

1) Internet Offerings Have Materially Altered Learning / Education Over the Past Quarter-Century…AI Will Do the Same, but Faster & Bigger

Learning, in some respects considered as accessibility of answers, has been a buyer's market since Google's search engine began to gain traction in 1998 and Internet access rose. AI is driving a new but familiar wave here. As these technology-driven trends continue, just keeping pace can be a challenge.

- **World's Leading Answer Engine Available 24x7** – Google processes ~8.5+ billion queries per day from its ~4+ billion global users. The company, which did not even exist 26 years ago, has transformed learning and research.

- **Social Media / YouTube / Online Courses Engagement Rising** – The brightest and best-informed (and the riffiest of the raff) can now share observations and teaching with an open mic and can help find the truth…or otherwise. Their impact stretches far beyond the classroom. Note that YouTube launched its first partnership for college course credit with Arizona State University in 2023.

- **University Online Content Engagement Rising** – Leading university course recordings, notes, and assignments are easily available online. MIT's OpenCourseWare, launched in 2001, now covers "virtually all MIT course content" and serves over 1MM unique monthly visitors. COVID also dramatically accelerated the shift toward online / hybrid learning. Coursera (a leading provider of online courses and education certificates) has 140MM global registered learners, +4x pre-COVID numbers. Coursera announced on its Q1 earnings call that via partnership with the University of Texas system, 16K+ course certificates have been awarded to date from companies like Google, Microsoft, and IBM.

- **Learning (for Languages) Optimized in Gamified Ways** – Duolingo, with its ~100MM monthly active users and $670MM in annualized revenue in Q1, shows how technology-enabled remote real-time learning can be captivating and effective.

- **Gatekeeping of Authority & Institutions (Distribution Channels) Eroding** – The rapidly accelerating volume and accessibility of information online, for better or worse, means that students (and others) no longer take leading opinions on faith. Experts (real or imagined) can be anywhere. Content creators (educational and otherwise) can now manage their distribution in expansive (and sometimes lucrative) ways that circumvent gatekeeping institutions. Trust in authority and institutions is foundational to a civil society, and earning (and re-earning) that trust is a challenge and an opportunity.

- **Innovation Half-Lives Shortening** – Education and skills (such as coding languages, advanced math, and what constitutes cutting-edge PhD research) can become obsolete in a matter of years. The growing usability and ubiquity of software, consumer apps and AI give students access to professional-level legal expertise, coding and more…a dramatic change for society and teachers.

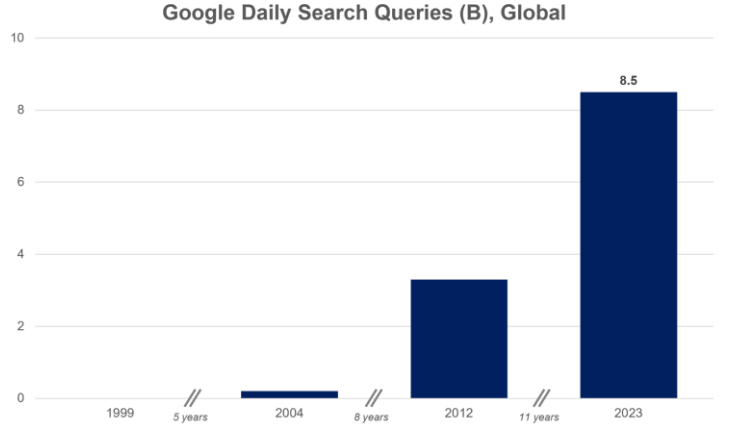
- **Large Language Models (LLMs) Emerging** – Crunching mass quantities of data and pattern recognition at scale while processing text / video / image / voice input has become a real-time phenomenon…and not just in the lab.

- **AI as Memory Aid / Enhancer / Replacement** – For better or worse, data recall via software can enable students to focus on utilizing information in practice…not primarily via recall from brains and books.

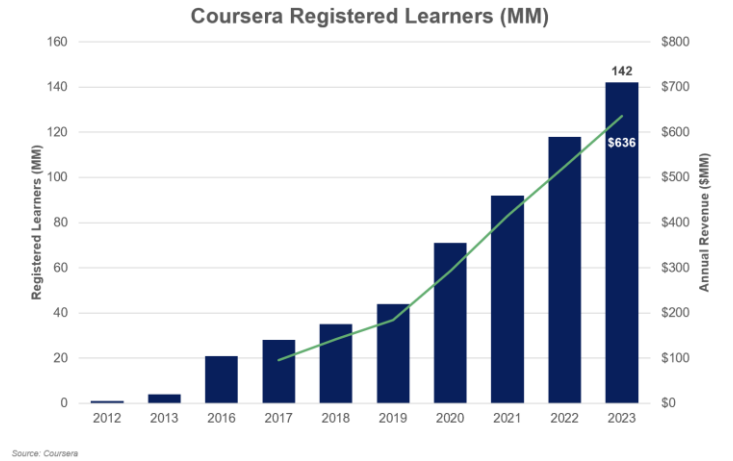
- **Instruction (Best- & Worst-in-Class) Available 24x7** – AI tutors are now available to anyone with Internet access…it's not just across the academic quad. And, in the land of artificial intelligence – well, the intelligence (just like in the real world) can be artificial. Models can provide one answer and get it way right…or way wrong.

- **Concept of Career Evolving** – Increasingly, younger people seek out income streams that do not require accredited licenses and/or degrees, with the ability to earn ad-hoc income via on-demand service work. More detail follows…

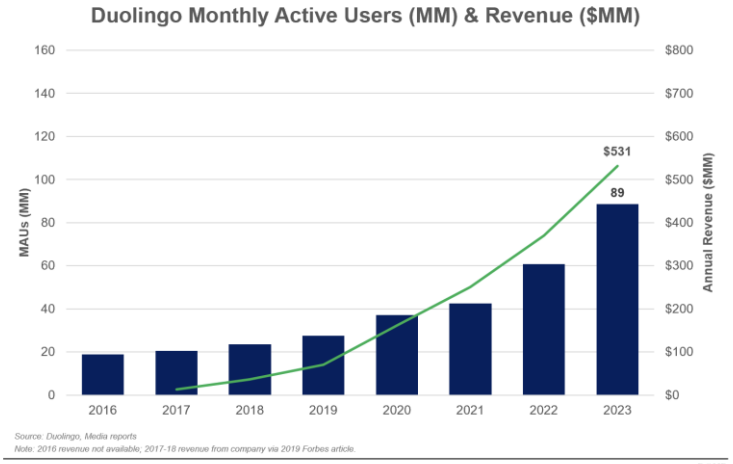
Google Searches = ~1 per Human per Day from Zero 26 Years Ago



Coursera Registered Online Learners = ~140MM, +4x Since COVID



Duolingo Monthly Active Users = ~90MM, +3x Since COVID



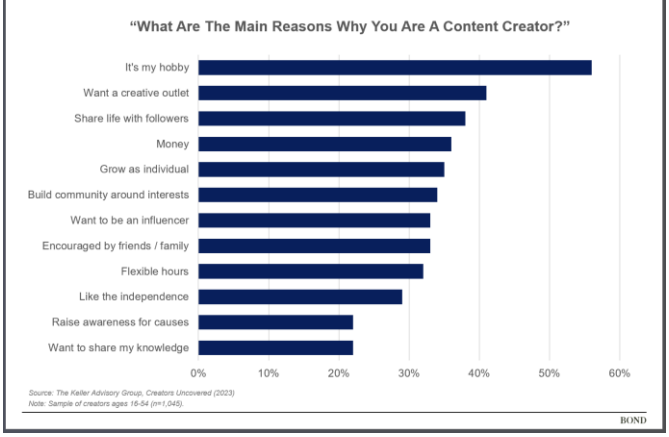
Nature of Income Opportunities Changing for Digitally Native Gen Z

- **It's difficult to measure just how much the opportunity to generate income has changed over several decades.** In addition to the ability to buy / sell / trade on the Internet, Checkr, a leading provider of background checks, estimates that tens of millions of Americans have applied for an on-demand job (including for the likes of platforms like Uber, DoorDash, Instacart and more…). Covid-driven constraints allowed many people (estimated at 34MM as of 5/24 per US Bureau of Labor Statistics) to adjust to all or part-time remote work. And social media platforms have allowed for the development of online creators / influencers.

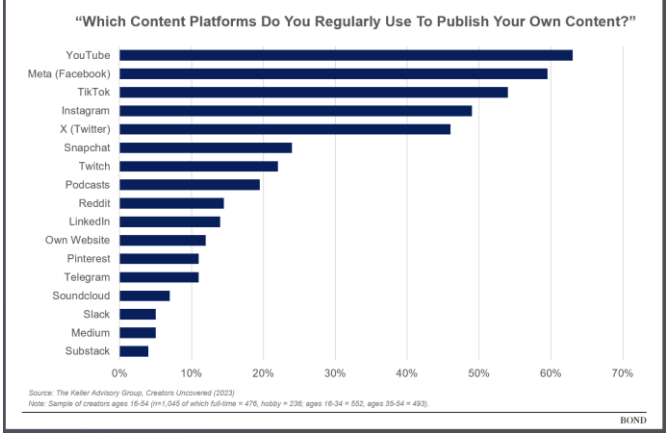
- **The social media creator economy, NCAA policies related to Name, Image & Likeness (NIL), and the transfer portal have changed the ways some young people think about financial opportunities.** Stanford economist Paul Saffo posits that the creator economy began in 1997 with niche artist communities on the Internet, but no distribution / monetization. Things changed with the explosive rise of advertising-based social media platforms like YouTube, Meta (Facebook), X (Twitter), Instagram and TikTok, each of which support more than 500MM users.

- **Estimates on the number of global digital content creators that monetize their efforts range from 20MM to 50MM.** USA influencer marketing revenue reached over $6B in 2023 (Goldman Sachs)…anyway you cut it, it's a big and growing number. Goldman Sachs estimated 50MM global content creators in 2023, of which ~2MM (~4%) make more than $100K per year, primarily via direct branding deals, share of ad revenue with host platforms, subscriptions, donations, and other forms of direct payment (Goldman Sachs, 2023). 187-year-old John Deere made headlines recently when it debuted a celebrity-driven social media campaign and launched a contest to recruit a Chief Tractor Officer focused on social media content. Net, younger people can clearly make real money, and increasingly want it. Morning Consult found in a 9/23 survey of 1,000 Gen Z'ers that 57% would become influencers if they could.

Top USA Creator Motivations (per Keller Advisory) = Hobby / Creativity / Share Life / Money / Individualism



Most Common USA Creator Platforms (per Keller Advisory) = YouTube / Meta (Facebook) / TikTok / Instagram / X (Twitter)



- **As with the creator economy, for better / worse, monetizing Name, Image and Likeness (NIL) in college sports is changing the game for a small number of athletes.** In late 2018, the NCAA created a transfer portal to digitize workflows so athletes could easily switch schools. In mid-2021, the NCAA allowed college athletes to build their own intangible assets and brands in its new policy. New money flows, chaos, disruption, and short-termism followed. Some college athletes have become income-generating brand ambassadors and / or transferred to other schools for more money and playing time. Athletic programs have been forced to sharpen their pencils in new ways.

- **It's important for universities to understand these media and monetization shifts both for teenagers and twenty-somethings, and for the best teachers whose skills can be amplified (and monetized) off campus.** What happens in media and sports may well roll into other disciplines. For better / worse, connectivity, transparency, fame, money, and short-termism can be tough competitors.

2) Higher Education in America…Macro Tradeoffs Increasing

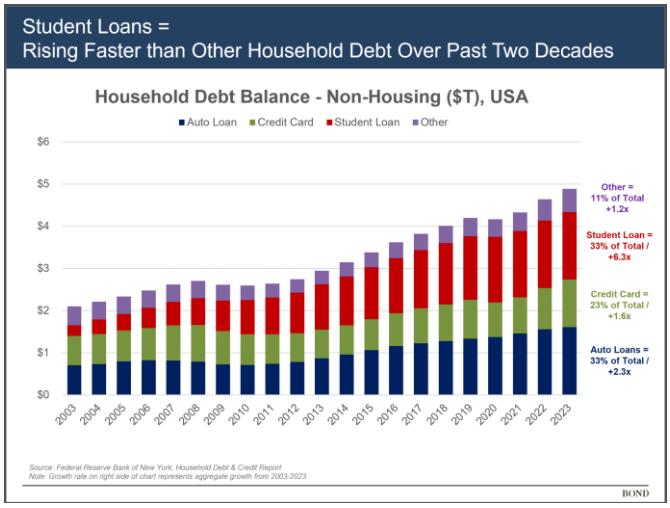
While there are many metrics to review, a few stand out…

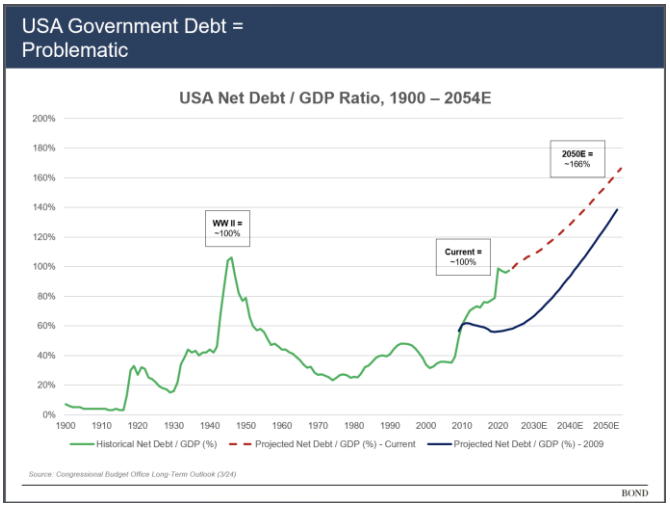
- **High School Student vs. Rest of World Rankings Weak to Mixed** – the output of American high school education, a key input to universities, has been weak to mixed. OECD and other international comparisons show that American high school student rankings have stayed low relative to comparable cohorts in math (from #36 in 2012 to #34 in 2022). While science (from #28 to #16) and reading (from #24 to #9) improved over the same period, they remain well below the world's gold standard (USA Department of Education).

- **Education Cost Post-High School Rising** – over the last forty years, the real costs of tertiary education have vastly increased. According to the US Bureau of Labor Statistics, education costs are up 3.4x vs. the Consumer Price Index since 1980.

- **Student Debt Loads Worryingly High** – behind growing concerns about education's return on investment (ROI) is the rise in aggregate USA student loan debt, which hit $1.7T in 2023. That amounts to ~$40K per graduate (Education Data Initiative). Though the rate of growth has decreased in the last 4-5 years, as a share of GDP and personal income, the student debt burden remains much higher than in the past. The seemingly unchecked rise in student debt (now tied with auto loans as the highest household debt burden) is part of a disturbing trend in our country.

- **Fiscal Irresponsibility Could Pressure University Funding** – 40%+ of US public university funding comes from state or local government sources. Meanwhile, America's debt load is rising to unprecedented levels, at ~100% net debt to GDP and rising rapidly…and rapidly rising interest rates mean the bill is going to come due. Geez, help, the math needs to work here… USA Inc: A Basic Summary of America's Financial Statements





PISA High School Student Assessment – Average Score Ranking By Country, 2000-2022

	Mathematics			Science			Reading		
	2000	2012	2022	2000	2012	2022	2000	2012	2022
1	Japan	China (Mainland)	Singapore	South Korea	China (Mainland)	Singapore	Finland	China (Mainland)	Singapore
2	South Korea	Singapore	China (Macau)	Japan	China (HK)	Japan	Canada	China (HK)	Ireland
3	New Zealand	China (HK)	Taiwan	Finland	Singapore	China (Macau)	New Zealand	Singapore	Japan
4	Finland	Taiwan	China (HK)	UK	Japan	Taiwan	Australia	Japan	South Korea
5	Australia	South Korea	Japan	Canada	Finland	South Korea	Ireland	South Korea	Taiwan
6	Canada	China (Macau)	South Korea	New Zealand	Estonia	Estonia	South Korea	Finland	Estonia
7	Switzerland	Japan	Estonia	Australia	South Korea	China (HK)	UK	Ireland	China (Macau)
8	UK	Liechtenstein	Switzerland	Austria	Vietnam	Canada	Japan	Canada	Canada
9	Belgium	Switzerland	Canada	Ireland	Poland	Finland	Sweden	Taiwan	**USA**
10	France	Netherlands	Netherlands	Sweden	Canada	Australia	Austria	Poland	New Zealand
11	Austria	Estonia	Ireland	Czech Republic	Liechtenstein	New Zealand	Belgium	Estonia	China (HK)
12	Denmark	Finland	Belgium	France	Germany	Ireland	Iceland	Liechtenstein	Australia
13	Iceland	Canada	Denmark	Norway	Taiwan	Switzerland	Norway	New Zealand	UK
14	Liechtenstein	Poland	UK	**USA**	Netherlands	Slovenia	France	Australia	Finland
15	Sweden	Belgium	Poland	Hungary	Ireland	UK	**USA**	Netherlands	Denmark
16	Ireland	Germany	Austria	Iceland	Australia	**USA**	Denmark	Switzerland	Poland
17	Norway	Vietnam	Australia	Belgium	China (Macau)	Poland	Switzerland	China (Macau)	Czech Republic
18	Czech Republic	Austria	Czech Republic	Switzerland	New Zealand	Czech Republic	Spain	Belgium	Sweden
19	**USA**	Australia	Slovenia	Spain	Switzerland	Latvia	Czech Republic	Vietnam	Switzerland
20	Germany	Ireland	Finland	Germany	Slovenia	Denmark	Italy	Germany	Italy
21	Hungary	Slovenia	Latvia	Poland	UK	Sweden	Liechtenstein	France	Austria
22	Russia	Denmark	Sweden	Denmark	Czech Republic	Germany	Germany	Norway	Germany
23	Spain	New Zealand	New Zealand	Italy	Austria	Austria	Hungary	UK	Belgium
24	Poland	Czech Republic	Lithuania	Liechtenstein	Belgium	Belgium	Poland	**USA**	Portugal
25	Latvia	France	Germany	Greece	Latvia	Netherlands	Greece	Denmark	Norway
26	Italy	UK	France	Russia	France	France	Portugal	Czech Republic	Croatia
27	Portugal	Iceland	Spain	Latvia	Denmark	Hungary	Russia	Italy	Latvia
28	Greece	Latvia	Hungary	Portugal	**USA**	Spain	Latvia	Austria	Spain
29	Luxembourg	Luxembourg	Portugal	Luxembourg	Spain	Lithuania	Luxembourg	Latvia	France
30	Mexico	Norway	Italy	Mexico	Lithuania	Portugal	Mexico	Hungary	Israel
31	Brazil	Portugal	Vietnam	Brazil	Norway	Croatia	Brazil	Spain	Hungary
32	–	Italy	Norway	–	Hungary	Norway	–	Luxembourg	Lithuania
33	–	Spain	Malta	–	Italy	Italy	–	Portugal	Slovenia
34	–	Russia	**USA**	–	Croatia	Turkey	–	Israel	Vietnam
35	–	Slovakia	Slovakia	–	Luxembourg	Vietnam	–	Croatia	Netherlands
36	–	**USA**	Croatia	–	Portugal	Malta	–	Sweden	Turkey
37	–	Lithuania	Iceland	–	Russia	Israel	–	Iceland	Chile
38	–	Sweden	Israel	–	Sweden	Slovakia	–	Slovenia	Slovakia
39	–	Hungary	Turkey	–	Iceland	Ukraine	–	Lithuania	Malta
40	–	Croatia	Brunei	–	Slovakia	Serbia	–	Greece	Serbia

Source: Program for International Student Assessment (PISA), National Center for Education Statistics, US Department of Education
Note: PISA Assessment treats different education systems in China (e.g. Mainland, Macau, Hong Kong) as separate entities for ranking purposes. 2000 assessment did not include non-OECD countries. Some year's surveys do not include certain countries due to lack of responses (for example, the last year China mainland data was included was 2018).

3) Technology-Driven Changes May Shift Winners & Losers in Higher Education… Securing Lanes of Excellence Will be Key

Just as the Internet disrupted media and other industries over the past three decades, AI will have consequences for even the biggest and best educational institutions…and many will seize the opportunity. When major technology changes kick in, it's inevitable that the need for competitive advantage rises and that market shares rise or fall. Universities have not traditionally thought of their students and alumni as customers – we believe that the evolution of learning, coupled with AI, may drive a shift towards the assessment of product offerings.

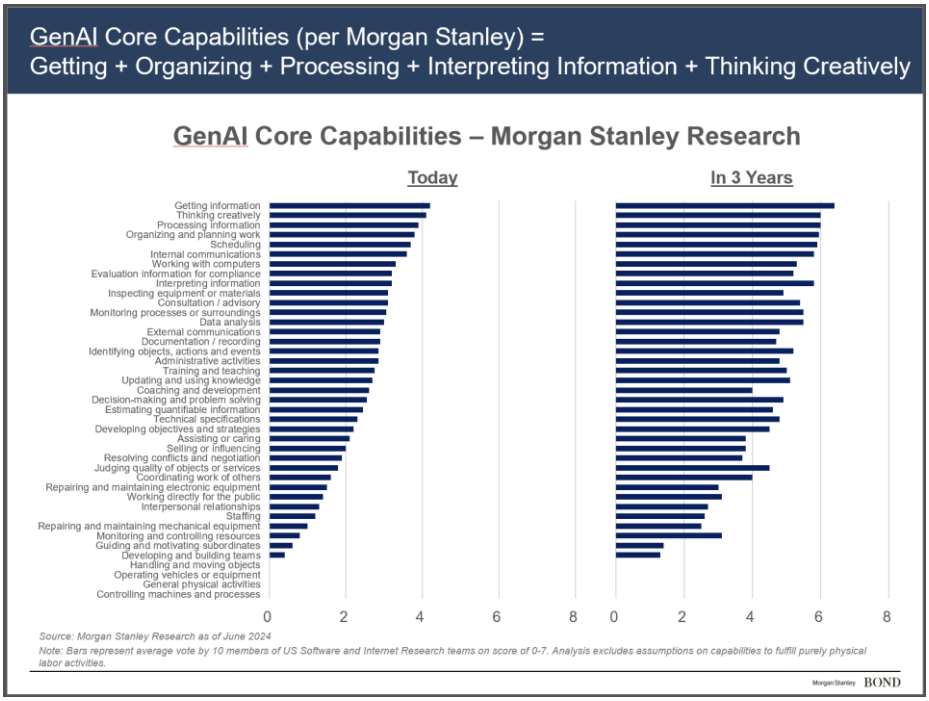
The economics of many universities are increasingly under pressure. ROI means different things to different people – here, we focus on the rising cost of university education relative to many future job and income opportunities. Clayton Christensen's prediction in 2011 that some universities could close in the coming years as the economics ceased to make sense was wrong on timing and scale, but AI may well prove the inflection point that makes his conclusions directionally on the mark. With costs to run universities already rising at a rapid pace, closings are already happening among the long tail of universities. Thirty American colleges folded in the first 10 months of 2023, 48 closed in 2022, per State Higher Education Executive Officers Association, and ~10% of universities are at risk financially per E&Y Research. There are a host of reasons…

University costs are rising while the number of potential students declines. The average cost of four years of American university is $109K (public) / $223K (private) (Education Data Initiative). That compares with an average annual salary of $60K for students recently post-graduation (New York Fed). That starting imbalance means that the average borrower takes twenty years to repay student loan debt (Education Data Initiative).

What's more, the US addressable market for universities actually declined in the last census: children under 18 fell 1.4% to 73MM in 2020, compared with 74MM in the 2010 census. In the latter part of the century, the US population may decline outright. It's hard to fight basic demographic math.

Today's innovation-oriented employers are excited about education programs that tie to strong business ROI and increasingly favor skills-based hiring, per Deloitte. As employers change their expectations for graduates' skills, at least some universities will shift accordingly. Students are following suit – enrollments in 2-year colleges with high vocational focus rose 16% in 2023 vs. total undergraduate enrollments, which grew 1% (National Student Clearinghouse). While some of this growth represents a rebound from COVID's impact on enrollments, the shift in relative enrollment growth may well be ongoing. In addition, USA apprenticeship programs total nearly 600K as of 2023, with the UK over 600K as of 2022 (per World Economic Forum), signifying broad-based interest in learning for career purposes.

As AI models improve & become better Assistants, labor demand will be affected, potentially further changing how students think about educational ROI. Morgan Stanley's USA Software and Internet Research teams have created an AI Index which "seeks to evaluate the Generative AI opportunity in software by analyzing the extent to which different labor activities are exposed to potential automation." Among these, getting / organizing / processing / interpreting information and thinking creatively are among the top work activities impacted by GenAI. The findings are instructive…see chart that follows.



In a time of rapid technological change led by American companies, American universities must determine how best to optimize for the future. Many institutions have work to do to meet these changes in demand, per the Burning Glass Institute. As the AI challenge looms, they will need thoughtful plans that balance their rich traditions and research history with the needs of a rapidly evolving marketplace supercharged by innovation. Keeping an eye on the output and trends in various AI skunkworks, such as the team at AI Acceleration at Arizona State, may help universities determine the products and software tools that could transform the educational experience.

Market / domain leadership matters more than ever. A key differentiator for universities has been the creation and duration of best-in-class and storied individual programs. These programs attract top young talent because they've cultivated cultures of excellence in specific areas, and participants in the programs have benefitted from their experience and association. Think Carnegie Mellon / MIT / Stanford in Computer Science; Harvard / Johns Hopkins / Penn in Medicine; and West Point / Naval Academy / Air Force Academy in Defense & Leadership. Outsized success has a simple formula that is extremely difficult to accomplish, let alone sustain over time.

At its essence, greatness begets greatness in the right setting, with the right people (and leadership), with the right resources at the right time and focus, focus, focus. Universities need to find, create, and sustain their differentiators – their best-in-class programs and advantages that attract students – or risk losing market share in an increasingly transparent and AI-enabled world that has already received a COVID-related remote work booster. The reality is that younger students (and lifelong learners) are getting smarter about their learning options, costs, and returns. They will be aggressive voters with their time and money.

4) AI May Make This the Best Time Ever to be a Self-Motivated Student… Both a Challenge & an Opportunity for Teachers & Universities to Match

AI can help students (of all types) improve learning. Education in many cases has flipped from rote, call-and-response, memory-based systems to a paradigm of search / discover / implement. This historically benefited the most self-starting and entrepreneurial learners. In the age of AI, however, with the advent of natural language query formats, all students can become expert searchers (and therefore learners). Improvements in models, breadth, and data quality will help the best answers and solutions rise to the top. The onus is on schools to help students make the best use of these technology breakthroughs.

>75% of American K-12 teachers are optimistic about the potential for AI in their craft (although over 90% feel unsure of where to start, indicating that we're still in early innings here), per Canva's 2023 survey. The promise of AI is to enable a new art of teaching that enhances students' ability to think and reason while letting AI do more of the processing – real "human in the loop" learning. Luis von Ahn, Duolingo Founder / CEO, notes that "AI can help one learn anything but so can books which have been around for >1,000 years. The riddle is how to

improve the learning process so more people do it…and learn more efficiently. At Duolingo, we do it with gamification. Universities can have the advantage of having people gathered together in person, their opportunity is to figure out ways to optimize in-person learning with the best computers can serve up."

The process for many types of teaching will change. The biggest change is that students will have more answers at their fingertips faster – some will be right and some will be wrong. For teachers, optimizing to accelerate learning with that evolving foundation – including students who don't want to (or can't) attend a one-off lecture in person – will be a new art form. On the research side, technical resource availability, such as GPU access, will likely be key to differentiation / leadership.

In the basics of teaching – from drafting lesson plans to reviewing assignments and managing classroom communications – teachers already have a full plate. Balancing content development with other responsibilities including classroom management and student instruction is even more challenging. As technology evolves and becomes more widely available, teachers should be able to save time and increase productivity, focusing more on their core craft by leveraging AI for more time-intensive tasks. Some of the many ways AI can help teachers save time and increase productivity follow:

Content

- **Personalized Learning Plans** – analyzing student performance and creating customized learning paths based on knowledge gaps and individual learning styles.
- **Course Development / Learning Immersion** – including, for example, generative models for imagery, text, and video, translating into supplemental educational material, assignments, and practice questions. Imagine discussing Newton's 3rd Law with Newton himself…or learning biology in a VR-based lab like Arizona State University's.
- **Social Interaction / Communications** – learning in conjunction with new AI tools (such as GPT-4o, in a spoken-word form factor) can equip students with better preparation tools for higher education and workforce contexts that rely heavily on spoken / presented communication.

Delivery

- **Copilots Available to Both Students & Teachers 24x7, Real-Time** – Providing personalized attention in education at scale can give teachers and students alike the equivalent of multiple people / tutors working for them in real time via software. Instead of discrete intervals of course-correcting feedback, AI can be an always-on real-time feedback generator that caters more to individual student development.
- **Teachers as Coaches & Guides** – For many, classrooms can be challenging or counterproductive environments owing to introversion, lack of confidence, or learning differently than others. In addition, many students have motivation challenges. Tomorrow's teachers may serve as cheerleader / coach as well as tutor, making the classroom more welcoming.
- **Optimizing Teaching Approaches** – Open-ended thinkers may enjoy dialogue in the Socratic method: Khanmigo (Khan Academy's AI guide) asks great questions rather than giving easy answers. Moreover, foundation models may be geared to student learning styles, such as automatic text-to-speech for dyslexic students.

Administration

- **Grading, Classroom Management, & Administrative Support** – using software assistants to support homework review, scheduling, attendance tracking, and intervention alerts for students falling behind.
- **Combating Teacher & Student Burnout** – minimizing stale lessons, reducing incremental / unpaid teacher prep work, and enhancing workplace creativity.

Beyond learning and teaching augmentations, AI will be fuel for student creativity and innovation. AI may reduce or replace direct human involvement in certain disciplines like coding, computation and design, but by making these technical skills more of an open utility and toolset, AI can liberate human intelligence to focus more on ingenuity – the root force behind building and producing new things and ideas.

5) It's a Crucial Time for Universities Both to Reaffirm American Values & to Revitalize Their Own Missions

At its best, America represents opportunity for newcomers. The USA remains the country more people want to immigrate to than any other place on the planet. It is still the greatest self-governing community around at scale. What do many people see who want to move to America where they believe the grass is greener on the other side? A key part of what they see and aspire to join is based on the values of America's founding fathers – life, liberty, and the pursuit of happiness…democracy, equality, freedom, and yes, capitalism. For many people, the American university experience is the embodiment of those ideals.

We're in a period of rising conflicts, both intramural and extramural, for universities – which means they must demonstrate anew the many advantages and opportunities they can offer students and employees. It's true, the latest trends in university protests and donor resistance (at some schools) suggest that some constituencies on campus find universities wanting. Likewise, the negative effects of too much social media and mobile phone usage among young adults imply something needs to change (Jonathan Haidt, 2024). There are serious voids to be filled for serious students.

To maintain academic relevance and market share, many universities require a mindset change. The key for universities today, we believe, will be creating education-as-a-service and generating ROI for student-customers while building best-in-class programs with differentiated teachers in a win-win environment. Yesterday's signaling credential may not make sense in a more meritocratic, skills-based world. Different students have different aims / desires – Amherst, Berkeley, Boston College, Florida, Georgia Tech, Michigan, Notre Dame, Pomona, Princeton, Rice, Spelman, Stanford, Texas, Vanderbilt, West Point, and on and on have different student constituencies and goals – so winning may mean different things. But in each case, universities must determine their competitive advantages, create relevant best-in-class programs and environments, and find ways to gain share in an increasingly competitive environment. A simple / first-pass check list follows…

- **Grounding in Reality / Liberal Arts / Civics** Are you preparing students for the real world while developing their competitive advantage based on understanding and reasoning? Are you doing all you can so your graduates can quickly add value in the workplace?

- **Affinity for Innovation & Adaptation** – Are you embracing new methods / technologies / ways of thinking to improve teaching and learning? Do you have an orientation to educational durability and adaptability (as with Georgia Tech's newly formed Division of Lifetime Learning?)

- **Product Velocity and Depth of Science & Research** – Can you design an organizational structure that incorporates frequent iteration and relentless data-driven self-improvement? Do you have compute / tooling / technical resourcing access? Have you shortened your cycles and ship time on new products / ways of thinking?

- **Culture / Quality of Life** – Have you created an environment and physical plant where students can develop and excel with the help of peers and mentors to learn from, trust, and admire in an in-person, collaborative environment? Is your social environment optimized to build lifelong relationships, underpinned by deep (and perhaps unexpected) intellectual and personal common interests? Is it a place where people *really* want to be with one another? Reality is…social / interpersonal life is foundational.

- **Teacher Quality / Availability** – Are your students getting ROI on their core expenditure – paying teachers to help them learn skills? Do your students feel their teachers are their coaches on a winning team? Do teachers and students have one another's backs?

- **Intellectual Diversity / Independent Thinking** – Are your students expanding their perspectives in positive ways?

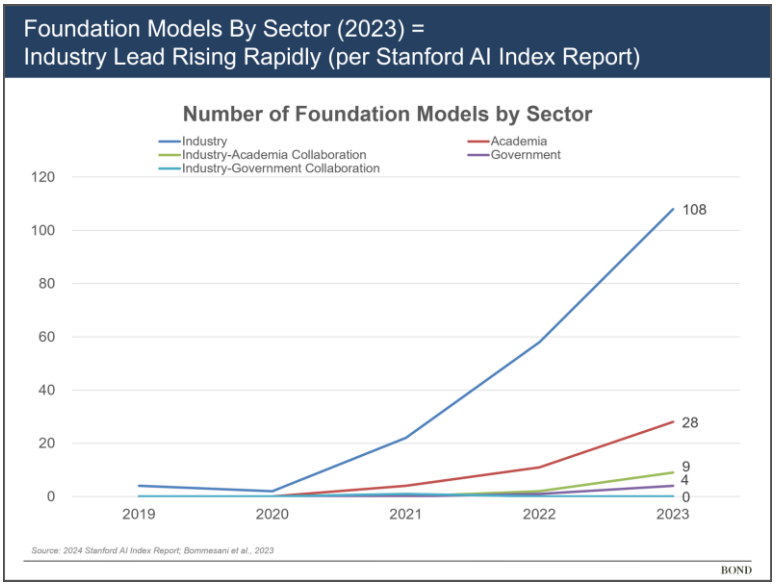
- **Positioning For Future Research Leadership** – Are you equipped with the knowledge / tools / personnel / unique datasets to lead in AI / other cutting-edge research? Do you have a well-honed interdisciplinary / collaborative approach across campus?

- **Affordability / Resources / Management** – Does the economic wiring diagram (current student money out vs. future graduate money in) make sense? Is the institution well-run and well-endowed? Do you orient towards serving your student-customers' needs and not the other way around?

- **Linkages with Local / Regional / Global Businesses** – Are you collaborating with industry to provide students valuable real-world experience and understand what needs they are prioritizing over the short and long terms?

- **Long-Term Orientation** – Like great companies, are you thinking about how to supplement or even cannibalize your own educational experience / delivery to serve students / other constituents best over the long term? Are you optimized not just for learning, but learning how to learn?

A related aside – AI compute power costs billions at scale and is scarce...GPUs enable unprecedented progress in STEM research and development, yet remain out-of-reach-expensive for students (and universities). Leading research universities trail leading corporations in GPU count by orders of magnitude – let alone the universities of the developing world that will serve the preponderance of young people in the future… Stanford's 2024 AI Index Report also underscores the massive lead that enterprise currently holds over academia in model ownership / development. To get AI processing power for students, universities will need to find creative ways to partner with industry (see, for example, the May 2024 release of ChatGPT Edu by OpenAI, providing access to OpenAI's most recent models and unique university-oriented customizations). Otherwise, the best-and-brightest emerging young engineers may consider skipping university to go straight to industry, and the best teachers may take the same route.



In Sum, If We Can Meet the Moment… We Should be Bullish on Education in America

We are living in an amazingly exciting time for technological innovation, and it can't be stopped. No one can predict exactly how it will all play out, but even the most aggressive of change agents out there are stunned at the current pace of change. History shows that technological improvements lead to productivity gains which lead to improvements in quality-of-life for more citizens (IEEE SA, 2023).

We are fortunate that America is leading the world here and has a foundational focus on deterrence in an increasingly hostile world. Our universities and regulators have a responsibility to rapidly and deeply understand the global stakes that AI presents for freedom, democratic values, good and evil…and take strong stands. AI creates once-in-a-lifetime opportunities for evolution, creativity and leadership (akin to the post-WWII Space Race). As these things are, it's riddled with risks. Now, we need to focus, galvanize attention and minimize our mistakes.

Ultimately, bringing AI to learning and teaching requires what Sal Khan calls "educated bravery." While technologies developing in real-time are always unpredictable, their thoughtful use may well prove exponentially beneficial to students and teachers alike. We should not be paranoid and restrictive about utilizing these technologies, but thoughtfully curious.

Special thanks to Alexander Krey and BOND partners and colleagues who helped prepare this report.

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