



The Rise of the Digital Native: How the Next Generation of Analysts and Technology Are Changing the Intelligence Landscape

**Team Futures Nerds
U.S. Army War College
May 2023**



The views expressed herein are those of the author(s) and do not necessarily reflect the official policy or position of the Department of the Army, Department of Defense, or the U.S. Government. The U.S. Army War College is accredited by the Commission on Higher Education of the Middle States Association of Colleges and Schools, an institutional accrediting agency recognized by the U.S. Secretary of Education and the Council for Higher Education Accreditation.



COL Nora Flott

nora.flott.mil@armywarcollege.edu

COL Derek Baird

derek.baird.mil@armywarcollege.edu

LTC(P) Tyler Standish

tyler.standish.mil@armywarcollege.edu

LTC(P) Brandon Van Orden

brandon.vanorden.mil@armywarcollege.edu

LTC James Esquivel

james.esquivel.mil@armywarcollege.edu

(This Page Intentionally Left Blank)

About This Document

The United States Army War College (USAWC) student team “Futures Nerds” prepared this report as a group research project for their Master of Strategic Studies degree. The model design, collection, analysis, and production of this research product occurred for approximately four months, from January 2023 through April 2023. The team constitutes a diverse and well-rounded group of military professionals in the United States Army: COL Derek Baird (Field Artillery), COL Nora Flott (Military Intelligence), LTC(P) Tyler Standish (Military Intelligence), LTC(P) Brandon VanOrden (Military Intelligence), and LTC James Esquivel (Civil Affairs).

Requirement

This report answers questions posed by LTG Laura A. Potter, Deputy Chief of Staff G2, Headquarters, Department of the Army (See [ANNEX A](#)):

How do 18-22-year-old intelligence analysts likely consume, synthesize, and communicate information today?

How is information consumption likely to evolve in ways that will change end-user information consumption habits between now and 2040?

Analytic Confidence

The overall analytic confidence for this report is *moderate* (See [ANNEX B](#)). The quality and accuracy of the forecasted answers may vary, due to the complexity of the requirement questions and the accuracy of open sources. The team’s research was unclassified and publicly available information that may not address technologies or applications specific to military intelligence. The team was unable to identify and research all factors relevant to the question due to a compressed timeline of competing academic requirements. The analysts’ worked alone and did not use a structured method. This report is sensitive to change due to the development of innovative technology and information.

Various artificial intelligence such as Unrestricted Intelligence, Elicit, ChatGPT, Bard, and Perplexity were evaluated. The ideas and sources from the results were utilized in the estimates; however, content inclusion was limited due to results not aligning with the subject and outdated sources. In addition, ChatGPT was used to conduct an analysis of competing hypotheses (ACH) with mixed reviews

of the results. The AI ACH provided direction for additional research; with more time and fine-tuning of prompts, the AI ACH may provide better results.

Words of Estimate Probability

The team utilized the Intelligence Community Directive 203 (See [ANNEX E](#)) as their Words of Probability (WEP) to determine the likelihood of how information consumption will evolve in ways that will change end-user information consumption habits between now and 2040?

Source Reliability

Overall, the sources were generally reliable, tended to corroborate one another, and were predominately rated as moderate or high. Source reliability is noted at the end of each citation as low (L), moderate (M), or high (H), and the citation is hyperlinked to the source. Source reliability is determined using Standard Primary Credibility Scale (see [Annex C](#)) and the Trust Scale and Website Evaluation Worksheet (see [Annex D](#)). Sourced figures and photos embedded in the report are also hyperlinked to their source.

Contents

About This Document	4
Requirement	4
Analytic Confidence	4
Words of Estimate Probability	5
Source Reliability	5
Key Findings.....	9
Section 1: Today's 18-22-Year Olds (Gen Z)	27
Understanding How Digital Natives, Gen-Z and Gen-A, Communicate and Consume Information Today and How They are Very Likely to Consume and Communicate in 2040.....	28
Growing Trust in Technology Likely to Improve Solving Complex Problems, but Critical Thinking Skills will Very Likely Remain Essential.....	32
Generation Z's Intuitive Attitude Very Likely Enables Them to Excel in AI and Emerging Tech for Information Processing and Analysis	35
Gen Z is Likely to Build Trusting Relationships With AI	38
Emojis Very Likely Used in CMC Over the Next 10-15 Years; Used to Quickly Facilitate Sentiment in Digital Messaging	41
Graphic Interchange Format (GIF) Very Likely Passe for Gen Z Within 5 Years, Antiquated by 2035-2040.....	43
Overcoming Generational Communication Barriers in the Workplace Very Likely Leads to Cross Generational Understanding.....	45
Professional Digital Natives, Gen Z, Likely Prefer Face-to-Face Communications	48
Section 2: 18-22-Year Olds in 2040 (Gen A)	51
Changes in Information Behaviors Likely Evolving Along Five Key Themes over the next Five to Ten Years.....	52
Attention Spans in Younger Generations Unlikely to Decrease Over Next Ten Years, Despite Popularly Quoted Study	57
Within Five Years, Generation Alpha likely Better Equipped to Identify Mis/Dis-information than Older Generations, Despite Young Age, Lack of Experience	60
Intelligence Analysts Almost Certain to Remain the Essential Component of the Intelligence Process Through 2040	63
Section 3: Education in 2040.....	66

Fundamental Changes in the Primary Education System Very Likely by 2030 Due to Rapidly Accelerating AI-enabling Technologies Today	67
Generative AI Personalized Education Very Likely by 2030	73
GEN-A Will Almost Certainly be the Pioneers for Shaping and Advancing Computer-Gaming Education through 2035-2040	77
Current Research Indicates Cognitive Enhancements as a Result of Video Gaming – Memory Processing and Problem Solving	79
Tech-Driven Gamification Likely to Improve Education Through Gaming Experiences for Future Generations	82
Experiential Learning through VR/AR Technologies will likely Impact Cognitive Behaviors of Intelligence Analysts within the next Five Years	86
Collaborative Tools Enhanced by AI Likely to Improve Cognitive Processes of Students and Analysts Over the Next Ten Years	90
AI-enabled Educational Assessment Tools Not Likely to Replace Standardized Aptitude Tests within Next Ten Years, Despite Significant Benefits to Other Areas of Learning	94
By 2040, AI-Integrated, Personalized, Continuous Learning Very Likely be the Preferred Workplace Education in Unified Ecosystem	98
Section 4: Technology in 2040	102
6G Integrated Digital, Physical, and Human Ecosystems Likely by 2030	103
Technologies For Immersive Virtual and Augmented Reality Ready Now, Fully Integrated Environments Likely in Workplaces Before 2040.....	106
Augmented Intelligence: Co-Existing Human and Artificial Intelligence Likely to Enhance Information Consumption	110
Transdisciplinary Skills Likely More Important than Knowledge Due to Advances in AI and Hyperconnectivity by 2040	116
Neural Link and AI Fusion: The Next Frontier of Information Consumption Likely in 15-20 Years	120
Accurately Forecasting Previously “Un-predictable” Events Using Artificial Intelligence and Human-Machine Teaming Very Likely Within Five Years	122
Hyperconnectivity and Robotic Process Automation Will Likely Drive Immersive Environments in Workplaces	125
Smart Robot Labor or High-Level Machine Intelligence Unlikely by 2040 Despite Technical Advancements	127
Quantum Computing Very Likely Essential for Scalable Predictive Models by 2040.....	129

Annex A - Terms of Reference (TOR): Forecasting End-User Computing Needs in 2040.....	132
Annex B - Assessing Analytic Confidence.....	136
Annex C Standard Primary Source Credibility Scale.....	137
Annex D - Trust Scale and Web Site Evaluation Worksheet	138
Annex E - Intelligence Community Directive 203 Analytic Standards	139
Annex F - The Future of Intelligence Analysis: A Conversation with NGA Enlisted Personnel	140

Key Findings

How do 18-22-year-old intelligence analysts likely consume, synthesize, and communicate information today?

18-22-year-old intelligence analysts today are very likely to place an outsized emphasis on visual and auditory communication, often at the cost of formal written correspondence, and almost exclusively through social networking sites such as YouTube, TikTok, Instagram, and Snapchat (See Figure 1). At the same time, some attributes that remain unchanged across generations are, “everyone wants a positive relationship with their supervisor, is cautious of change, and appreciates feedback,” as found by an extensive 2019 study from the Center for Creative Leadership. Some key digital behavioral differences between 18–22-year-olds compared to older generations can be organized by how they consume, synthesize, and communicate information:

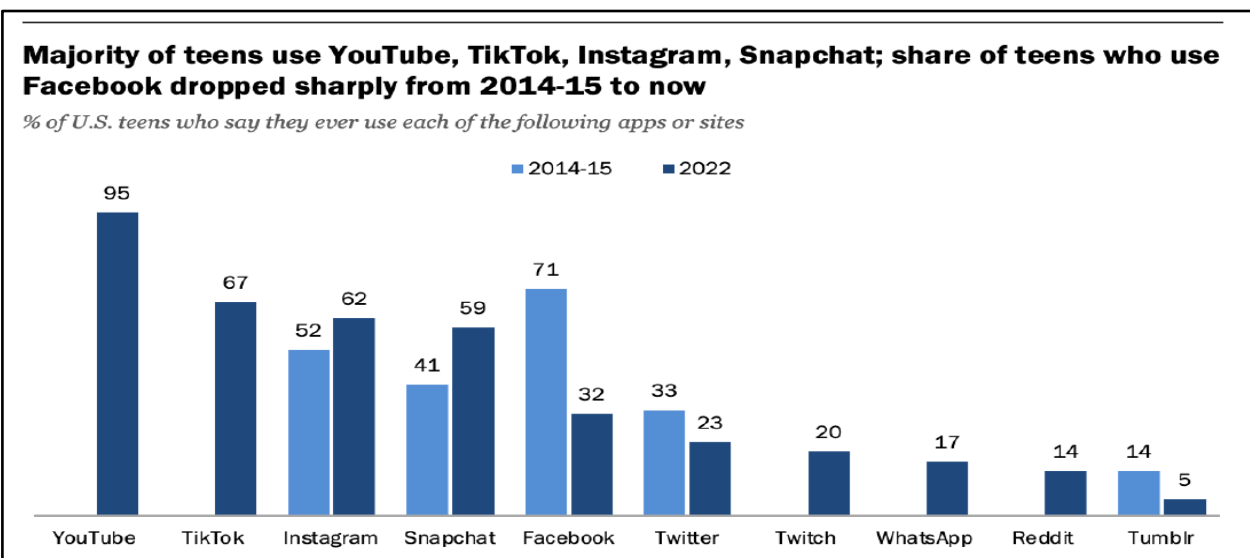


Figure 1: TikTok on the Rise-Pew Research ¹⁴

1. **Consume.** 18-22-year-old intelligence analysts today almost certainly consume information across multiple platforms in a variety of mediums simultaneously throughout their day-to-day personal lives. 18-22-year-olds likely prefer concise, visually immersive technologies, such as YouTube and TikTok, that can efficiently provide them with information and guidance for achieving tasks. Some typical consumption behaviors of 18-22-year-olds include:

- a. 85% of Millennials and Gen Z reported watching at least one online video within the last week to help them learn a new skill, according to the Center for Generational Kinetics (See Figure 2).



Figure 2: Center for Generational Kinetics courtesy of Maryville University ⁴

- b. According to a Pew Research Center study, 95% of 18-22-year-olds own a smart phone and 97% of those send or receive text messages every day.

- c. More than half of 18–22-year-old households have six or more connected devices; 18% of those are considered “hyper-connected” (10 or more devices), according to Pew Research Center (See Figure 3).

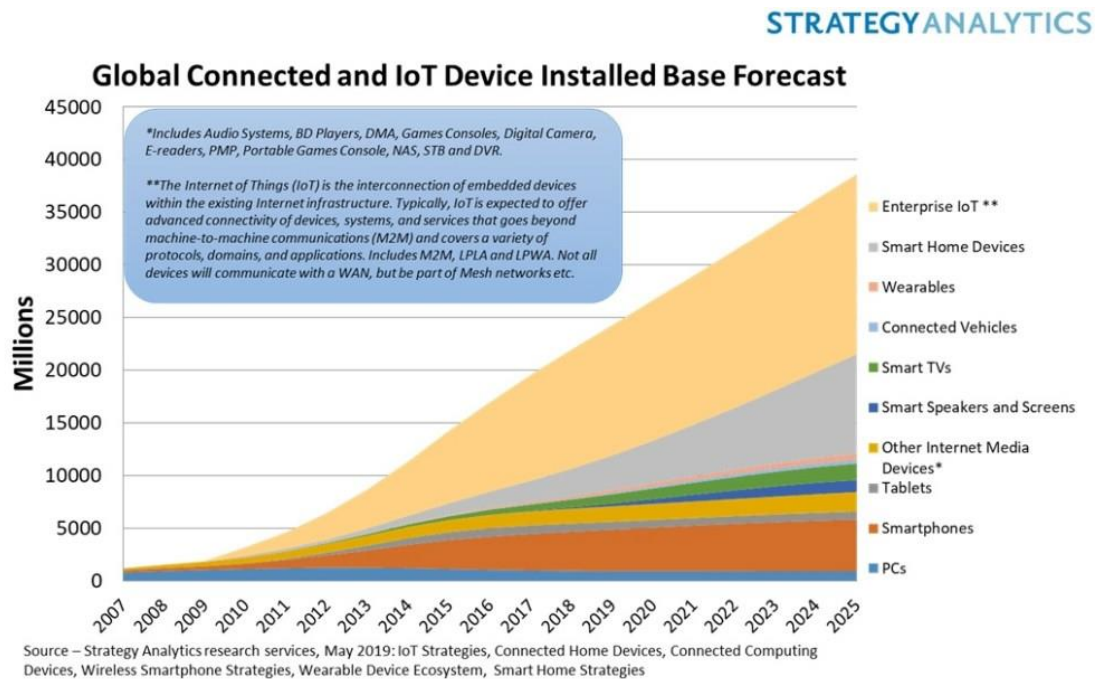


Figure 3: IOT Business News connected device forecast [M](#)

- d. 61% of teens preferred texting their friends, video-chatting, or using social media over in-person communication as reported by Commonsense Media.
- e. According to GWI.com, an international marketing firm, millennials primarily use Facebook to message friends and family. GEN-Z leads TikTok use to view entertainment content in short video format (see Figure 4).

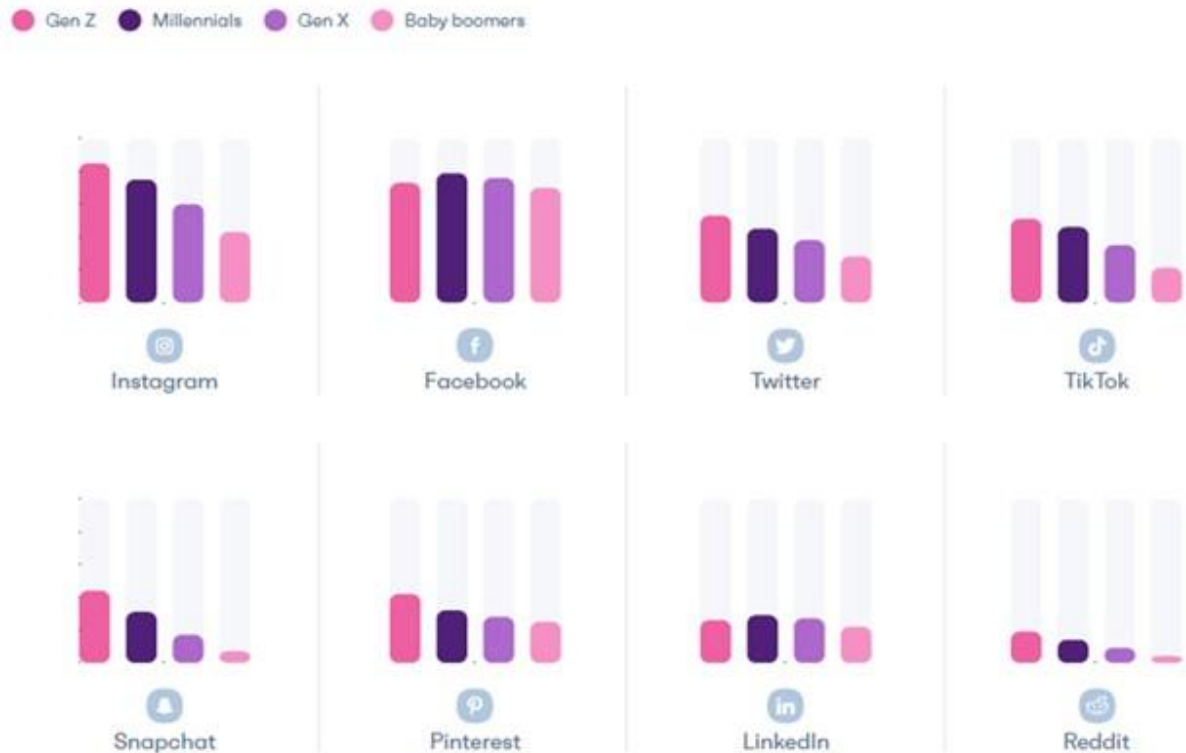


Figure 4: The Heart of Social Media [H](#)

2. **Synthesize.** How people synthesize, or understand, information is a long and highly debated subject among researchers and academics. While 18-22-year-old intelligence analysts likely synthesize information in similar ways to previous generations, some research suggests their cognitive behaviors may be changing, potentially because of sustained digital engagement:

- a. In 2021, the *Frontiers in Psychology* journal reported cognitive control of teenagers becomes less efficient over a ten-year period and could be measured through brain scans. The same study suggested a correlation between this measured decrease in cognitive control and teens with extensive (six or more hours a day) of social media engagement. Researchers acknowledged the need for more study in the area but noted the concerning neurological changes appeared temporary; teens who decreased social media engagement saw brain scans return to typical cognitive control levels.

- b. According to a 2018 study published in the journal *Nature Communications*, adolescents are highly susceptible to acceptance and rejection emotions caused by social media engagement. Further, their ability to understand, manage, and react to these emotions appeared to be directly corollary to the number of hours they were on social media sites.
3. **Communicate.** 18-22-year-old intelligence analysts are virtually certain to communicate frequently across multiple media and platforms, including Short Message Service, TikTok, Twitter, Instagram, Snapchat, and other mobile applications (See Figure 5). At the same time, they naturally tailor and compartmentalize their communication depending on the audience. They prefer personalized videos and pictures that represent their generation and often engage in simultaneous conversations with multiple people.



Figure 5: Every Minute of the Day on the Internet [M](#)

- a. According to a LivePerson Inc. survey, 65% of 18-22-year-olds prefer their personal communication to be digital (e.g., text, chat, or video). At the same time, while in professional settings, 18-22-year-old employees prefer face-to-face communication with their supervisors via in-person or video-assisted platforms.
- b. According to Maryville University and a 2017 Center for Generational Kinetics survey, 45% of 18-22-year-olds are self-aware and acknowledge the importance of improving their formal written communication skills to establish their professional credibility.
- c. In 2021 a Commonsense Media survey found 35% of young adults, the plurality, reported texting to be their preferred form of communication. A similar survey by the same group six years before claimed just under half (49%) of teens stated face-to-face was their preferred form of communication.

How is information consumption likely to evolve in ways that will change end-user information consumption habits, between now and 2040?

End-users' future information consumption habits will likely be technologically and sociologically diverse, highly immersive, driven by AI-enabled technologies, and almost exclusively mobile. In the future digital environment, end-users, keenly familiar with its' capabilities and limitations, will inherently trust AI-enabled technologies and depend on them as an extension of their own human capability. At the same time, they will likely be highly skeptical of the information they engage with in their daily lives. Future end-users will seek out disconfirming information through multiple platforms and mediums, trusting socially networked peers or other like-minded groups at the same level as traditional government or media sources. These evolving characteristics of the future environment can be organized along five key themes:

1. Artificial Intelligence as a Core Enabler
2. Ubiquitous Immersion
3. Trust in Technology but Skeptical of Information
4. Instant, Adaptive, Ubiquitous Personalization.
5. Transdisciplinary Skills Standardization

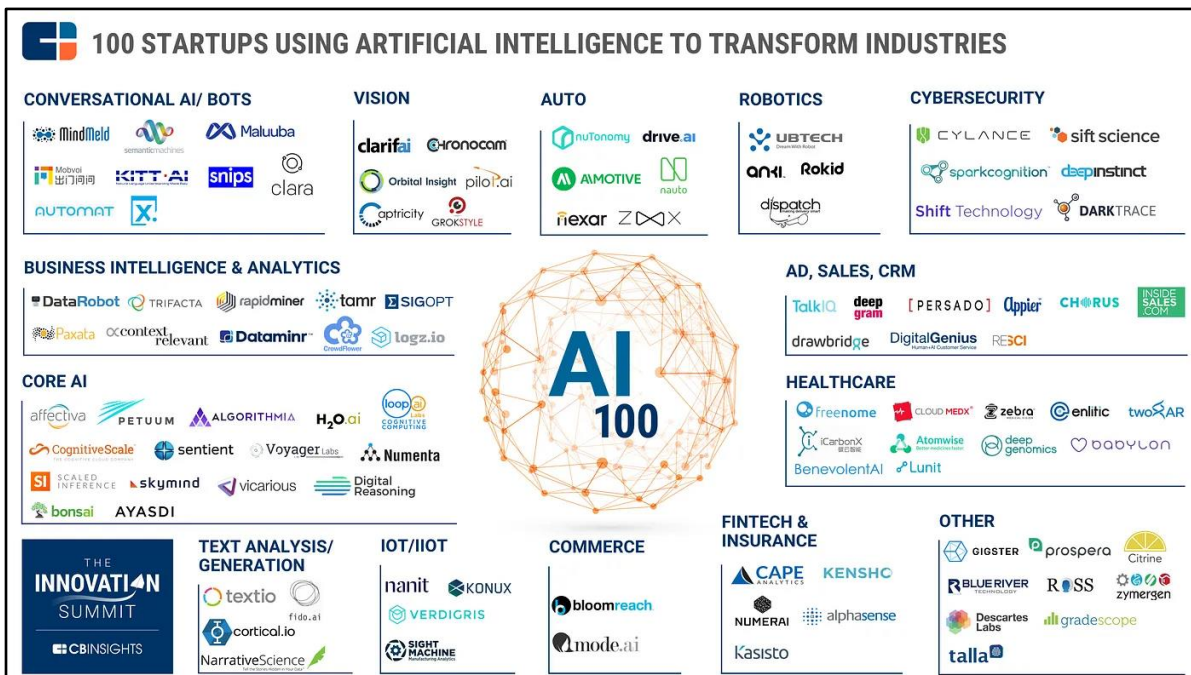


Figure 6: AI Outside the Lab: An Overview of Practical Applications in Industry from medium.com [M](#)

1. Artificial Intelligence (AI) as Core Enabler. AI is almost certainly a core enabler of emerging technologies, including robotics, Internet of Things (IoT), big data, data analytics, and many others. In the future environment, AI will very likely have transformed industries and society by having provided significant efficiencies in time and tasks that will, in turn, shift end-user behaviors toward higher-level reasoning, critical and creative thinking, and problem-solving. Technology experts and industry analysts already track advancements that are likely the initial indicators of pending transformation, such as the New York based technology intelligence firm CB Insights' annual, *"100 Startups using Artificial Intelligence to Transform Industries."* (See Figure 6). Other potential indicators that exist today include:

- a. Generative AI will very likely have disruptive effects on future end-user behaviors. The AI research and development company OpenAI publicly released its large language model AI generative pre-trained transformer (GPT) chatbot "Chat GPT," in November of 2022. According to a February 2023 study conducted by the global investment firm UBS, ChatGPT had one million registered users in the first five days and 100 million within two months, making it the fastest growing user base of a consumer application in history. To put ChatGPT's success in context, it took social media sites TikTok nine months and Instagram 2.5 years to gain the same number of registered users (See Figure 7).



Figure 7: UBS study compiled by Yahoo Finance and App Economy Insights [link](#)

- b. In the weeks following ChatGPT's release, Microsoft, a major financial backer of OpenAI, acknowledged that the company had invested over \$10 billion to support the development of the disruptive technology. In January 2023, Microsoft incorporated ChatGPT into its chromium-based web browser Bing, fundamentally changing the way users may search the internet.
- c. As the success of ChatGPT became apparent, Microsoft and OpenAI's major competitors began or accelerated investment, development, or release of generative AI tools. Google, probably Microsoft's biggest competitor in the AI space, announced the release of Bard AI, its own conversational AI tool. While Alphabet, Google's parent company, does not publicly disclose how much they have invested in Bard's development, the company's research and development budget exceeded \$39 billion in 2022, as reported by Forbes.com in February 2023. The company, as reported by multiple media outlets including CNBC in February, suffered a \$100 billion loss the day following a failed press demonstration of Bard. The financial implications alone are significant; the potential impact on the advancement of other technologies promise to be larger.
- d. One of the potentially most significant examples of AI as a core enabler of other technologies may be in AI-to-AI communication. As described in part by international business solutions advisement firm Zoot Systems, AI-to-AI communication, or intelligence machine to machine coordination, can maximize communication and efficiency while enhancing effectiveness in business operations. They can anticipate future challenges and allocate resources before a crisis occurs, without human intervention. The upshot, while still highly debated by many analysts including researchers at Oxford, points to AI potentially replacing humans in over 800 million jobs, or about 30%, currently done by humans globally within the next 30 years.

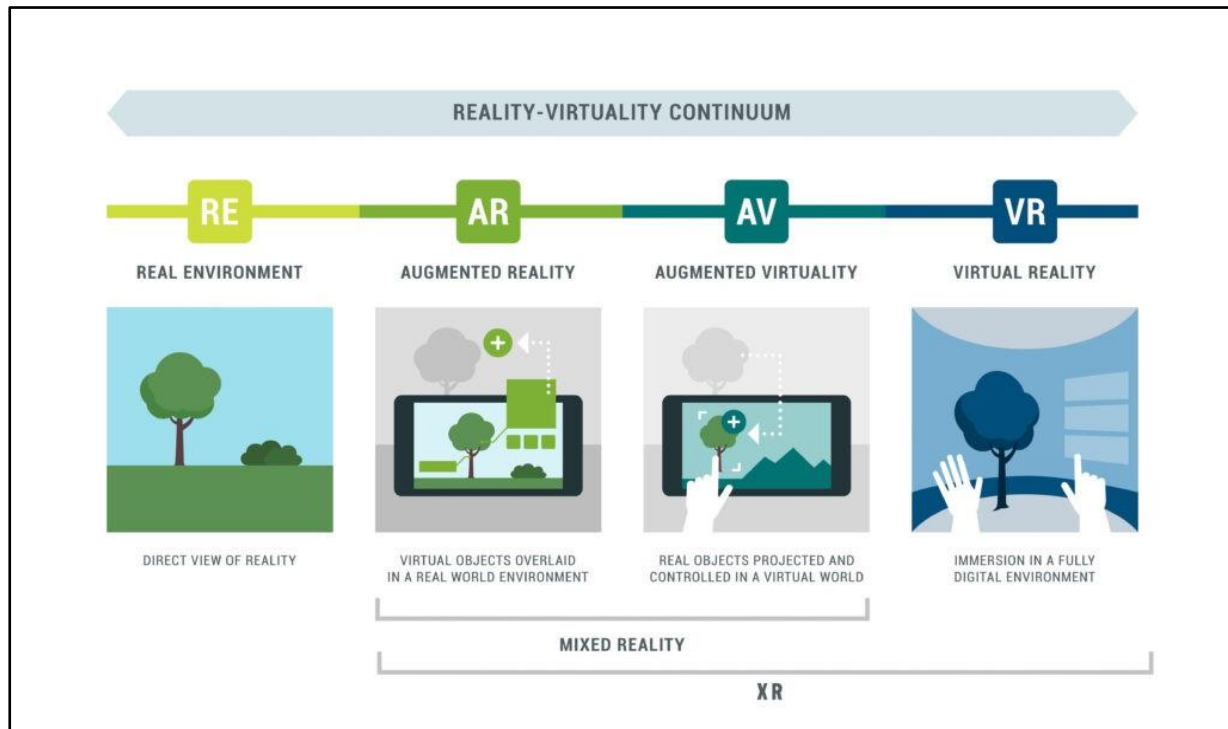


Figure 8: Reality-Virtuality Continuum [M](#)

2. Ubiquitous Immersive Technology. Pervasive immersive communications, such as virtual reality (VR), augmented reality (AR), mixed reality, extended reality (XR), haptic interfaces, brain-computer interfaces (BCI), and others, will enable lifelike interactions that will very likely blend real environmental experiences with the virtual world (see Figure 8). As this technology becomes ubiquitous, it promises to fundamentally change the behaviors of the future end-user.

- a. In the future environment, end-users will likely have mobile, completely integrated, XR technologies that support their daily work and personal lives. By completely integrating hardware platforms and software applications, as described by eInfoChips Advisors, a technology firm, has the potential to replace smartphones, TV screens, gaming consoles, fitness trackers, headsets and smart glasses. Having one, wearable, AI-enabled, XR device will likely change end-users' relationship with technology from a deliberate act (e.g., sitting at a computer or texting on a smartphone) to a truly seamless and fully immersed experience (e.g., BCI activated smart contact lenses or voice controlled wearable smart patches).

- b. Some of the most profound benefits of extended reality are demonstrated in education today. An extensive 2021 study by the World Bank in partnership with the Korea World Bank Partnership Facility concluded that students who incorporate VR into their learning environments report a 20% higher confidence rate, show a 30% increase in socio-emotional skills assessments, and are 30% more efficient in the use of their time than students in a traditional classroom.
- c. Potentially the most surprising outcome was that, for every additional hour of training in a VR environment, students score 3% higher on technical/cognitive assessments than students in a traditional setting studying the same content.
- d. Additionally, the World Economic Forum's (WEF), *"Education, Skills, and Learning,"* global issue, curated by the Technical University of Munich, identifies VR/AR as key link under Education Innovation and its ability to transform education globally. Through WEF's partnership with VirtualiTeach, a non-profit educational consulting firm, they identified 10 key potential benefits to VR in education (see Figure 9).

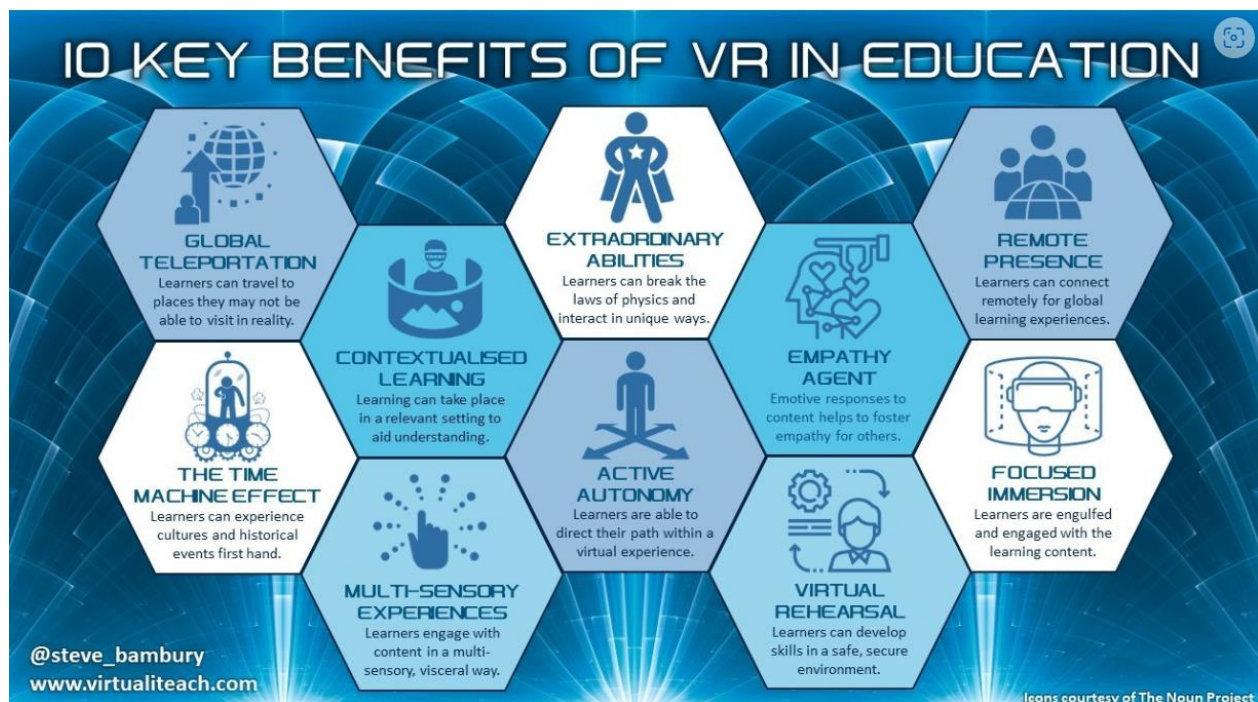


Figure 9: 10 Key Benefits of VR in Education, courtesy of VirtualiTeach ^M

3. **Trust in Technology but Skeptical of Information.** In the future environment, end-users, who have grown up using AI-enabled, immersive, and mobile technologies their entire lives, will inherently trust those applications to accomplish assigned tasks. That said, these same users will very likely be skeptical of information they engage with in the digital world and will seek out both disconfirming and confirming information as they form opinions or make decisions.
- a. Generation Z, for example, are true digital natives who have grown up in a world where technology is integrated into nearly every aspect of their lives. They are more apt to trust AI than previous generations. In March 2021, The University of Queensland, Australia conducted a five-country study on trustworthy AI. The study concluded that Gen Z trust AI 10% more than the Baby Boomer generation (34% vs 24%). More recent surveys, as provided by Businesswire.com this year, also suggest that over 70% of Gen Z believes AI will have a positive impact on the world.
 - b. There is already well-established literature, such as that from Dr. Sonia Livingstone of the London School of Economy and Politics in a 2010 study, associating media literacy, necessary for identifying information reliability, with the ability to navigate new and emerging technologies. A 2021-2022 joint study by Princeton and New York Universities took that research further, linking increased age with the likelihood to believe or share dubious information online (See Figure 10). They found that older generations were more likely to share fake news than their successively younger generations. A compelling finding was that those over 65 years old were seven times more likely to believe and share fake online news than their 18-29-year-old counterparts.

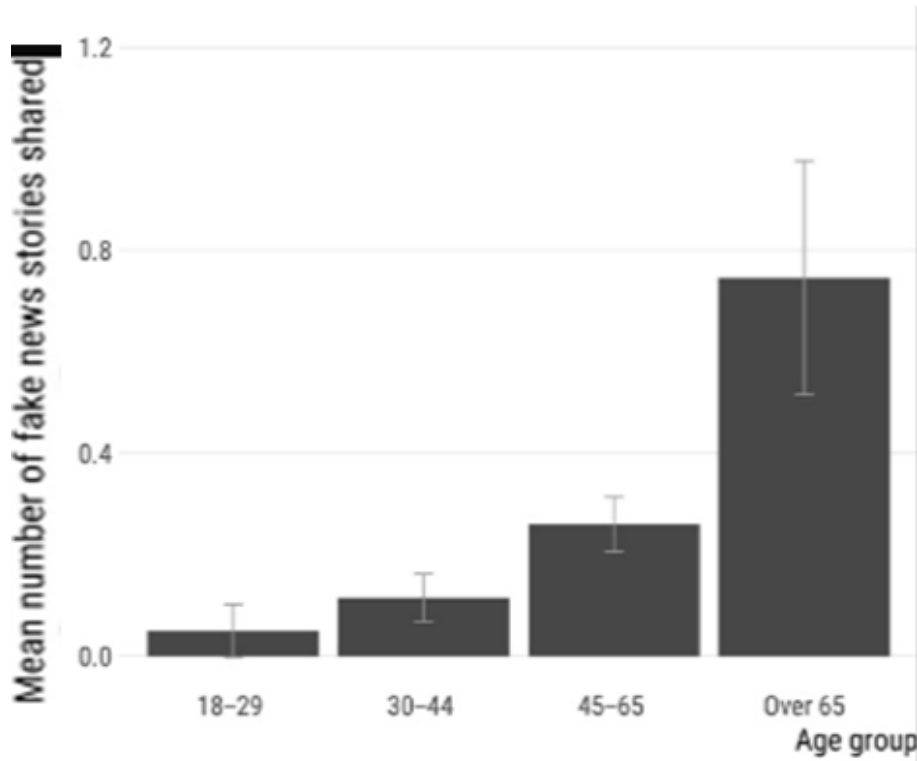


Figure 10: Princeton & NY University study found users over 65 shared nearly seven times as many articles from fake news domains as the youngest age group [4](#)

- c. While more research is required to better understand other factors that may influence the study's findings, such as confirmation bias, future generations are likely positioned to continue the trend of being better at identifying mis and dis-information online.
- d. Another notable example of trusted AI are virtual assistants. Anthropomorphism, attributing human characteristics to objects such as virtual assistants, increases trust resilience. Virtual assistants are becoming more ubiquitous in society. Gartner, a technology research firm, predicts that by 2025, 50% of knowledge workers will use a virtual assistant on a daily basis, up from 2% in 2019. The success of ChatGPT is very likely to accelerate the adoption of sophisticated virtual assistants.



Figure 11: Control on image to play video - The World in 2030 | Top Future Technologies [M](#)

4. Instant, Adaptive, Ubiquitous Personalization. In the future environment, a consensus of experts expects instant personalization to fundamentally change end-user behaviors and the way technology and humans integrate through the Internet of Things (IoT). End-users will highly likely prefer concise communication that is visually appealing, interactive, and personalized to their beliefs and values. The expansion of IoT will enable devices to collect data in real-time and use it to personalize content and experiences for users instantly (See Figure 11 – Video).

- a. In the field of education, generative AI is likely to play a significant role in instant personalization. By collecting data on students' learning needs and preferences, generative AI can quickly create course content that meets their specific requirements. Virtual teachers powered by generative AI can provide 24/7 support, allowing students to learn at their own pace and schedule.
- b. Another example in personalization is the “gamification” of learning. Gamification, as described by educational curriculum provider Waterford.org and used in the context of education means, broadly, to enhance learning by creating an environment and experience like that of a game. While the effectiveness of gamification is still a sub-

ject of debate among some scholars, many research studies, according to the academic research institute SpringerOpen, have demonstrated a correlation between student comprehension and retention improvements when gaming is incorporated in the curriculum.

- c. Other benefits to gamification may include an improved learning experience, the ability for a student to receive instant feedback, and its ability to tailor many subjects (See Figure 12).

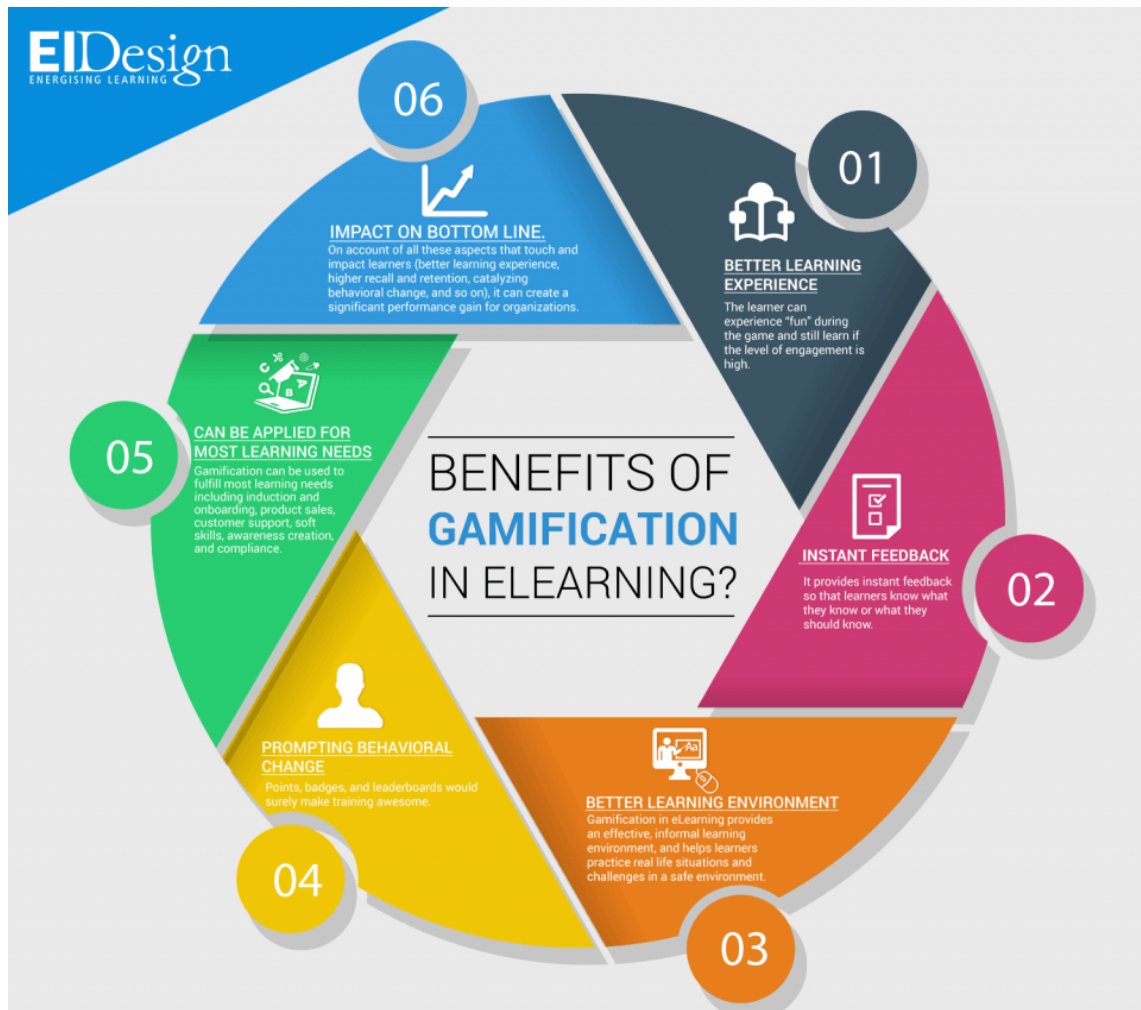


Figure 12: Six potential benefits of gamification according to educational consultant ELearning [M](#)

- d. Instant personalization will also very likely be dependent on other emerging technologies besides generative AI, such as 6G. Where 5G connected the Internet of Things (IoT) and industrial automation systems, 6G promises to improve download speeds, eliminate la-

tency, reduce network congestion, and supporting technological advancements, as described by telecommunications company Nokia (See Figure 13).

Main Technology Enablers per generation:

6G: Deep learning, TerraHertz, Human Chip Implants, Distributed Network Computations, Optical Wireless Communications, Intelligent Reflective Surfaces

5G: Enhanced Mobile Broadband, Massive Machine Type Communications, Ultra Reliable Low latency Communications, Cloud Computing, Software-defined Network

4G: MIMO Antennas, OFDM/OFDMA, Improved Modulation and Coding, Voice over IP

3G: High speed internet, IP technology, WCDMA, UMTS

2G: Digital voice communication, TDMA, CDMA

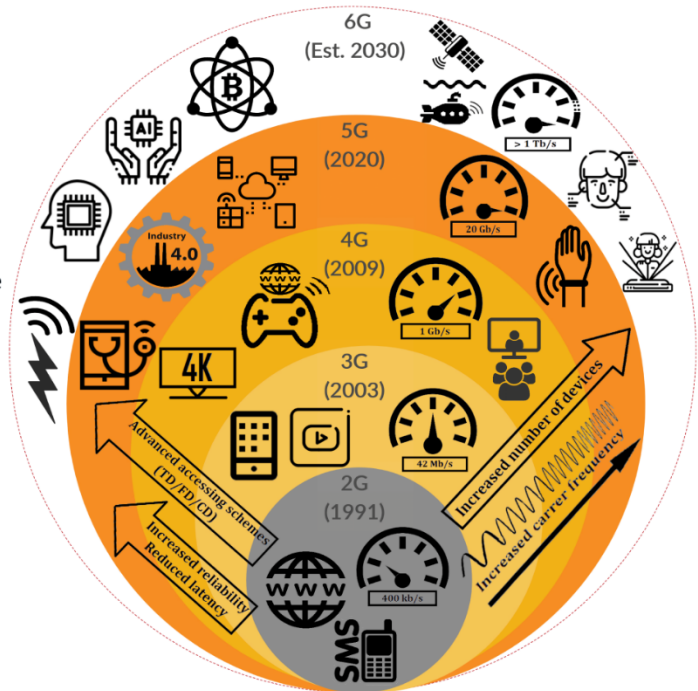


Figure 13: History of Wireless [H](#)

- e. Further, according to a recent article in applied sciences, “6G is anticipated to be an autonomous ecosystem with intelligence and consciousness on par with humans.” AI over a 6G network will very likely be able to analyze human emotions or reactions and provide tailored, personalized content and ultimately offer a better user experience during chats between human and bots, as noted by a 2022 study published by American University of Sharjah.
- f. Ultimately, according to an April 2023 article in the *journal Science Direct*, the 6G network sensing can help create a “mirror,” or digital twin, of the physical world in combination with other sensing modalities, extending the sensors to touch every point of the network. Ahmed Salameh, from the University of Sharjah notes, “These work by creating an identical version of a physical system with all the real-life constraints, parameters, variables, objects, conditions, etc., in such a way that the digital version behaves identically to the physical version.” The digital twin models allow users to analyze

what is happening in the physical world, simulate possible outcomes, anticipate needs, and then take productive actions back into the physical world.

5. **Transdisciplinary Skills Standardization.** Transdisciplinary skills will likely be more important than expert knowledge in specific disciplines for analysts to solve complex problems in the future environment. Transdisciplinary Skills, or skills that cross many disciplinary boundaries to create holistic approaches such as social skills, communication skills, thinking skills, research skills and self-management skills will likely be considered essential competencies required to navigate a digital world.
 - a. Phillip Tetlock, in his book *Superforecasting: The Art and Science of Prediction*, describes transdisciplinary skills as the “strongest predictor of rising into the ranks of superforecasters.” He also specifies the need to update beliefs and the importance of continuous self-improvement on accurate forecasting. He notes that these skills are “roughly three times as powerful a predictor as its closest rival, intelligence.” He boldly states “How you think matters more than what you think” to reinforce the need for transdisciplinary skills.
 - b. Described in part by American entrepreneur Frans Johansson in his 2004 book, *The Medici Effect: Breakthrough Insights at the Intersection of Ideas, Concepts, and Cultures*, the ability to bring a diverse group of experts, technologies and ideas together is very likely essential to innovating in a future digital world.
 - c. Noted psychologist Dr. Neil Farber went further highlighting the need to cultivate autodidactic traits in education, especially in a more connected, digital world. His concept of the “A+9Cs,” or 10 essential traits of an autodidactic learner, will very likely continue to be important in the future environment. Dr. Farber’s A+9Cs are: Accountable, Charged, Confident, Controlled, Committed, Conscientious, Curious, Creative, Courageous, and Critical.
 - d. Educators and experts continue to recognize that transdisciplinary skills are essential to navigate the digital world. As an example, the Organization for Economic Co-operation and Development (OECD), World Economic Forum (WeF) and The Digital Quotient Institute (DQ Institute) identify as series of “transformative skills,”

(i.e., transdisciplinary skills) every student requires to thrive in a digital world (See Figure 14).

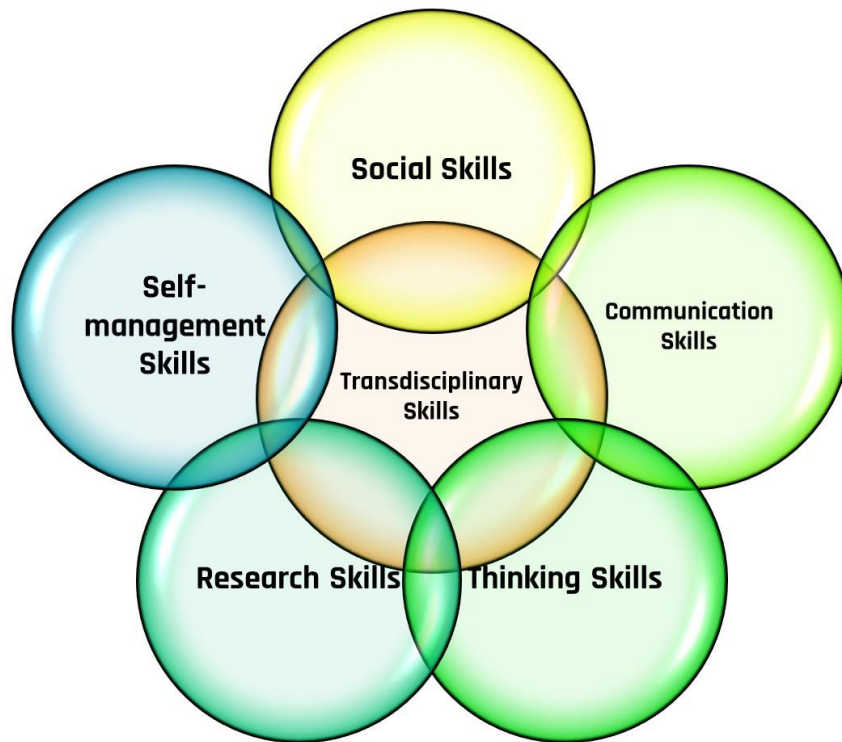


Figure 14: Transdisciplinary Skills: graph is authors work; data compiled from DQ Institute, OECD, and WeF

Section 1: Today's 18-22-Year Olds (Gen Z)

Understanding How Digital Natives, Gen-Z and Gen-A, Communicate and Consume Information Today and How They are Very Likely to Consume and Communicate in 2040

Executive Summary

Due to the democratization of smart phones and technology advances, it is very likely (80-95%), that Gen-Z and Gen-A will continue to prefer quick, immersive, and visually aided technologies that provide them information and knowledge of how to accomplish a task with expediency through 2040. Despite the technological comfort and proficiency that Gen-Z and Gen-A exercise, it will remain crucial for older generations to understand how and why these digital natives¹ prefer to communicate in social environments and professional environments. This will provide a better exchange for collaboration between generations throughout the Intelligence Process in 2035-2040.

Discussion

Gen-A is currently the youngest generation, born completely in the 21st century between 2010-2024². [M](#) This young generation will almost certainly grow up as true 100% digital natives³, immersed in technology, smartphones, and social media that was created before their birth. [M](#) [M](#) Gen-A and society are actively discovering and learning about their personal preferences and re-

sponses to a technological environmental habitat. The current data suggests that Gen-A embraces multiple forms of technology from smart phones, computer gaming, and computer based visual-experiential driven education. [M](#) [M](#) [M](#) In particular, Gen-A, has shown a proclivity for educational and game playing experiences that require creativity, teamwork and collaboration. [M](#) A unique research

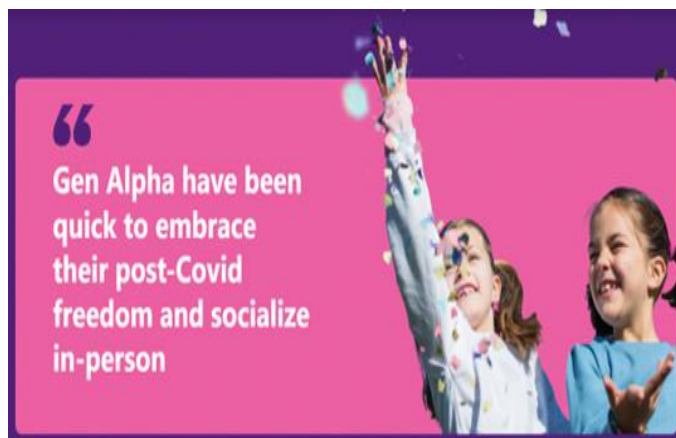


Figure 1: Getting To Know Gen-A [M](#)

¹ Oxford dictionary defines digital native as a person born or brought up during the age of digital technology and therefore familiar with computers and the internet from an early age

² Depending on the source, the age bracket year of birth for Gen-A will vary from 2010 to 2012 and end from 2024-2025

³ Oxford Dictionary - a person born or brought up during the age of digital technology and therefore familiar with computers and the internet from an early age

finding in the post COVID environment suggest that Gen-A is embracing the post-pandemic lockdown and showing an increasing interest for in person activities such as physical play time with friends and attending cinema film watching in person vice online. [M](#) This data suggests that while Gen-A does have access to digital communication platforms, they are showing an increased interest in personalized face-to-face communication in the post COVID environment.

Gen-Z, born between the mid-1990s and mid-2000s,^H prefers concise communication that is visual, interactive, personalized and relatable to their beliefs-values. [M](#) [M](#) [M](#) [M](#) These digital natives have evolved and mastered the ability of multitasking technology applications across multiple platforms, but frequently prefer the use of their

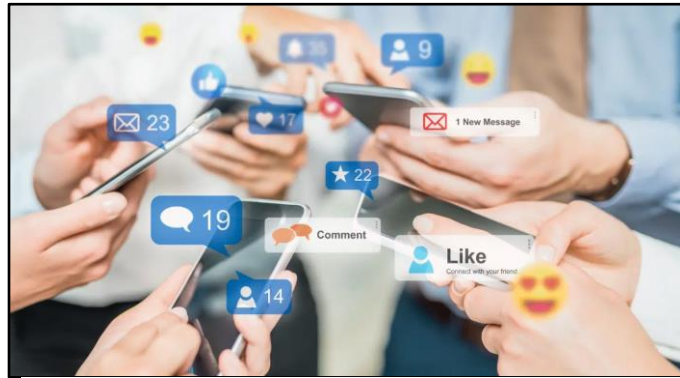


Figure 2: Gen-Z Preference of Digital Communication Amongst Friends [M](#)

smart phones. [M](#) [M](#) Growing up as digital natives, Gen-Z is accustomed to the availability and immediacy of information and will continue to expect this immediacy and flow into the future. [M](#) Gen-Z shows a proclivity for visuals and images in their personal communication environment, especially short burst text and short form videos. Research and marketing results show that Gen-Z spends up to 5 hours a day on varying social media and entertainment platforms absorbing visual and video media. [M](#) [M](#) [M](#) [M](#)

In regard to Gen-Z's communication habits, texting is the preferred method of communication amongst friends and social groups [M](#) which facilitates rapid, short text exchanges. One-on-one communication in the workplace is the preferred and more effective way to communicate with this generation. [M](#) [M](#) Gen-Z wants to be taken seriously and expects a personal interaction with their bosses and superiors when conducting work related matters. [M](#) [M](#) [M](#) [M](#) They prefer to communicate through SMS, email, and social media when working on routine matters or activities, but expect their superiors to communicate directly when working on important or personal issues. [M](#) [M](#) [M](#) [M](#)

The use of technology is beneficial when communicating with Gen-Z , but it is also important to provide a personal touch in communication with Gen Z. [M](#) [M](#) Varying the ways in which feedback is given can also be effective, as Gen Z values feedback from others and wants leaders who listen to their ideas and show they

value their opinions. ^M Utilization of informal communication methods such as chat and videos to quickly exchange ideas and contribute to conversations in order to establish appreciation for their intuitive mode of communication. ^M Finally, it is important to prioritize and value face-to-face communication with Gen-Z as they value honesty, authenticity, and transparency. ^M

Regarding current technological commonality between Gen-A and Gen-Z is the ubiquitous use of the social media application known as TikTok. This application is a video-sharing social media platform that is gaining massive popularity across Gen-A and Gen-Z age ranges. ^{M M M M} TikTok's technological effectiveness is found in the form of



Figure 3: Why is TikTok so Popular? ^M

short-video format that captures the user's attention at a personal preference level, relying on visually attractive-short form video footage ranging from 5-60 seconds. ^{M M} The app is convenient to use, and anyone with a smartphone can easily create and post content. ^M TikTok utilizes a recommendation algorithm that is not reliant upon the building an individual's network of shared recommendations. This recommendation algorithm is proving to be highly effective, and addictive as witnessed by the continuous increase of use and popularity. ^{M M} Despite its current ongoing concerns over national security and pending legislation to ban TikTok, it is very likely (80-95%) chance that young people will continue using the platform to send political messages, coordinate social actions, and hang out in an online space largely free of adults. ^M Current research indicates that Gen-Z spends more than five hours per day on this platform. ^M

Prabhakar Raghavan, a Senior Vice President at Google, indicated in a Fortune Magazine online interview that approximately 40% of Gen-Z prefer to use other platforms other than Google Search to discover information. The internal Google review indicates that the younger population, e.g., Gen-A and Gen-Z, favors platforms such as TikTok or Instagram to meet their information search requirements. ^H

In a July 2022 NBC News interview, young Gen-Zs indicated that they prefer a visual platform that is easily accessible and provides a quick and informative associated video on their search query. One of the responses that was predominant in the interviews was “It’s one thing to read about what to do in this area or how this product works, but it’s another thing to see it.”^H

A key finding in the interview with Prabhakar Raghavan reveals that today’s generation has more technical ability than ever before and prefer quick, immersive, and visually aided technologies that provide them the information and how to accomplish the task or thing they are attempting.^H It is very likely (80-95%) chance that these findings hold true and consistent in the years 2035-2040.

Analytic Confidence

The analytic confidence for this estimate is *moderate*. Sources were generally reliable and tended to corroborate one another but were mostly non-scientific in nature and methodology. Artificial Intelligence platforms were encouraged and utilized in the creation and research for this project, as an example, Perplexity, Bard, and Chat GPT. There were competing academic requirements for time, and the analyst worked alone and did not use a structured method. Furthermore, given the lengthy time frame of the estimate, this report is sensitive to change due to new information.

Author: James R. Esquivel

Growing Trust in Technology Likely to Improve Solving Complex Problems, but Critical Thinking Skills will Very Likely Remain Essential

Executive Summary

It is likely (55-80%) that generational increases in the trust of technology will lead to analysts' increased use of AI to solve complex problems over the next 10 to 15 years. While AI tools may be critical additions to expert teams, it is very likely (80-90%) that it will continue to be important to have a team with strong critical thinking skills and problem-solving abilities to effectively consume, synthesize, and verify information. However, future generations are unlikely (20-45%) to successfully integrate AI without targeted education and practice with the tools in practical situations. Additionally, due to the increased generational use of social media, collaborative platforms in the workplace that resemble social media are very likely to appeal to future analysts and will likely become commonplace by 2030.

Discussion

Generation Z (Gen Z), born between the year 1997 and 2012, is considered the first generation that grew up with the internet and social media. [H](#) This familiarity with digital information sources has led them to be more trusting of online information compared to previous generations and more likely to adopt new technologies. [H](#) They also tend to be more trusting to put their information online, including online payment methods, than previous generations. [M](#) This trust is likely to influence their use of online artificial intelligence (AI) tools in problem-solving. Additionally, due to Gen Z's increased use of social media it is likely they prefer to use platforms that resemble social media because of the ability to display uniqueness and diversity while embracing collaborative technology. [M](#)



Figure 4: Ranked - Gen Z's Favorite Brands, Compared with Older Generations [M](#)

AI tools are increasingly sophisticated and can address a wide array of issues, from medical diagnoses to weather predictions. [M M](#) However, concerns are rising about AI's potential to manipulate people and disseminate misinformation. [M](#) Gen Z's trust in online information is likely to increase their susceptibility to these risks. Advances in AI will provide some safeguards to filter misinformation, but ultimately it will require critical thinking of analysts to determine the quality of information. [H](#) It is very likely that these skills will need to be honed through practice to be useful in identifying and addressing misinformation; some of the techniques mentioned in research results include “visual analysis, total quality management, the Five Whys, and empathy mapping.” [H M M](#) While AI tools may be useful in identifying misinformation, it is very likely that it will be important to have a team with strong critical thinking skills and problem-solving abilities to effectively consume, synthesize, and verify information. [H](#)

As digital natives, Gen Z has lived through the benefits and risks of online social media and technology companies. [M](#) Because of this, Gen Z's trust in online information may also foster a more critical and discerning attitude towards AI tools. [H](#) As digital natives, they are likely to be more skeptical of online information and place higher value on collaboration, inclusion, ethics, and responsibility. This attitude could drive a more ethical and responsible approach to AI development and usage. [M](#)

Predicting exactly how future generations will perceive AI is challenging. As with Gen Z, there is a likely chance that Gen A will be more trusting of AI, given their familiarity with it, however, there is a chance they may be less trusting due to concerns about bias and error. Trust in AI will likely depend on AI's societal role, transparency levels, and educational initiatives about the technology. [M](#) According to reviews, for AI to earn the trust of human operators, it must manifest qualities that inspire confidence such as tangibility, transparency, reliability, responsiveness, and even a hint of humanity for emotional trust. [H](#) In other words, to be trusted, the AI should be brilliant, candid, and feel like a human team member. Just as future generations need to trust AI, AI developers and users need to earn that trust by being transparent about their work and by ensuring that AI systems are developed and used in a responsible and ethical manner. [M](#)

Analytic Confidence

The analytic confidence for this estimate is moderate. Sources were generally reliable and tended to corroborate one another. There are numerous meta-analyses that discuss trust of online sources across generations, but all acknowledge that further research is needed to better understand the impact of Gen Z's trust in online information on AI tool use. ChatGPT was used to conduct an analysis of

competing hypotheses (ACH) (available below), Bard, and Perplexity were tested, and ideas from the results were utilized to continue research; however, content inclusion was limited due to some sources not aligning with the subject. The results from the ACH were mixed, but provided a direction for additional research, with more time and fine tuning of prompts, the AI ACH may provide better results. There was adequate time, but the analyst worked alone and did not fully use a structured method.

Author: Tyler J. Standish

Generation Z's Intuitive Attitude Very Likely Enables Them to Excel in AI and Emerging Tech for Information Processing and Analysis

Executive Summary

Generation Z, as true digital natives, are very likely (80-95%) to continue to adopt artificial intelligence and emerging technologies to consume, synthesize and analyze information. Gen Z has an intuitive trust in technology because they have always had instant access to information anytime and anywhere and have never experienced the alternative. These traits allow Gen Z to embrace AI, augmented and virtual reality, and other technologies to engage with their surrounding environments. Despite the risks such as security and privacy, Gen Z will continue to immerse themselves in and expand the evolving digital environment to consume information.

Discussion

Generation Z, as digital natives, embrace technology and trust that it is going to have a positive effect on their livelihood. [MM](#) The digital native generation grew up with technology to assist in their daily lives, from hyperconnected enhanced social media presence and virtual assistants to emerging upgraded artificial intelligence. [MMMM](#) Gen Z is leading the change in technology shifts, information consumption and future learning environments. [MM](#) Current and emerging technology, such as augmented intelligence, augmented and virtual reality, and META's Segment Anything Model (SAM) provide ways for current 18-22-year-olds to consume information. These technologies increase the speed of information gathering and decision-making more rapidly than previous generations. [MMM](#) META's SAM is a recently released technology that integrates AR with AI to assist people interacting with their environment. SAM's ability to identify and analyze its surroundings and provide analysis of unknown objects⁴ can enable META's SAM to assist intelligence analysts in future daily operations. [M](#)

An example of integrating new technology into information consumption habits is the use of extended reality. [M](#) Figure 1 provides a visual representation of where extended reality (XR) falls into the virtuality spectrum. [M](#) Virtual reality markets, the technology of today, are predicted to reach \$1.25 billion USD by 2025, and extended reality (emerging technology) is predicted to expand to nearly 25% of the market. Additionally, nearly 78 percent of US citizens are already familiar with VR technologies and believe that extended reality jobs will increase from

⁴ The YouTube video, 3:10-3:27, describes the benefits of META SAM's analysis tool and its uses.

80,000 to over 2 million by 2030. [M](#) This data suggests that Gen Z, as a digital native generation used to technological shifts, is very likely to continue to consume information with emerging technology.

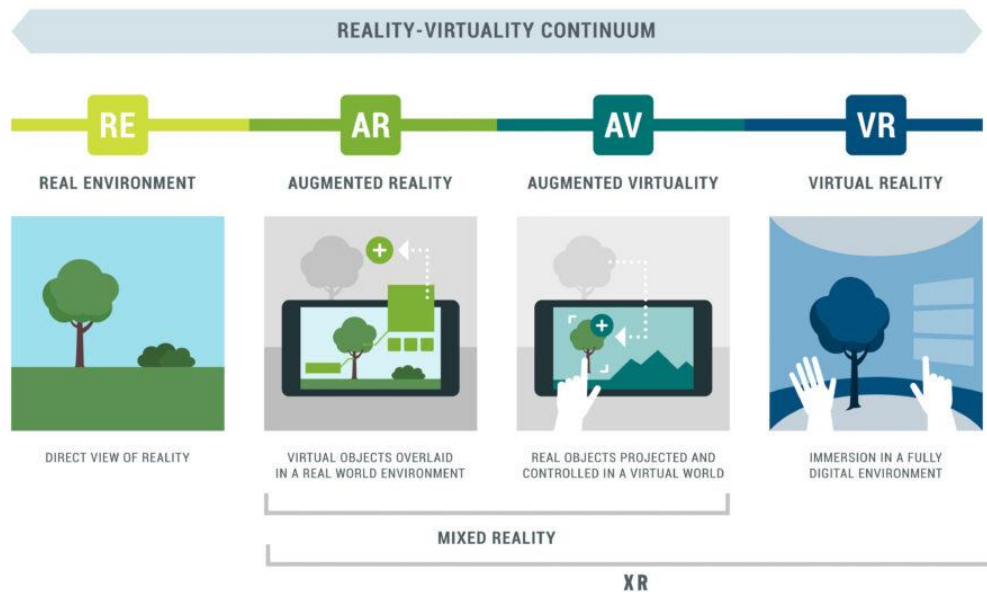


Figure 1: The Virtuality Spectrum — Understanding AR, MR, VR and XR [M](#)

Extended Reality, using collaborative Artificial Intelligence (AI) tools, is an emerging technology that Gen Z is very likely to embrace. Extended Reality capabilities are projected to provide immersive, synthetic training environments for multiple venues. [MM](#) As Tyler Standish discovered, “the development of extended reality technologies has made it possible to create hybrid environments that combine the best of VR and AR. [M](#) With extended reality, users can interact with digital objects in a real-world environment, creating more immersive experiences that are well-suited for training, simulation, and remote collaboration” (see [Tyler Standish’s report](#) titled Technologies For Immersive Virtual and Augmented Reality Ready Now, Fully Integrated Environments Likely in Workplaces Before 2040). [M](#)

The Integrated Visual Augmentation System (IVAS) is a notable example of a future extended reality, immersive environment. The Army’s Program Executive Office Simulation, Training, and Instrumentation (PEO-STRI) teamed up with Microsoft to develop an extended reality environment to assist Soldiers with future training and daily operational needs. [MMM](#) The IVAS provides the Army with a new way to train Soldiers using technology that the current generation understands and is comfortable with using (Figure 2).

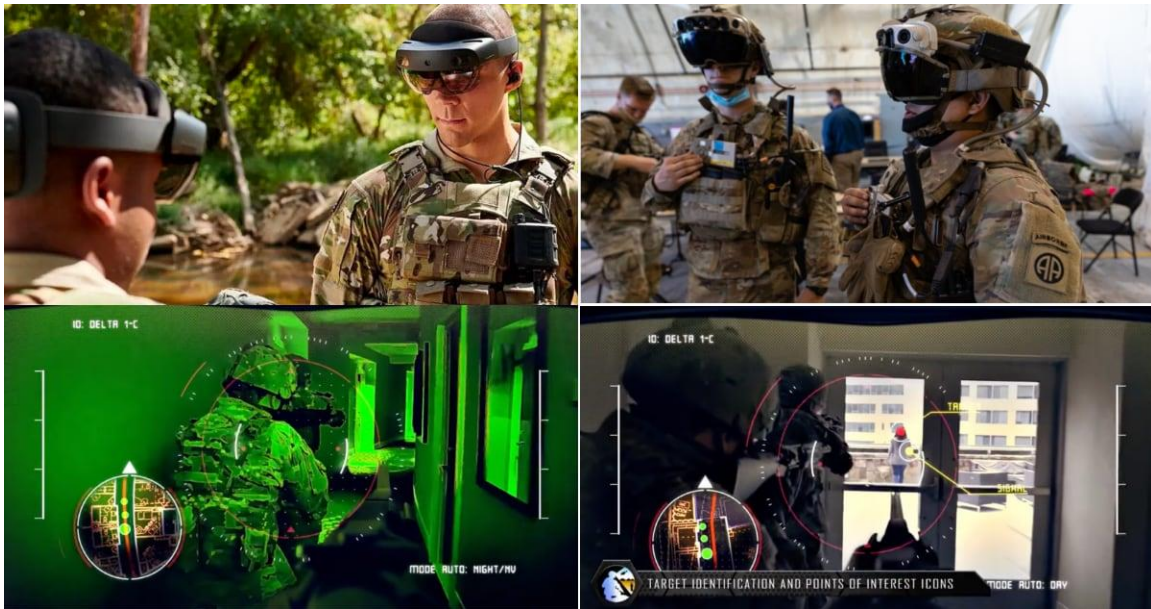


Figure 2: How IVAS will work - Microsoft's version of HoloLens for the military [H](#)

The rise of emerging technology comes with risk, the biggest being security breaches. Cyber hacking and stealing information are significant risks in today's information environment. AI can be exploited by malware, weaponizing email and social engineering attacks. [M](#) However, the adaptation of future technology such as AI is likely to mitigate risk. The Identity Management Institute, a pioneer and forward-thinking certification organization in identity and access governance, risk management, and compliance, states that 75% of enterprises currently rely on AI-based solutions for network security, and 51% use AI as a "primary" threat detection option. Additionally, AI combined with robust cybersecurity policies enables comprehensive protection. [M](#)

Habits change from generation to generation. Gen Z are more apt to embrace AI and emerging technology to assist them with information consumption due to their digital native nature and their ability to shift to emerging technology.

Analytic Confidence

The analytic confidence for this estimate is *moderate*. Sources were reliable and corroborated with one another. This report was generated using the author's analysis and AI (Chat GTP, Perplexity, Unrestricted Intelligence, and Elicit) to help develop a framework and identify resources. All AI provided resources were verified to ensure validity. This report is subject to change based on new information gathered and analyzed through more detailed, collaborative research.

Author: Derek R. Baird

Gen Z is Likely to Build Trusting Relationships With AI

Executive Summary

Generation Z is likely (55-70%) to trust AI more than past generations, leading to increasing use of artificial intelligence. Trustworthiness is a key element of sustained use of AI today and the future. Gen Z trust is due to their digital native status, accessing information anytime, anywhere, and their ability to integrate emerging technology into their daily lives. [MM](#) Despite several unique challenges to trustworthy AI, such as transparency, reliability, security and privacy, Generation Z is likely to continue to integrate AI into their daily lives.

Discussion

Generation Z is known for being digital natives who have grown up in a world where technology is integrated into every aspect of their lives. [M](#) They are more apt to trust AI than previous generations. [M](#) In March 2021, The University of Queensland, Australia conducted a five-country study on trustworthy AI. The study concluded that Gen Z trust AI 10% more than the Baby Boomer generation (34% vs 24%).[M](#) More recent surveys also suggest that over 70% of Gen Z believes AI will have a positive impact on the world.[MM](#)

A notable example of trusted AI are virtual assistants. Anthropomorphism, attributing human characteristics to objects such as virtual assistants, increases trust resilience. [M](#) Virtual assistants are becoming more ubiquitous in society. Gartner, an organization that uses experts and tools to guide organizations to make smarter decisions and stronger performance on an organization's mission-critical priorities, predicts that by 2025, 50% of knowledge workers will use a virtual assistant on a daily basis, up from 2% in 2019. [M](#)

Generation Z, as digital natives, embrace technology and trust that it is going to have a positive effect on their livelihood. [MM](#) Gen Z have only experienced accessing information at anytime and anywhere, as well as leading the change in technology shifts. [MM](#) These attributes enable Gen Z to be more comfortable with and are more willing to trust AI. [MM](#)

Developing trustworthy AI is important to pave the way for increased integration of AI now and in future generations. [M](#) Trustworthy AI refers to artificial intelligence systems that can be relied upon to function as intended, while also operating in an ethical and socially responsible manner. [MM](#) It is built on a foundation of autonomy, privacy transparency and security. [M](#)

Trustworthy AI should be able to recognize and mitigate errors, and alert humans or secondary systems when necessary. [M](#) Constant feedback loops provide mecha-

nisms to reduce machine learning biases and ethical dilemmas, thereby increasing trustworthiness in the system. [M](#) The Deloitte AI Institute developed a framework (Figure 1) to identify and mitigate potential risks related to AI ethics at every stage of the AI lifecycle. [M](#)

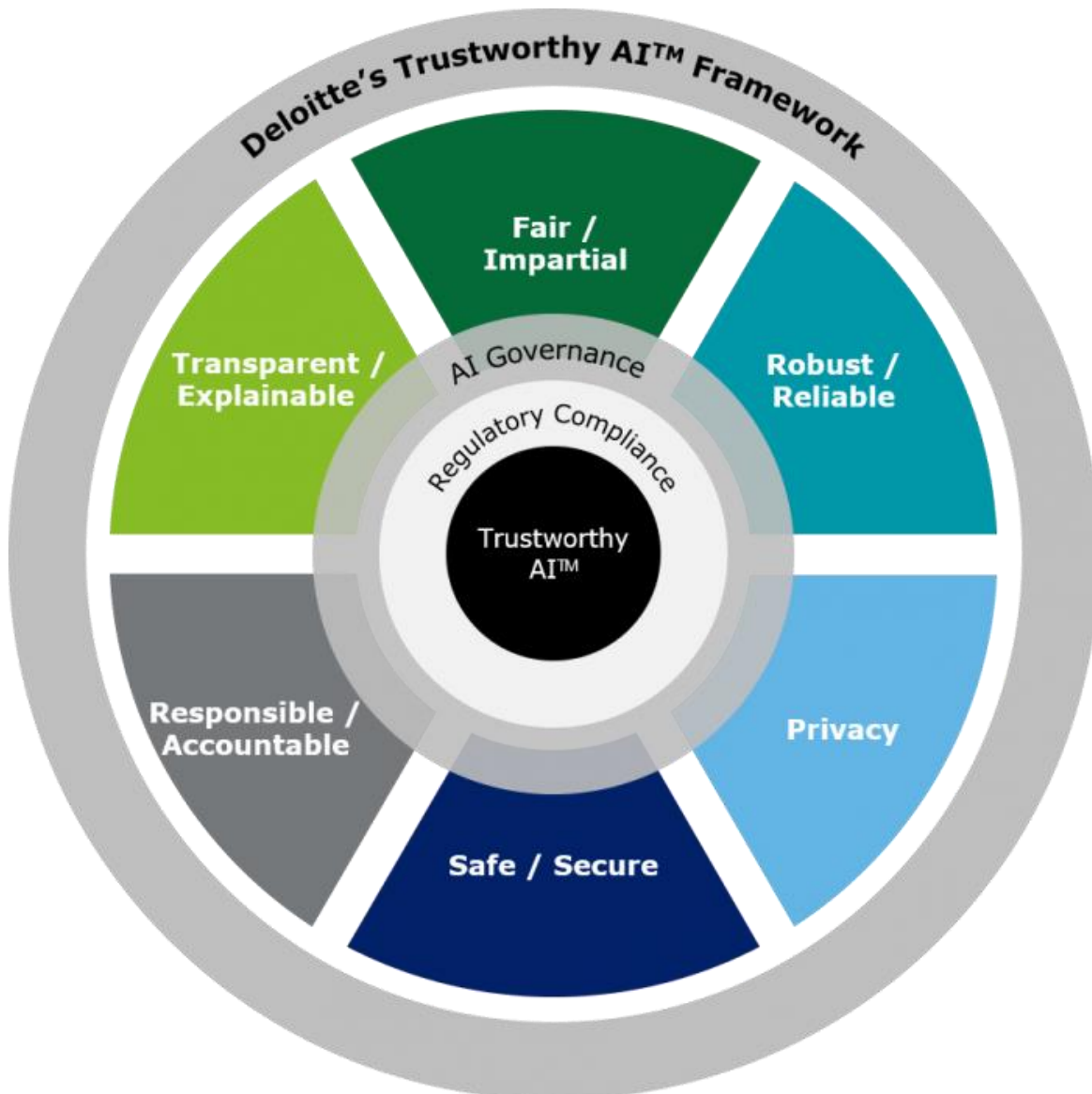


Figure 3: Deloitte AI Institute Trusted AI Framework [M](#)

Trustworthy AI comes with unique challenges. A review of trust in AI highlighted five central AI trust challenges (Table 1): 1) transparency and explainability, 2) accuracy and reliability, 3) automation, 4) anthropomorphism, and 5) mass data extraction. These challenges represent vulnerabilities as a key element of trust. Understanding and mitigating these risks is central to building trust in AI. [M](#)

Table 1: Concept matrix of the five AI trust challenges and the respective vulnerabilities each creates for stakeholders. ^M

AI trust challenge	Stakeholder vulnerabilities		
	Domain expert	End user	Society
1. Transparency and explainability	<ul style="list-style-type: none"> • Ability to know and explain AI output, and provide human oversight • Manipulation from erroneous explanations 	<ul style="list-style-type: none"> • Ability to understand how decisions affecting them are made • Ability to provide meaningful consent and exercise agency 	<ul style="list-style-type: none"> • Knowledge asymmetries • Power imbalance and centralization • Scaled disempowerment
2. Accuracy and reliability	<ul style="list-style-type: none"> • Accountability for accuracy and fairness of AI output • Reputational and legal risk 	<ul style="list-style-type: none"> • Inaccurate / harmful outcomes • Unfair / discriminatory treatment 	<ul style="list-style-type: none"> • Entrenched bias / inequality • Scaled harmed to select populations
3. Automation	<ul style="list-style-type: none"> • Professional over-reliance and deskilling • Loss of expert oversight • Loss of professional identity • Loss of work 	<ul style="list-style-type: none"> • Loss of dignity (humans as data points; de-contextualization) • Loss of human engagement • Over-reliance and deskilling 	<ul style="list-style-type: none"> • Scaled deskilling • Reduced human connection • Scaled technological unemployment • Cascading AI failures
4. Anthropomorphism and embodiment	<ul style="list-style-type: none"> • Professional over-reliance • Psychological wellbeing 	<ul style="list-style-type: none"> • Manipulation through identification • Over-reliance and over-sharing 	<ul style="list-style-type: none"> • Manipulation through identification • Human connection and identity
5. Mass data extraction	<ul style="list-style-type: none"> • Accountability for privacy and use of data • Reputational and legal risk 	<ul style="list-style-type: none"> • Personal data capture and loss of privacy • Inappropriate re-identification and use of personal data • Loss of control 	<ul style="list-style-type: none"> • Inappropriate use of citizen data • Mass surveillance • Loss of societal right to privacy • Power imbalance & societal disempowerment

To this end, the European Commission's AI High-Level Expert Group (AI HLEG) developed an initiative to ensure that AI is human-centric and trustworthy. Regulating AI to ensure security and privacy is a key variable to ensure AI trustworthiness. ^{HMM}

Trustworthy AI is crucial in ensuring that the development and use of AI systems in the public and private sectors are safe and effective. It is also important to note that trustworthy AI is not only a technical matter but also a social and ethical one, requiring collaboration across different fields and perspectives to ensure that AI works for the benefit of all. ^M A framework like trustworthy AI can help organizations manage the unique risks associated with AI while ensuring that their systems remain transparent and accountable. ^M

Analytic Confidence

The analytic confidence for this estimate is *moderate*. Sources were reliable and corroborated with one another. This report was generated using the author's analysis and AI (Chat GTP, Perplexity, Unrestricted Intelligence, and Elicit) to help develop a framework and identify resources. All AI provided resources were verified to ensure validity. This report is subject to change based on new information gathered and analyzed through more detailed, collaborative research.

Author: Derek R. Baird

As smartphone technology and accessibility became more globally democratized, so did the range and frequency of emoji usage. Research indicates that 72% of people between the ages of 18 and 25 are more likely to use emojis in their digital communication habits in order to express or clarify their emotion. [M](#) The use of emojis in digital communication provide users the ability to convey tone and non-verbal context in a digital medium. [M](#) This is historically supported by studies conducted in the 1950's by psychologist Albert Mehrabian, for which he hypothesized that "7 percent of communication is verbal (what we say), while 38 percent is vocal (how we say it) and 55 percent is nonverbal (what we do and how we look while we are saying it)." [M](#)

In a 2021 Adobe global emoji trend survey of 7,000 people reported the following impacts of emoji use: 88% are more likely to feel empathy, 55% feel more comfortable expressing emotions via emoji vs. conversation, 89% feel it easier to bridge language barriers, 70% feel inclusive emojis spark positive conversations regarding cultural and societal issues, 75% feel comfortable sending an emoji response vs. words. [M](#)

Because digital communication provides a platform for rapid-short burst digital exchanges, in the absence of face-to-face communication, the intended exchange of information across different platforms presents conditions for misinterpretation. [H](#) The sentiment (emotional analysis) and semantics (meaning) of the message can be variable from sender to receiver. The proliferation and standardization of emojis in digital communication fill the gap of face-to-face communication and provide the users a socio-emotional bridge to ensure clarity of message and function as a digital emotional communication multiplier. [H](#) This is supported statistically by an all-time high use of emojis on Twitter which increased over 40% 2016 to 2021. [H](#)

Analytic Confidence

The analytic confidence for this estimate is *moderate*. Sources were generally reliable and tended to corroborate one another. There were competing academic requirements for time, and the analyst worked alone and did not use a structured method. Furthermore, given the lengthy time frame of the estimate, this report is sensitive to change due to new information and technology advancements.

Graphic Interchange Format (GIF) Very Likely Passe for Gen Z Within 5 Years, Antiquated by 2035-2040

Executive Summary

Despite the democratization and free access to GIFs, it is very likely (80-95%) that Gen Z will choose not to use GIFs in computer mediated communication (CMC) by the years 2035 to 2040. Digital Natives, more precisely – Gen Z, already describes the use of GIFs as “cringe”⁵ and favor more personalized visual communication applications. While Boomers, Gen X and Millennials are currently the highest users of GIFs in CMC, there is roughly even chance (45-55%) that these generations will transition to different modern applications as technology advances from 2023-2040.

Discussion

The use of Graphic Interchange Format (GIF) is a form of expressive non-verbal communication utilized in text messaging, marketing tools and social media platforms. [M](#) According to a (2017) Harris Poll commissioned by the GIF platform Tenor, 36% of 18- to 34-year-old persons, who use “visual expressions”⁶ in CMC, prefer GIFs over words. [M](#) [M](#)



Figure1: GIFs are a form of visual communication [M](#)

Boomers, Millennials, and GenX [M](#) use GIFs and other animated pictures to deliver personalized messages, providing emotional connection, emotional response, and humor to difficult topics when operating on smartphones or social media platforms. [M](#) Experian Marketing Services indicates an upsurge from 2012-2015 in the usage of GIFs in mobile messaging apps, utilizing companies such as Riffsy and Giphy, which provide search engines for thousands of free accessible collections of GIFs. An indication of the ubiquitous use of GIFs in CMC transactions is reflected in Tumblr⁷ reporting 23 million GIFs posted to its site each day. [M](#)

Even though animated GIFs have existed since 1987 there has been little scientific study on specific age population usage and proclivity for use. [M](#) [M](#) David

⁵ So embarrassing and awkward as to cause one to cringe.

⁶ Ideas, feelings, and values visually represented.

⁷ Tumblr is a microblogging and social networking website.

McIntosh, CEO of Tenor⁸, attributes the use of GIFs, as a direct result of mobile lifestyles and the increased role of text messaging, which has been driven by the democratization of smartphone use worldwide. [M](#) Other contributing factors to the use of GIFs in CMC are the ease and speed of downloading from embedded applications, shared recognition of trending topics, and the ability to either provoke emotion or express emotion in a visual art form. [M](#)

Despite the three decade existence and usage of GIFs, Gen Z considers GIFs as "cringe". [M](#) [M](#) [M](#) Linda Kaye, a cyberpsychology professor at Edge Hill University, hypothesizes that the increasing popularity of video-sharing on TikTok means that younger generations (such as Gen Z) prefer “personalized content creation”. She also attributes the lack of Gen Z interest in GIFs as an older generation’s (Boomers, Millennials and Gen X) mode of communication, which Gen Z considers uninspiring. [M](#) An August 2022 Teen Social Media and Technology report published by Pew Research supports the hypothesis of Linda Kaye, that Gen Z prefers the more personalized platforms of TikTok and YouTube, which indicate TikTok usage at an estimated 67% vs Twitter 23%, Facebook 32%, Reddit 14%, and Tumblr 5%, where most GIF files are utilized. [M](#)

Analytic Confidence

The analytic confidence for this estimate is *moderate*. Sources were generally reliable and tended to corroborate one another but were mostly non-scientific in nature and methodology. There were competing academic requirements for time, and the analyst worked alone and did not use a structured method. Furthermore, given the lengthy time frame of the estimate, this report is sensitive to change due to new information.

Author: James R. Esquivel

⁸ Tenor is an online GIF search engine and database owned by Google.

Overcoming Generational Communication Barriers in the Workplace Very Likely Leads to Cross Generational Understanding

Executive Summary

Communication challenges between generations are very likely (80-95%) to occur due to the distinct communication styles between people from different generations. Understanding that communication tensions exist enables decision makers to use communication processes to better communicate across generational lines.

Discussion

Generational differences very likely have a significant impact on communication. Generational communication challenges are not a new phenomenon; however, understanding the challenges and breaking through communication barriers very likely remains a challenge. [M](#) These challenges create misunderstanding across generational lines, particularly between older generational DMs and younger employees. [MM](#) Baby Boomers are more likely to prefer face-to-face communication, Gen X prefers personal and virtual networks, Millennials prefer digital communication and networks, and Gen Z is primarily virtual with superficial networks. [M](#) Baby Boomers may be more resistant to change and may be more comfortable with traditional communication methods, while Gen X and Millennials may be more open to new technologies and communication methods (Figure 1). [MMM](#)

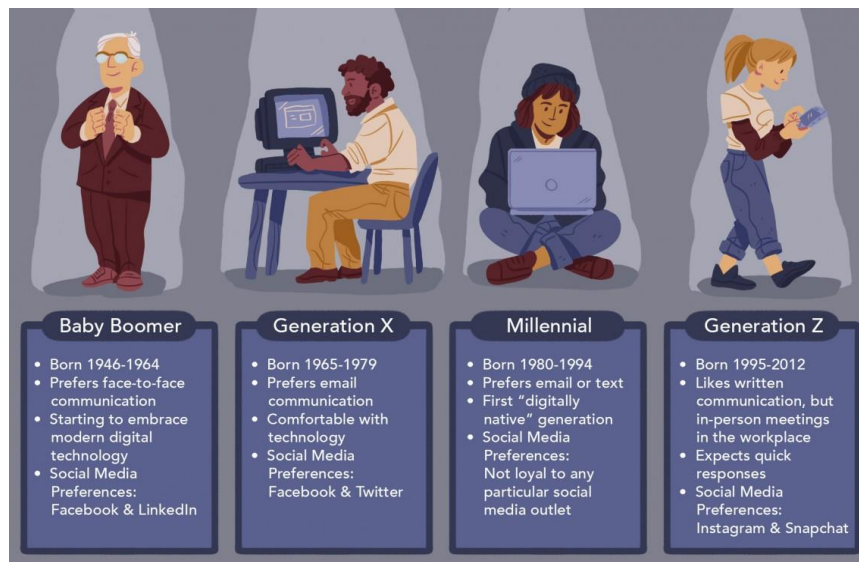


Figure 1: Cross generational communication differences [M](#)

A recent CNN video showing CNN anchors discussing the differences in ways that 18-22-year-olds communicate highlights cross generational communication challenges. [M](#) The International Journal of Adolescence and Youth describes challenges between Baby Boomers and Millennials based off their preferred method of communication. Baby Boomers like face-to-face communications while the

digital native Millennials prefer computer-mediated communication (CMC). These differences in communication create tension between these two generations. [M](#)

The Leadership Institute agrees that Baby Boomers prefer in person meetings, while Millennials prefer short messages without personalized messages. Generation Z (Gen Z) and Baby Boomers share a preference for face-to-face meetings; however, Gen Z is more likely to use video chat rather than an in-person meeting. [M](#) These communication conflicts are likely to create misunderstanding when interpreting written communications such as emails and texts, and the use of emojis. [MM](#) For example, the “laughing crying” emoji that is popular with Millennials is no longer popular with Gen Z. [M](#)

The differences in communication between generations is not all doom and gloom. Business Insider provides a 9-step process better enable cross generational communications: 1) don’t overthink it; 2) modify your style 3) get out of the office; 4) Let younger employees be heard 5) mix generations 6) be present for younger generations; 7) encourage millennial employees to accept change, and lead by example; 8) balance hybrid work models with occasional in-person opportunities; 9) get employee feedback. [M](#)

The GenSpring Family Offices, a wealth management fund that provides comprehensive personal advice and service, hosted an event splitting up generations from Baby Boomers to Millennials to evaluate the intricacies of generational communication challenges. “Each group identified numerous cross-generational communication challenges. The list ranged from a lack of respect for different world views to the use and non-use of technology, the barriers created by geographical distance, the casting of judgments and aspersions and a lack of transparency with regard to subjects considered taboo.” [M](#) The event participants developed 7 recommendations to enable cross generational communication mindedness: 1) recognize the contents of each group; 2) turn and face the change; 3) the stories you can tell; 4) skill sets go both ways; 5) the right tool makes the chore easier; 6) let’s meet and 7) open the closet. [M](#)

George Box, a British statistician, stated that “all models are wrong, some are useful.” The two models listed above are similar in nature and can be applied to daily life in a useful manner. [M](#) Communication models are not enough to eliminate tension with cross generational communication; however, the processes used appropriately mitigate communication tension. [MMM](#) Recent research shows that “the cooperation of different age-groups could provide not only conflicts, but positive results as well for the organization.” [M](#)

Analytic Confidence

The analytic confidence for this estimate is *moderate*. Sources were reliable and corroborated with one another. This report was generated using the author's own analysis, working alone and without structure. This report is subject to change based off new information gathered and analyzed through more detailed, collaborative research. The analyst used an Analysis of Competing Hypothesis methodology to further develop the hypothesis.

Author: Derek R. Baird

Professional Digital Natives, Gen Z, Likely Prefer Face-to-Face Communications

Executive Summary

Professional digital natives, Gen Z, likely (55-80%), prefer to communicate face-to-face. Despite the preference for daily communication to be 65% digital in their personal lives, in professional settings, face-to-face communication is likely the best way to communicate with Gen Z employees. Gen Z employees know their written communications could be more robust and eschew email or messaging in favor of face-to-face communication as the better way to prove themselves professionally. Despite the older generations who may like email or phone calls for collaboration, Gen Z prefers more instant forms of digital collaboration. Due to the collaborative culture of this generation, many Gen Z professionals also look for a culture that is open and transparent from their leaders and expects open conversations around strategy and decisions, including “bad news.”

Discussion

By 2025, Gen Z will comprise about 30% of the global workforce. [M](#) Born between the mid-1990s and 2010, members of Gen Z are characterized as “digital natives” stemming from a five-screen culture that communicates visually across multiple screens (TV, phone, laptop, desktop, iPad, etc.), with digital collaboration and live-streaming technology (See Figure 1). [M](#) While older generations may like email or phone calls for collaboration, Gen Z prefers more instant forms of digital collaboration. [M](#) In addition, Gen Z employees communicate through frequent conversations across multiple media and platforms, such as text (SMS or iMessage), Instagram, FaceTime, Snapchat, and other mobile applications, and often communicate simultaneously with multiple people. [M](#)



Figure 1: Unlock the Gen Z employee: Inside the mind of a native digital | Hannah Williams TEDxAsheville [M](#)

Despite the preference for daily communication to be 65% digital in their personal lives, in professional settings, the best way to communicate with Gen Z employees is through face-to-face communication (See Figure 2). [M](#) Gen Z employees know their written communications are weak and eschew email or messaging

Generations at a Glance

	Baby Boomers 1946-1964	Gen Xers 1965-1977	Gen Yers 1978-1989	Gen Zers 1990-1999
Behavior	Challenge the rules	Change the rules	Create the rules	Customize the rules
Training	Preferred in moderation	Required to keep me	Continuous and expected	Ongoing and essential
Learning style	Facilitated	Independent	Collaborative and networked	Technology-based
Communication style	Guarded	Hub and spoke	Collaborative	Face-to-face
Problem-solving	Horizontal	Independent	Collaborative	Entrepreneurial
Decision-making	Team informed	Team included	Team decided	Team persuaded
Leadership style	Unilateral	Coach	Partner	Teaching
Feedback	Once per year, during the annual review	Weekly/daily	On demand	Consistent and frequent
Change management	Change = caution	Change = opportunity	Change = improvement	Change = expected

Sources: • The Changing Workforce: Urgent Challenges and Strategies, 2007, Joe Kristy, associate partner, Human Capital Management Practice, IBM
• Bruce Tulgan, founder, RainmakerThinking

Figure 2: Generations at a Glance [M](#)

in favor of face-to-face communication as the better way to prove themselves professionally. [M](#) In addition, this generation views continual back-and-forth communication via digital platforms or in person as valuable in establishing genuine relationships and loyalty. [M](#) Due to the collaborative culture of this generation, many Gen Z professionals also look for a culture that is open and transparent from their leaders and expects open conversations around strategy and decisions, including “bad news.” [M](#) In addition, Gen Z employees do not want to learn from computers and communicate via handheld devices; they want hands-on, coaching-style managers who customize and calibrate their direction and feedback. [M](#)

Despite concerns that their technology or smartphones would control this generation, research has found that Gen Z employees limited their usage based on what was happening in the workplace, such as working with people or focusing on important work assignments. [M](#) Also, due to workplace expectations, most

Gen Z employees use email in professional settings. [M](#) In addition, Gen Z employees prefer to collaborate with a small group in an office. [M](#) Like the older generations, Gen Z prefers collaborative workspaces that can support teamwork – a commonality that may help unite the multi-generational workforce internally and externally. [M](#)

Analytic Confidence

The analytic confidence for this estimate is *moderate*. Sources were generally reliable and tended to corroborate one another. Unrestricted Intelligence, ChatGPT, and Perplexity were evaluated, and ideas from the results were utilized in furthering research; however, content inclusion was limited due to sources not aligning with the subject. There was adequate time, but the analyst worked alone and did not use a structured method.

Author: Nora L. Flott

Section 2: 18-22-Year Olds in 2040 (Gen A)

Changes in Information Behaviors Likely Evolving Along Five Key Themes over the next Five to Ten Years

Executive Summary

The way people consume, understand, and communicate information is always changing. That said, the rapidly accelerating pace of technology and subsequent changes to end-users' information behaviors are likely (55-80%) evolving along five themes: 1) the rise of artificial intelligence; 2) the growth of immersive technologies; 3) the advent of the “attention economy;” 4) the transition to mobile platforms; and 5) the increasing need for critical thinking. Over the next five to ten years, advancements along these five themes will continue to drive changes in the behaviors of end-users. The military intelligence community, despite concerns over privacy, information security, and other cyber threats will very likely (85-90%) continue to make significant investments in adopting technologies along these themes as it modernizes in preparation for a multi-domain and joint all domain operations capable force by 2040.

Discussion

The rise of Artificial Intelligence (AI) applications in the past decade, and its promise to fundamentally transform diverse sectors of industry and human society over the next ten years, will also very likely cause profound changes in the information behaviors of end-users. [H,H](#) AI is the foundational enabler of many other emerging technologies ranging from robotics and the Internet of Things (IoT) to big data and data analytics. [H,H,M,M](#)

As such, AI is the first of the five themes of evolving information behaviors as it very likely drives many aspects of the other four (See Figure 1). [H,M,M](#) As users begin to fully exploit AI's powerful ability to harness massive amounts of data, through its learned intelligence models, in a consistent and logical manner, they



Figure 1: This infographic is the work of the author using VISME.CO.

will likely gain significant efficiencies in time and tasks. [H,H,M,M](#) As a result, users will likely be able to direct their focus to more valuable, human-specific tasks, such as higher level reasoning, critical and creative thinking, and applying judgment to complex or ambiguous emerging problems. [H,H](#)

One way users may approach understanding and then solving new, complex, or emerging problems will likely be increasingly through immersive experiences. [M,H,H](#) The growth of Virtual, Augmented, and Mixed Realities, collectively known as “extended reality (XR),” all powered in part by advances in AI, offer opportunities to improve learning comprehension, retention, and the confidence of routine users (see Figure 2). [H,H](#)

As extended reality technology improves, costs come down, and more organizations integrate immersive experiences into their learning, training, or collaboration models, end-users’ expectations of how they interact with information will forever change. [H,H,H](#)

When combined with powerful AI technology, extended reality systems can offer a wide range of applications, both in private and public sectors generally as well as in the military specifically. [H,H](#) Augmented training and exercise programs, such as the Army’s recent adoption of virtual anti-tank training, or procurement of IVAS VR goggles can offer significant cost savings while reducing safety risks associated with live environment events. [H,H,H](#) Military Intelligence analysts will likely be no different. [H,M](#) Their experiences growing up with XR in schools and in their personal lives, will likely cause them to become accustomed to using similar technology when performing their assigned duties. [H,H](#)

No other information behavior change may be as apparent to a casual observer more than the third theme, which is the continued transition to mobile platforms. [M](#) As networks become more resilient and ubiquitous, computing gets more pow-

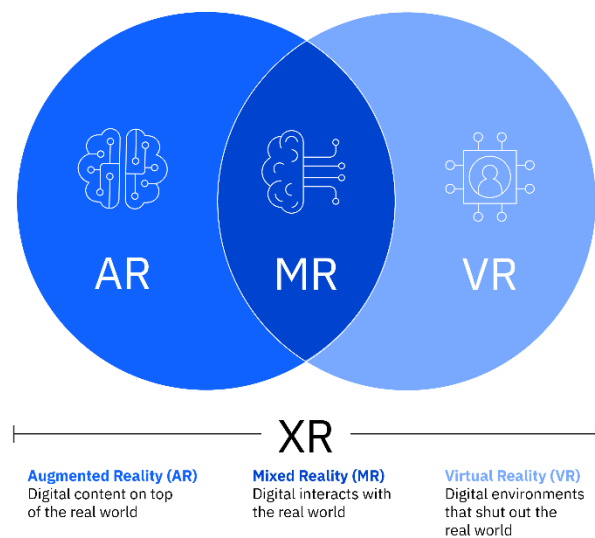


Figure 2: AR/MR/VR explanation courtesy of IBM.com through Technologies for Immersive Virtual and Augmented Reality Ready Now, Fully Integrated Environments Likely in Workplaces Before 2040, Standish 2023 [H](#)

erful, and the form factor of end-user devices continue to shrink while adding additional capability, mobile platforms are likely to become an expectation, not just a convenience. [H,H,H,H](#)

While traditionally hesitant to adopt mobile devices and platforms due in large part to very valid concerns over privacy, information security, and other cyber threats, the military intelligence community is investing in the technology to enable analysts now and in the future. [H,H](#) Commercial Solutions for Classified (CSfC) is already provided limited secure, classified capability over cellular or Wi-Fi networks to mobile devices. [H,H](#) As generations of future potential intelligence analysts grow up almost exclusively using mobile platforms, the Army will very likely have to continue to adopt such technology. According to a 2019 Pew Research study, for example, 58% of young adults, age 18-29 used their smartphone almost

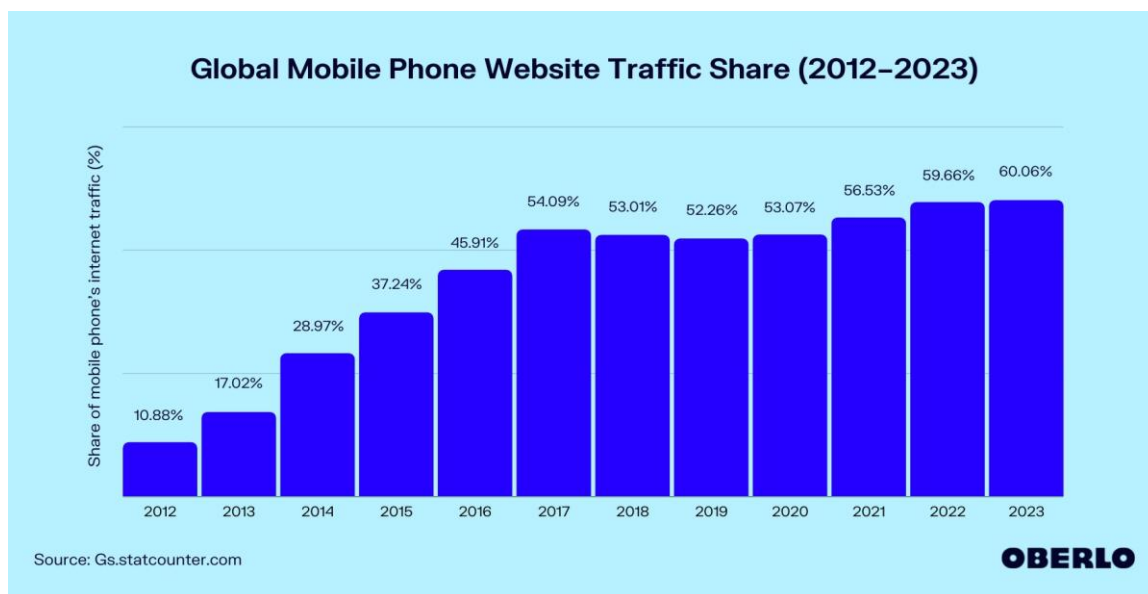







Figure 3: Mobile phone internet traffic share courtesy of Oberlo [M](#)

exclusively to access the internet. [H](#) In 2022 alone, over 60% of all internet traffic came from mobile phones, as compared to 10.8% in 2012 (see Figure 3). [M](#) The first three themes offer tremendous opportunity for users to have access to ever increasing sources of information for more sustained periods of time. As a result, the relatively new, but potentially consequential, concept of the “attention economy,” has emerged. [M](#) The attention economy, first coined by psychologist and economist Herbert Simon is the recognition that in a hyper connected world human attention is a scarce resource. [H](#) Tristan Harris, a tech ethicist and founder of the Center for Humane Technology, while serving as Google’s lead “Tech Philosopher,” went further in describing the attention economy saying it creates an envi-

ronment in which how technology engages with the user becomes more important to the survival of that technology. [M,H,H](#) It must be effective, efficient, and simple to use to be relevant and useful. [M](#)

The wealth of information sources and AI-enabled applications available has conditioned end-users to expect instant gratification or immediate positive results. [H](#) This is not to say users are not capable of focusing their attention for a long period of time on engaging technology or content. [H](#) The myth of a decreasing attention span has been continually proven through research. [H,H](#) The essential idea, however, is users have options when it comes to how they engage with information and technology. The result is how these applications compete for attention (e.g., the attention economy).

Finally, the fifth theme is educators and experts continued recognition that critical thinking is an essential skill required to navigate the digital world. [H](#) In fact, the Organization for Economic Co-operation and Development (OECD), World Economic Forum (WeF) and The Digital Quotient Institute (DQ Institute) all

 Transformative Competencies	 Future Workforce Competencies	Digital Intelligence (DQ) Competencies																							
		Digital Citizenship								Digital Creativity								Digital Competitiveness							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
 Creating New Value	Analytical Thinking and Innovation																								
	Active Learning and Learning Strategies																								
	Creativity, Originality, and Initiative																								
	Technology Design and Programming																								
 Reconciling Tensions & Dilemmas	Systems Analysis and Evaluation																								
	Complex Problem Solving																								
	Emotional Intelligence																								
 Taking Responsibility	Critical Thinking and Analysis																								
	Leadership and Social Influence																								
	Reasoning, Problem-Solving and Ideation																								
	Coordination and Time Management*																								

*Note: Top 10 Skills in-demand as of 2018, as listed in WEF's Future of Jobs 2018 Report

Figure 4: Table 28 from the DQ Institute's 2019 Global Standards Report. See Annex G for original sized image [H](#)



identify critical thinking as an “essential competency” every student requires to thrive as a digital citizen in a digital world (see Figure 4). [H,H,H](#)

Analytic Confidence

The analytic confidence for this estimate is *moderate*. Sources were generally reliable and corroborated each other. The analyst worked alone and used an unstructured method. Given the nature of rapidly changing technology and the potential for continued evolutions in AI-enabled technology the findings of this report are subject to change as new information becomes available. The analyst continued to use a variety of AI Chatbots to include Perplexity-AI, ChatGPT, The New Bing, and Unrestricted Intelligence for source prompts or to key in to follow up supporting research questions.

Author: Brandon L. Van Orden

Attention Spans in Younger Generations Unlikely to Decrease Over Next Ten Years, Despite Popularly Quoted Study

Executive Summary

Attention spans in younger generations unlikely (20-45%) to decrease over the next ten years, despite popularly quoted study. Subject and task, rather than changes in or applications of technology, impact attention spans in most neuro-typical humans. Attention spans in humans is a well-researched, but sometimes misunderstood subset of IQ in the field of psychology. Popular media and some experts continue to attribute the supposed shortening of attention spans on the frequency and duration of technology use, often citing a flawed 2015 study conducted by Consumer Insights, Microsoft Canada.

Discussion

In recent years, popular media and some technology experts have pointed to the rapidly accelerating sophistication and ubiquitous nature of AI-enabled technologies as the primary reason average attentions spans, particularly in younger generations, is shortening dramatically and will continue to do so in the future. [M](#)

Well established academic research in the field of psychology, however, continues to demonstrate the length of one's attention span is task-oriented, rather than technology oriented, meaning the capacity to pay attention

is subject dependent and can change dramatically from person to person or day-to-day. [H](#)

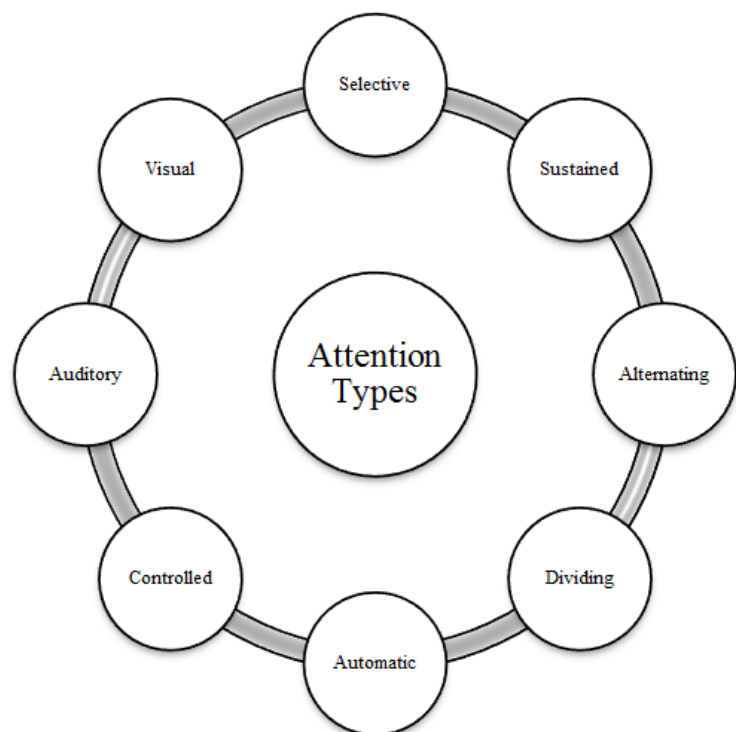


Figure 1: types can affect behaviors, research shows, but likely has no effect on humans' cognitive abilities. [M](#)

First articulated in 1973 by Dr. Daniel Kahneman, "capacity theory," posits that a human's ability to perform a task, or multiple tasks, depends on the "capacity" of

each individual task.⁹ Further, “attention,” as defined by the American Psychological Association (APA) has eight subtypes (Figure 1) that may impact voluntary and involuntary attention scope, but there is no evidence any of the attention subtypes changes the cognitive abilities of humans. [H](#), [H](#)

Many reputable media outlets, authors, and researchers have perpetuated the myth that changing technology is shortening the average attention span in humans. The New York Times, Time Magazine, the Guardian, the Telegraph, and even the seminal leadership book, “Brief” all cited the popular 2015 Microsoft Canada study that linked shortening attention spans to technology use. [M](#), [M](#), [M](#), [M](#), [M](#) Since then, various marketing firms have adopted the concept of a shortening attention span and have shaped for-profit campaigns around the same idea. [M](#) Despite Simon Maybin’s 2017 investigative work for the BBC demonstrating researchers fabricated much of the data related to attention span in the Microsoft Canada study by the contributing firm Statistic Brain, the myth persists. [H](#)

The most controversial part of the Microsoft Canada study attempted to link the ubiquitous use of technology to declining attention spans. To highlight the dramatic decline in attention spans, the study compared 2013 attention span averages (8 seconds) to that of goldfish (9 seconds) (Figure 2). In addition to evidence of fabrication, previous and subsequent research have been unable to replicate Statistic Brain’s results. In fact, some psychologists claim the very idea of attention spans is “largely meaningless.” [M](#) The Association for Psychological Science (APS), in turn, points practitioners toward the need for further research to determine how technology is changing the behaviors, rather than cognition, of habitual users. [M](#)

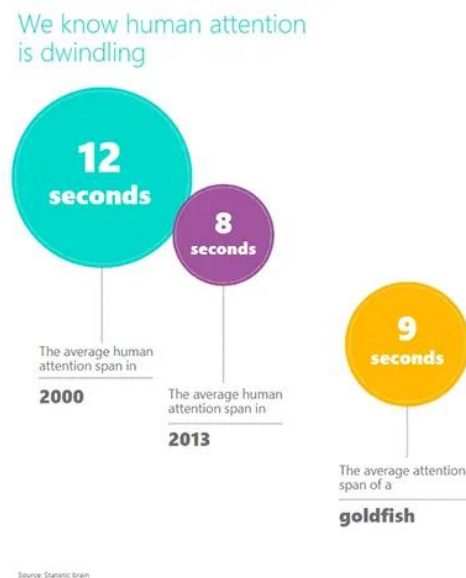


Figure 2: Developed during the Microsoft Canada study using data provided by Statistic Brain that was completely fabricated [H](#)

While the idea that a human’s connection to digital technology will cause a decrease in attention span is likely not valid, there is a growing amount of research suggesting one’s relationship with technology can change behaviors. In a recent

⁹ Daniel Kahneman, *Attention and Effort*, First Edition (Englewood Cliffs, N.J: Prentice-Hall, 1973), 73.

report from the University of North Carolina, researchers found that children, aged 10-13, who were habitual users of social media, had brain development distinct from those who rarely or never went online. [H](#) This study generally corroborates previous studies on observed behaviors. [H](#) Teens and young adults who are habitually checking social media show demonstrative differences in behaviors than those who do not. [H](#)

Analytic Confidence

The analytic confidence for this estimate is *moderate*. Sources were generally reliable and tended to fall into two main categories, sources supporting a decreasing attention span and sources refuting a decreasing attention span. Sources supporting a decreasing attention span tended to cite the debunked study from Microsoft Canada as primary or secondary reference. Sources refuting decreasing attention spans tended to be, or reference, recognized professional associations or reputable academic institutions. There was adequate time, but the analyst worked alone and did not use a structured method. Furthermore, given the complicated nature and science's understanding of how the human brain works, this report is sensitive to change as new information or research becomes available.

Author: Brandon L. Van Orden

Within Five Years, Generation Alpha likely Better Equipped to Identify Mis/Dis-information than Older Generations, Despite Young Age, Lack of Experience

Executive Summary

Within five years, Generation (Gen) Alpha will likely (55-80%) be better equipped to identify mis and dis-information than older generations. Despite their young age and relative lack of experience and education, Gen Alpha will likely be the most digitally literate, connected, and technologically comfortable generation in history. Due to these factors, coupled with an increased emphasis from their parents and educators to question and confirm what they see on the internet, younger generations will likely be better at identifying fact from fiction online than their generational predecessors.

Discussion

As Gen Alpha's oldest members begin to reach college age within the next five years, they will have been immersed in a connected, digital world since birth making them incredibly tech-savvy. [M](#) The result will be a near subconscious relationship with technology. [M](#) Likely more than any other generation, Gen Alpha will consider digital AI-enabled technologies an extension of their own human capability. [M](#), [M](#) This near ubiquitous use of digital AI-enabled technology comes with the risk for increased misunderstanding and manipulation of online information. [H](#) Despite these formidable risks, through the combination of education, technological familiarity, and willingness to challenge published information, Gen Alpha will be the best-equipped generation ever at identifying mis and disinformation. [H](#), [H](#)

Misinformation is defined as false or misleading information that is unwittingly shared, while disinformation is intentionally created to deceive or harm. [M](#), [H](#) Both pose a significant risk to nearly every aspect of society, from commercial intellectual property issues to national security challenges. [H](#), [H](#) The ability to quickly identify mis and dis-information is a critical skill that only promises to become more

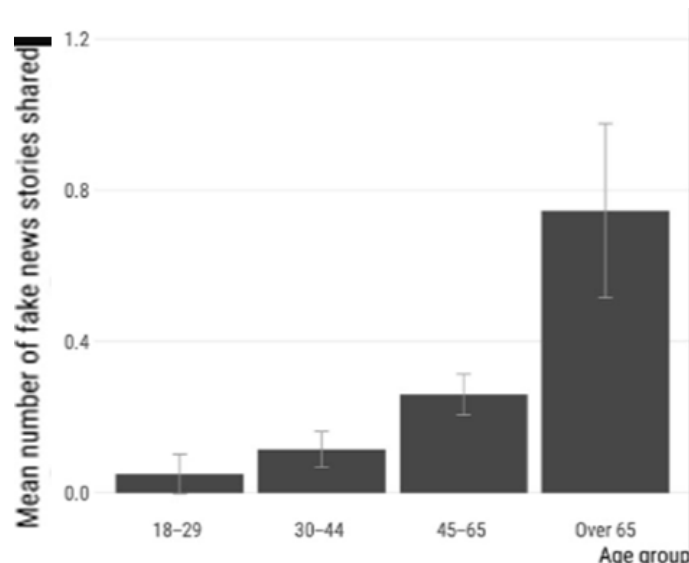


Figure 1: Princeton & NY University study associating age with the likelihood of sharing fake news: On average, users over 65 shared nearly seven times as many articles from fake news domains as the youngest age group [H](#)

important in the future. [H](#) There is already well-established literature associating media literacy, necessary for identifying information reliability, with the ability to navigate new and emerging technologies. [H](#) A recent joint study by Princeton and New York Universities took that research further, linking increased age with the likelihood to believe or share dubious information online (Figure 1).[H](#) They found that older generations were more likely to share fake news than their successively younger generations. [H](#) A compelling finding was that those over 65 years old were seven times more likely to believe and share fake online news than their 18-29-year-old counterparts. [M](#) While more research is required to better understand other factors that may influence the study's findings, such as confirmation bias, researchers have begun to forecast that future generations are positioned to continue the trend of being better at identifying mis and dis-information online. [H,H,M](#)

Critics of the study and its findings point to those other factors as more relevant indicators of one's ability to identify mis and dis-information, rather than the age or generational cohort. [H](#) While Gen Alpha is still growing, with its generally accepted bounds between 2010 and 2024, its members' biases and predilections are almost certainly not yet fully developed. [H](#) As people age, research suggests, the average person becomes less likely to accept new or divergent information and ideas. [H,M,M](#)

Gen Alpha, however, still has a few more unique advantages when it comes to identifying mis and dis-information. [M](#) As mentioned earlier, research shows that one's comfort with new and emerging technologies directly relates to their digital media literacy, a strong component of being able to identify accurate and reliable information from less reputable or biased sources. [H](#) Gen Alpha is coming of age during a technological inflection point, where AI-enabled technologies promise to change the very character of the information space. [H,H](#) Gen Alpha's understanding of and comfort with using those technologies likely puts them at an advantage in identifying accurate and reliable content. [M,M,M](#)

Further, Gen Alpha is growing up in an era of almost unprecedented distrust in media and traditional news outlets, as indicated by a recent Gallup poll. [M](#) Parents and educators are emphasizing to their Gen Alpha children that they think critically about online information and seek out disconfirming data to best understand an issue. [H,H,M](#) Recent programs in countries like the one in Finland teach children in primary and secondary schools how to best navigate non-traditional online information sources for trustworthiness and accuracy. [H](#) Factors such as these are likely to arm Gen Alpha with the critical thinking skills and online know-how to better identify mis and dis-information that they can carry with them as they age.

Analytic Confidence

The analytic confidence for this estimate is *moderate*. Sources were generally reliable but tended to disagree dramatically on the factors that indicate one's ability to identify mis and dis-information, or even the prevalence of misinformation on traditional versus non-traditional online media sources. Most sources agreed that additional research is required to best identify a range of factors influencing mis and dis-information online. Due to the time and scope of the research question, the analyst did not consider Socio-cognitive Polarization (SCP)* but acknowledges its potential impact on this forecast. As a result, this report is sensitive to change as new information or research becomes available.

Author: Brandon L. Van Orden

**Socio-cognitive polarization is a phenomenon in which people's beliefs and opinions become more extreme due to their interactions with others on social media. [M](#) It is associated with the spread of fake news, as fear of COVID-19 has been linked to seeking out and believing in false information. [M.M](#) Cognitive-motivational mechanisms are also involved in political polarization, which can lead to decreased trust in institutions and cooperation between different groups. [M](#)*

Intelligence Analysts Almost Certain to Remain the Essential Component of the Intelligence Process Through 2040

Executive Summary

Despite rapid advances in artificial intelligence (AI), machine learning (ML), and large-scale data collection technologies, it is almost certain (95-99%) that the human intelligence analyst will remain the essential component of the intelligence process in the year 2040. The Intelligence Community (IC) and technology manufacturing companies are very likely (80-95%) to pursue initiatives to replace the intelligence analyst's data processing and sorting requirements with technology by 2040. However, due to the requirements of understanding human behavior, emotions, sense-making, planning and collaboration, the analyst will remain the essential component in the intelligence cycle.

Discussion

Over the past ten years, AI has evolved from a futuristic concept to a tool used in various civilian business sectors and federal agencies. [M M](#) In the field of intelligence analysis, AI is currently employed to categorize images and efficiently sift through large volumes of data, enabling humans to identify crucial information amidst the clutter of waves of data. [M M M](#) These applications merely scratch the surface of what possible with AI. They offer a glimpse into a future where strategically implemented AI will assist analysts in extracting value from information. [M](#)

Recent global conflict and near-peer competition provides an additional stimulus for a sense of urgency across the entire U.S. IC. [M M](#) The current and future operating environment for the IC analyst is driving a focus of coupling AI and Machine Learning ML with human subject matter expertise, tradecraft, and cognitive abilities to maximize analyst forecasting abilities. [MMMM](#)

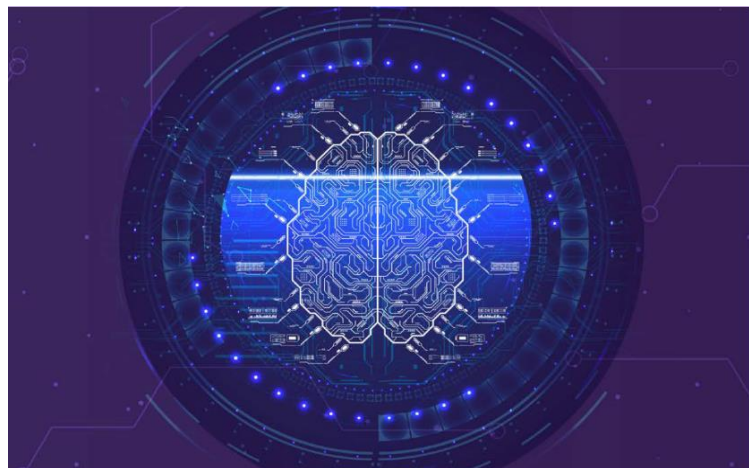


Figure 1: Deloitte Article - The Future of Intelligence Analysis [M](#)

The Washington Post has been utilizing AI to assist journalists on what the company considers more “high-value work” and implementing AI to data-collet and

create short articles on specific areas such as congressional-gubernatorial races, local area high school football scores, automate earnings coverage, and create short stories. [M](#) Digiday.com reports that in 2017¹⁰ the Washington Post produced 850 articles utilizing AI as the primary reporting and writing source, allowing the human journalist to focus on reviewing data and information and concentrate on the analysis of data and information trends. [M](#) [M](#)

Data Scientist and Astrophysicist Zigfried Hampel-Arias posits that despite the rapid advancements in AI and ML, the human analyst will remain an essential component of the intelligence process. [M](#) [M](#) [M](#) Specifically, Hampel-Arias hypothesizes that technologies will help the IC with tasks such as collection and processing large data, however the steps in the intelligence cycle such as planning, dissemination, and evaluation will remain the domain of the human analyst. [M](#)

At the heart, or more accurately, “the mind” of the discussion; professional analysts, academia, and scientists suggest that it is the unique human capacity of the analyst to perform methodical sense-making from AI collated data, which ultimately provides the true value to decision makers. [M](#) [M](#) “It is the assessment or sense-making process that yields intelligence, as opposed to raw information.” [M](#)

Carmen Medina, former CIA Deputy Director of Intelligence, and Zigfried Hampel-Arias, independently support the social behavioral science concept of “Thinking Fast and Thinking Slow” also referred to as “System 1 and System 2 Thinking”. [M](#) [M](#) Medina and Zigfried suggest that it is the technological ability of AI and ML to collect and sort large data volumes which creates valuable time dividends to the human analysts. But it is the human analysts who use experience, understanding of human behavior, and emotions to apply “sense making” tradecraft to construct and produce actionable analysis in support of decision-makers. [M](#) [M](#)



Figure 2: The Potential of Integrating Intelligence and Intuition [M](#)

¹⁰ Last published data on robot articles posted by the Washington Post

The increased efficiency and effectiveness of intelligence analysts in the year 2040 will be driven by the development of more sophisticated tools and technologies. For example, advances in virtual reality and augmented reality technologies will enable analysts to interact with data in a more immersive and intuitive manner.^M Additionally, advances in AI, ML, and natural language processing technologies will enable analysts to quickly and accurately process large amounts of data and identify patterns and trends with increased efficiency and time savings.^{M M} The Deloitte Center for Government Insights projects that due to AI driven tasks such as large data collection, labeling, and pattern recognition will yield a positive net gain of 58% for the analyst to spend more time devoted to creative, deliberate analysis, planning, and collaboration in support of useful product development for decision maker requirements. ^M

Analytic Confidence

The analytic confidence for this estimate is *moderate*. Sources were generally reliable and tended to corroborate one another but were mostly non-scientific in nature and methodology. There were competing academic requirements for time, and the analyst worked alone and did not use a structured method. Furthermore, given the lengthy time frame of the estimate, this report is sensitive to change due to new information.

Author: James R. Esquivel

Section 3: Education in 2040

Fundamental Changes in the Primary Education System Very Likely by 2030 Due to Rapidly Accelerating AI-enabling Technologies Today

Executive Summary

The emergence of powerful large language models (LLMs), the promise of augmented intelligence, and the advent of “smart” robots on the horizon will very likely (80-95%) require fundamental changes to the current primary education system by 2030. A student’s ability to know an answer immediately will likely be a less valuable skill than asking the right questions, thinking critically about the AI-provided response, and refining that response through follow-on questions to receive an optimal answer. Interactive, including gamification and scenario-based education in a hybrid virtual and physical environment, will likely test students in essential concepts such as critical thinking, critical ignoring, computational thinking, digital ethics, and others. Despite resistance from some educators with valid concerns about student development, privacy, and cost, schools will very likely embrace AI-enabled tools to establish standards and protocols for use, keeping graduates competitive in the global market.

Discussion

AI-enabled technology will very likely change the current education system by 2030. [M](#) AI-enabled technologies are already in many classrooms around the world; In Nordic countries, over 90% of primary and secondary schools are considered highly equipped and connected classrooms (HECC). [H,H,H,H](#) In the United States, over 50% of primary schools and 90% of Universities employ AI “early warning” algorithms to identify students at risk for dropping out or failing courses. [H](#) According to a January 2023 report by Global Market Insights, AI in education was a \$4 billion market in 2022, and industry experts expect it to exceed \$30 billion by 2032. [M](#) As AI-enabled technologies become more prevalent in society and the classroom, many educators, academic institutions, industry experts, and government agencies are studying the potential impacts on traditional education systems. [H,H,H,M](#)

Eight Emerging Trends in the Classroom



Figure 1: Eight Emerging Trends with AI in Education categorized along technology, skills, and responsibility themes [H](#)

One such study, conducted by Google for Education in partnership with Canvas8, identified eight emerging AI trends in K-12 (Figure 1). [H](#) The trends helped categorize not only some of the technologies needed to enable AI tools in the classroom but also some of the skills and responsibilities students, teachers, and parents may need to master to navigate an AI-enabled world. [H](#)

AI-enabled technologies could benefit everyone involved in traditional education systems, including administrators, teachers, and students. According to a poll of school district leaders in May 2020 by Education Weekly, administrators may also use AI-enabled technologies to support a variety of other tasks ranging from curriculum writing to the identification of harmful or unethical use of technology in the school (Figure 2). [M,M](#)

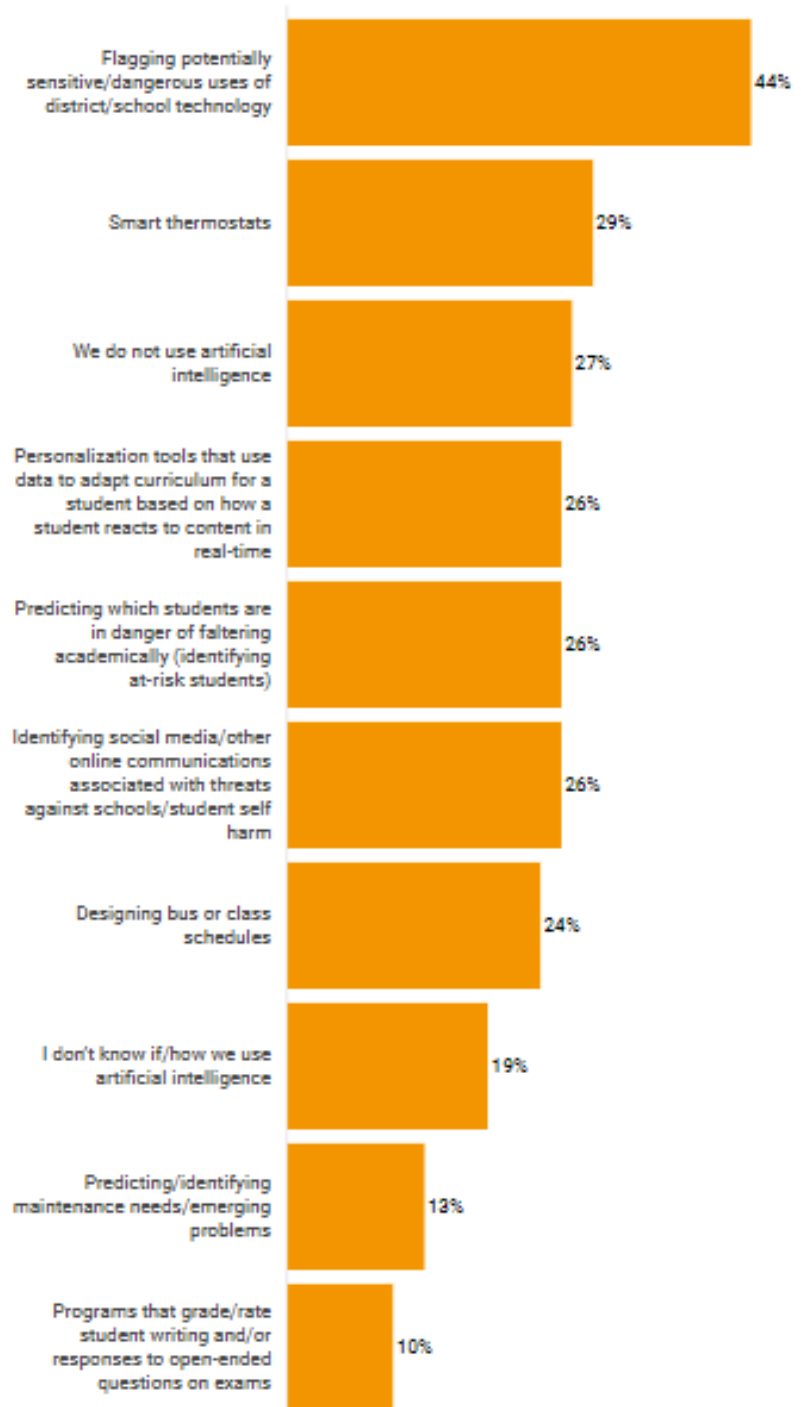
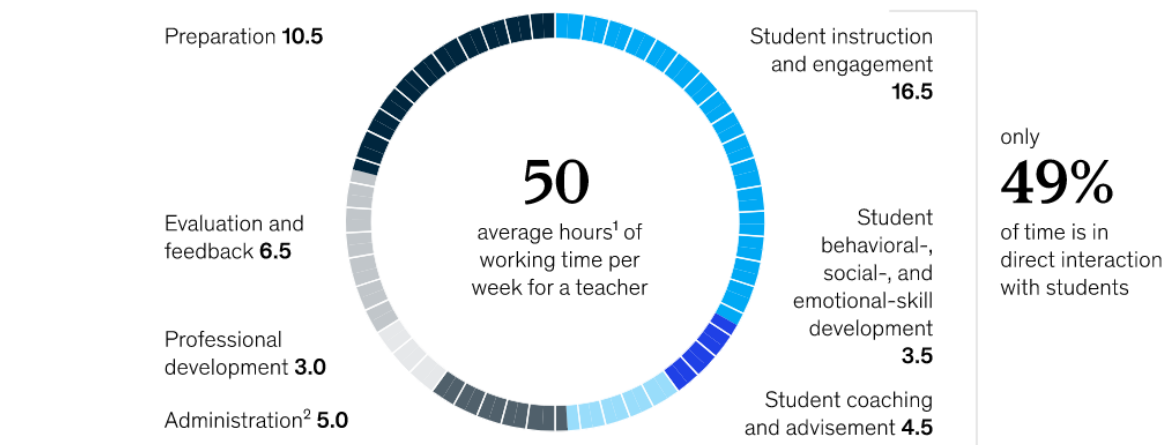


Figure 2: Ways Educators Use AI ^H

According to the global management firm McKinsey and Company, who surveyed over two thousand teachers in four countries, including the United States, teachers spend less than half their time engaging with students (Figure 3).

Teachers work about 50 hours a week, spending less than half of the time in direct interaction with students.

Activity composition of teacher working hours, number of hours



¹ Average for respondents in Canada, Singapore, United Kingdom, and United States.

² Includes a small "other" category.

Source: McKinsey Global Teacher and Student Survey

Figure 3: Activity composition of teachers ^H

The other 51% is spent preparing for class, evaluating students' work, continuing education, and other administrative functions. [M](#) Teachers will likely realize immediate gains in time savings when using AI-enabled technologies to assist with course planning, the evaluation of student's work, and other tasks that can be automated or optimized. [M,H](#)

Students will likely be the biggest benefactors of AI-enabled technology in the classroom. [M](#) They may receive tailored and interactive educational experiences with a personalized AI-enabled digital assistant that can help answer questions, fill in gaps in learning, track progress, and adjust coursework at anytime from anywhere. [H,H](#)

AI-enabled technologies may also enable the "gamification" of learning. Gamification, used in the context of education, means, broadly, to enhance learning by creating an environment and experience like that of a game. [M](#) While the effectiveness of gamification is still a subject of debate among some scholars, many research studies have demonstrated a correlation between student comprehension and retention improvements when gaming is incorporated in the curriculum. [M](#)

Other benefits to gamification may include an improved learning experience, the ability for a student to receive instant feedback, and its ability to be tailored to many subjects (Figure 4).



Figure 4: Impacts of gamification^H

One of the biggest changes to the educational system by 2030 will likely be the concepts and skills taught. Educators are focused more and more on teaching skills such as critical thinking, critical ignoring, and computational thinking. [M,M](#) Critical thinking is a well-respected concept commonly taught in schools today. [H](#) Critical thinking is, at its base, the objective review of facts without bias to form a judgment. [M](#) As AI-enabled tools in both education and society writ large become more common, it is likely critical thinking will remain an essential skill that educators must teach students. [M](#)

Critical ignoring, however, is less well known and is largely an acknowledgment that with the depth and breadth of information available in a digitally connected world, critical thinking alone is not enough. [M](#) Critical ignoring is the artful skill of quickly identifying superfluous information that is not relevant, or trustworthy. [H](#) A recent paper published in the Association for Psychological Science went so far as to call critical ignoring a “core competency for a digital citizen.” [H](#) As AI-enabled technologies promise to provide more data faster; students must develop the skill to both think objectively (critical thinking) and discern fact from fiction and relevant from interesting information (critical ignoring) when operating in a digital world. [M,H](#)

A third core competency likely to be taught in 2030 and beyond is computational thinking. [H](#) At its core, computational thinking is an analytical approach to problem-solving focusing on science, technology, engineering, and math disciplines. [M](#) Computational thinking is an iterative three-stage process of abstraction, automation, and solution. [H](#) Developed alongside computer science, computational thinking promises to be more relevant in an AI-enabled, digitally connected world. [H](#) As reported in 2018 by Australia’s independent government body Innovation and Science Australia (ISA), 92% of jobs by 2030 will require digital skills. [H](#) There is some disagreement in the academic and computer science fields on computational thinking’s application outside computer science, but regardless it will likely remain a significant skill required for 2030 and beyond. [M,H,H,M](#)

AI-enabled technologies in education do not come without risks or concerns. [M](#) One concern is that AI-enabled tools will enable students to cheat, thereby circumventing the education process and risking their development. [M](#) Another risk is security and privacy, particularly given that the students in this situation are children. [H](#) As AI-enabled technologies become more prevalent in the classroom, a student’s “digital footprint” becomes larger. [H,H](#) Much like a traditional “cyber persona,” a digital footprint can provide a signature that criminals and other bad actors can target. [M](#) When coupled with individualized AI-enabled technologies, the risk may increase. If compromised, hackers may be able to access or imitate users’ information making them more susceptible to attack or hijack. [M,M](#) Users can address these first two concerns through a combination of emphasized education and layered security. Referred to as “digital responsibility,” when introduced early and consistently enforced, educators, parents, and security experts can help students develop a healthy relationship with technology. [H](#) Students will learn from an early age how to manage risk online, becoming experts at an early age. [H](#)

Another concern is the likely upfront cost of AI-enabled technologies in education breaking along traditional socio-economic lines, further disadvantaging already marginalized populations. [H](#) While the cost early on will likely be significant, advancements in scale and production will eventually bring costs down. [M](#) In the interim, government and nongovernmental or intergovernmental organizations will likely burden share initial costs to ensure access to marginalized groups. [H,H,H](#)

Analytic Confidence

The analytic confidence for this estimate is *high*. Sources were generally reliable and corroborated with each other. The analyst worked alone and used an unstructured method. The analyst used early access to “The New Bing” ChatGPT 3.5 powered AI Chatbot. Very similar to other tools such as Perplexity, ChatGPT, and Unrestricted Intelligence, The New Bing provides eloquent and referenced responses. The New Bing did, however, appear to be able to access information after 2020, a capability the other tools do not currently have. The findings of this report are subject to change as new information becomes available.

Author: Brandon L. Van Orden

Generative AI Personalized Education Very Likely by 2030

Executive Summary

Generative Artificial Intelligence (AI) personalized education is very likely (80-95%) by 2030, despite technical limitations and data biases. Due to personalized learning content, individualized real-time feedback to learners, and the ability to analyze learning patterns and preferences, generative AI will allow educators to adapt content and teaching methods to the student's needs and abilities. Despite over a third of educators believing that Generative AI, ChatGPT, should be banned in schools and universities, most students admit to using ChatGPT. Given the increase in AI even in workspaces, integrating generative AI tools in the classroom and teaching students how to use them constructively and safely will also prepare them to thrive in an AI-dominated work environment.

Discussion

Generative AI produces or generates text, images, music, speech, code, or video by a Generative Pretrained Transformer (GPT), a type of large language model (LLM) that uses deep learning to generate human-like text. [M](#) They are called "generative" because they can generate new text based on the input received, "pretrained" because they are trained on mass text data before being fine-tuned for specific tasks, and

Timeline of images generated by artificial intelligence

These people don't exist. All images were generated by artificial intelligence.

Our World
in Data



OurWorldInData.org - Research and data to make progress against the world's largest problems.

Licensed under CC BY by the authors Charlie Giattino and Max Roser

Figure 1: Generative AI - Timeline of images generated by AI [M](#)

"transformers" because they use a transformer based neural network architecture to process input text and generate output text. [M](#) Before the onset of transformers, users had to label objects for the machine to learn. "In contrast, machines now pay attention to the most critical data features and ignore the things that are not relevant, mimicking human cognition." [M](#)

Generative AI stretches beyond text generation with ChatGPT, text-to-image programs (Figure 1) such as Midjourney, DALL-E, and Stable Diffusion, and computer engineering such as Microsoft-owned GitHub Copilot that suggests code and assists developers in autocompleting their programming tasks. [M](#)

ChatGPT can maintain a conversational style with a consistent persona or identity throughout a conversation and generate human-like responses to the prompts and questions due to ChatGPT training on conversational text from forums, chats, and social media. [M](#) For example, "ChatGPT created a concept of what a day in the life of a 2040 student might look like with integrated AI (see Figure 2):

8:15 AM – Morning Meeting *My class begins with a morning meeting, which is conducted virtually. My teacher greets us and reviews the day's objectives. We share our ideas and collaborate on upcoming projects. Our virtual meeting is facilitated by an artificial intelligence (AI) assistant, who helps to manage the discussion and provide feedback.*

9:00 AM – Core Curriculum *Our morning continues with core curriculum subjects such as math, science, and language arts. These subjects are taught through a combination of virtual and in-person instruction. The AI assistant provides personalized feedback and assessment, and we use a variety of tools such as simulations and games to help us learn.*

11:00 AM – Project-Based Learning *After a short break, we move on to project-based learning. This is where we apply our knowledge to real-*



Figure 2: What will Schools look like in 2040? AI forecasts the future of learning. [M](#)

world problems and collaborate with our peers. We have access to a variety of tools and resources, such as 3D printers, coding software, and virtual labs. Our teacher acts as a mentor, guiding us through the project and providing feedback.

12:00 PM – Lunch and Recreation Lunch is a social event, and we have access to a variety of healthy and delicious food options. After lunch, we have time for recreation and exercise. The school has a variety of indoor and outdoor spaces, including a gym, a swimming pool, and a nature trail.

*1:00 PM – **Electives and Special Programs** In the afternoon, we have time for electives and special programs. We can choose from a variety of courses, such as music, art, robotics, or entrepreneurship. We can also participate in internships, apprenticeships, or community service programs. These experiences allow us to explore our interests and develop new skills.*

*3:00 PM – **Reflection and Wrap-Up** At the end of the day, we take time to reflect on what we have learned and set goals for the future. We use digital portfolios to document our progress and showcase our achievements. Our teacher provides personalized feedback and encouragement, and we leave the classroom feeling empowered and inspired.” [M](#)*

In addition, ChatGPT can remotely collect course development needs and generate course content within seconds resulting in a future of generative AI-integrated, adaptive, personal, and collaborative learning. [M](#) Generative AI will very likely create virtual teachers that provide students with 24/7 support, allowing them to learn on their own schedule and pace. [M](#) Due to personalized learning content, individualized real-time feedback to learners, and the ability to analyze learning patterns and preferences, generative AI allows educators to adapt content and teaching methods to the specific student’s needs and abilities. [M](#) Finally, generative AI can modify text for different reading levels, translate and compose new vocabulary in different contexts, generate contrasting case examples for understanding concepts, generate writing examples, and generate assignments and assessments. [M](#)

There are risks and concerns with generative AI. Risks include the potential for cheating, plagiarism, overreliance, bias and harmful content, and misinformation. [M](#) Machines can learn the wrong thing but think it is correct,

known as hallucinations - where the deep learning model follows the wrong patterns. [M](#) Despite reinforcement learning from human feedback (RLHF), ChatGPT may respond with plausible sounding but incorrect answers, overuses certain phrases, exhibit biased behavior, and respond to harmful instructions. [H](#) Due to the risks and concerns with generative AI, educators have the role of mitigating potential harms. Given the increase in AI even in workspaces, integrating generative AI tools in the classroom and teaching students how to use them constructively and safely will also prepare them to thrive in an AI-dominated work environment after school. [M](#)

Analytic Confidence

The analytic confidence for this estimate is *moderate*. Sources were generally reliable and tended to corroborate one another. Unrestricted Intelligence, ChatGPT, and Perplexity were evaluated, and ideas from the results were utilized in further research. ChatGPT results were used as referenced in primary sources. There was adequate time, but the analyst worked alone and did not use a structured method.

Author: Nora L. Flott

GEN-A Will Almost Certainly be the Pioneers for Shaping and Advancing Computer-Gaming Education through 2035-2040

Executive Summary

There is an almost certain chance (95-99%) that Generation Alpha (GEN-A) will continue to shape the future of computer-gaming education through 2035-2040. As technology of computer-gaming education advances and proliferates, GEN-A will be at the forefront of this educational development as consumers of edtech and matriculate to become the eventual designers. Current research indicates that computer-based gaming is showing positive dividends in student creative problem-solving, critical thinking, and decision making. Despite research reporting associated negative attributes of video gaming, there is a very unlikely (05-20%) chance that educational gaming will be removed from the classroom.

Discussion

GEN-A is shaping and informing the educational systems of the future by providing instantaneous feedback to learning and technological emersion of today. This will provide an active educational laboratory to learn and adapt for the years 3035 through 2040.

GEN-A is the first generation that will arguably grow up as true digital natives, immersed in a world of technology, smartphones, and social media that was created before their birth. [M](#)[M](#)[M](#) As technology advances at an exponential rate, it is almost certain (95-99%) that GEN-A will grow with and shape computer-gaming education. [M](#)[M](#) Computer-based gaming has shown to improve cognitive skills such as creative problem-solving, critical thinking, and decision making. [M](#)[M](#) A 2021 research article published by Texas A&M University stated that classroom computer-based gaming can help students achieve the following measurable indicators: higher scores in STEM¹¹ based subjects, provide experiential learning, mature and learn from failures by competing with the gaming systems, stay engaged with the complex content for longer periods of time, and gaming makes complex knowledge fun which increases consumption and absorption of core educational fundamentals. [M](#) An additional



Figure 1: Computer-Gaming Education [M](#)

¹¹ Science, Technology, Engineering, Math

study conducted by Nottingham Trent University showed that computer gaming improved kinesthetic responses such as reduction in reaction times, improved hand-eye coordination, and raises players' self-esteem, motivation, and engagement within social activities. [M](#)

Despite studies suggesting video games can help students engage in education more effectively, there are other studies that have reported that chronic exposure to violent video games can lead to lower social empathy, emotional intelligence, addiction to violent games, and destructive behaviors. [M](#) [M](#) Despite these negative effects examined in the literature reviews, these studies indicate that the impacts of computer gaming on education vary depending on the individual and their social habitat. Therefore, it is very unlikely (05-20%) chance that computer-gaming education will yield a predominant negative impact on the learning population.

GEN-A is the newest generation; therefore, society is learning about GEN-A as they actively learn about their personal preferences and responses to a technological environmental habitat. Current data shows that GEN-A embraces and explores multiple forms of technology: 84% of GEN-A currently uses technology in their classroom, to include Kindergarten through elementary. 38% of GEN-A prefers video gaming that allows them to build or create while playing with either a single player or multiple players. [M](#) GEN-A has shown a proclivity for playing Minecraft and Roblox online with multiple teammates. These games require creativity, teamwork, and fundamental construction and engineering of structures. [M](#)

Analytic Confidence

The analytic confidence for this estimate is *moderate*. Sources were generally reliable and tended to corroborate one another but were mostly non-scientific in nature and methodology. There were competing academic requirements for time, and the analyst worked alone and did not use a structured method. Furthermore, given the lengthy time frame of the estimate, this report is sensitive to change due to new information.

Author: James R. Esquivel

Current Research Indicates Cognitive Enhancements as a Result of Video Gaming – Memory Processing and Problem Solving

Executive Summary

By the year 2035, there is a very likely (80-95%) chance, that scientific research will definitively indicate cognitive benefits such as critical thinking and information filtering are developed from playing video games. Despite current research indicating that video games improve cognitive abilities, roughly even chance (45-55%), further longitudinal scientifically based research and clinical diagnostic techniques will be required to definitively confirm cognitive benefits are derived from video gaming.

Discussion

The video gaming industry continues to exhibit rapid growth and popularity on a global scale. [M](#)[M](#) TrueList gaming statistics reports that approximately 3.22 billion people world-wide play video games, 1.3 billion people participate in online gaming, and 76% of Americans age 18 and under play video games either on a mobile phone, smart device, personal computer, or gaming console. [M](#) Despite the increasing democratization of video game players across the U.S. and globe, there remains a need for scientific longitudinal studies on the beneficial cognitive impacts of video game playing. [M](#)[M](#)



Figure 1: How Playing Video Games Affect Your Brain - Control [M](#)

Two specific recent studies (2022 JAMA study and 2014 Radboud University study) which submit that video game playing can improve cognitive functioning, attention allocation, spatial resolution in visual processing, enhanced motivation, and memory recall aptitude. [M](#)[M](#) The ages of the population within the studies ranged from 2-17 years of age, with the median age of 9.91 years in the October 2022 JAMA -Adolescent Brain Cognitive Development study. Of particular interest, these age ranges are inclusive of today's digital natives, GEN-Z and GEN-A, which comprise the largest demographic population (58%) of U.S. video game players today. [M](#)[M](#)[M](#)

The 2022 JAMA study utilized tasked based functional resonance imaging (fMRI) to diagnostically isolate blood oxygen level-dependent (BOLD) signals within the brain. [M](#) This particular type of brain imaging facilitates the researcher's ability

to accurately locate isolated and grouped blood flow activity within regions of the brain that are responsible for memory recall, emotional responses, and visual-kinesthetic response. Despite the ability to accurately analyze and visualize blood flow, the researchers recommend further research with larger population sample sizes to validate their results and working hypothesis of video gaming cognitive benefits. [M](#)

The Radboud University study relied upon comprehensive literature reviews to formulate their video gaming cognitive benefits hypothesis. [M](#) This study highlights the difficulty in differentiating a comprehensive taxonomy in modern day gaming due to the diversity in gaming platforms (e.g., smart phone, PC, gaming consoles) and the ability to play with multiple players or as a single player. Therefore, the researchers elected to simplify the effective categories into two distinct genres along two dimensions: the level of complexity and the extent of social interactions while playing the game. [M](#)

The results of this literature review indicate that cognitive benefits are appreciated in single shooter games and multiple player shooter games. The researchers submit that these video games enhance the player's spatial skill attributes and problem-solving abilities, because the player(s) are learning to problem solve through trial and error and collecting experiential evidence through experimentation rather than a linear didactic manual format instruction. [M](#) Despite these optimistic cognitive findings, the researchers posit that further scientific studies need to be performed to validate the hypothesized cognitive benefits gained from video games.

In October 2020, the World Health Organization (WHO) officially classified the diagnosis of "gaming disorder", under the International Classification of Disease (ICD). The WHO characterizes the diagnosis as people with impaired control from gaming which leads to priority of gaming over daily activities despite negative consequences. [M](#) Despite the small sample population officially diagnosed, the WHO submits gamers and parents should be aware of the amount of time devoted to gaming, especially when it excludes other daily activities, as well as any changes in physical or psychological health and social functioning behavior. [M](#)

Further scientific research is warranted in order to study the effects of cognitive abilities secondary to playing video games. The World Health Organization (WHO) suggests that much of the current research lacks a grounded scientific physiological and psychological approach. Researchers indicate that when studying this field of cognitive benefits, the control and attention to variables such as

content of the game, composition of the game, dynamics of the game are key variables to determining the throughput of cognitive benefits of video gaming. [M](#)

Analytic Confidence

The analytic confidence for this estimate is *moderate*. Sources were generally reliable and tended to corroborate one another but were mostly non-scientific in nature and methodology. There were competing academic requirements for time, and the analyst worked alone and did not use a structured method. Furthermore, given the lengthy time frame of the estimate, this report is sensitive to change due to new information.

Author: James R. Esquivel

Tech-Driven Gamification Likely to Improve Education Through Gaming Experiences for Future Generations

Executive Summary

Due to the popularity of electronic gaming, gamification is likely (55-80%) to improve the learning experience and change the character of how we learn 10-15 years in the future. Despite knowing that gamification benefits learning, barriers such as lack of resources and time prevent it from fully integrating into formal education. [HH](#) Future teachers will likely shift the gamification paradigm and fully integrate gaming into education.

Discussion

Gamification combines game elements and design to motivate and stimulate to enrich the learning experience. This process creates immersive learning experiences that are more engaging and effective than traditional methods. [HHHH](#) Gaming and gamification are closely linked to each other. According to Gerald Christians, wrote in his thesis for the University of South Carolina, that gaming is typically focused on just the game, while gamification is outwardly focused. Gamification extends games beyond the “just playing the game” and moves the purpose towards outward integration, such as education or persuasion. [HH](#)

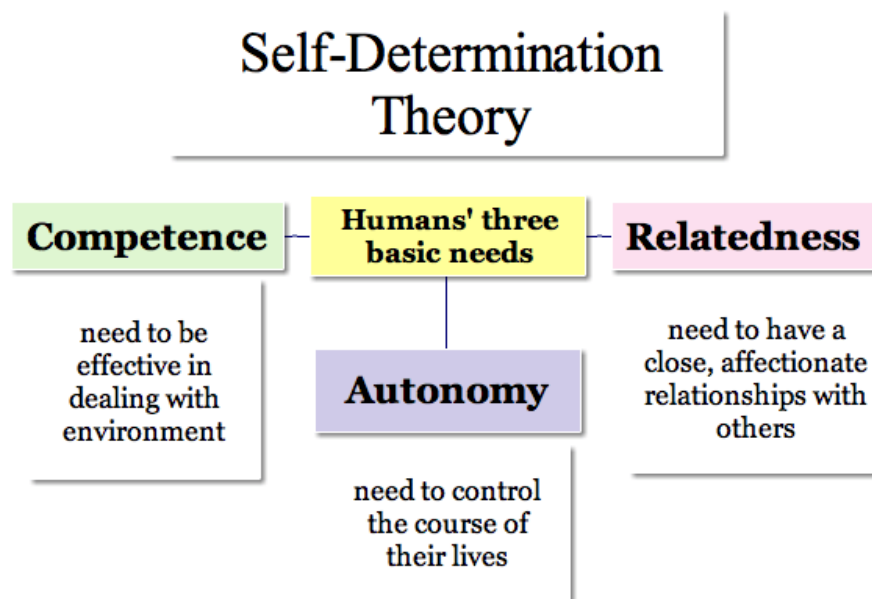


Figure 1: Self Determination Theory [M](#)

The effects of gamification provide motivation, performance measures, and engagement. [HHH](#) Gamification, when properly designed, ensures that students and teachers reach their desired educational objectives. Courtney E. Ackerman, a researcher and evaluator of mental health programs for the state of California, describes this as the Self Determination Theory Model (SDT), linking motivation with personality to optimize learning. [M](#) The SDT model (Figure 1) imbued with a points, badges and leaderboards (PBL) system coupled with game mechanics, dynamics and aesthetics ensure students remain engaged with their assigned task(s). [H](#) An experiment on the effects of gamification on task performance demonstrated that gamified users provided almost 50% better quality deliverables than the control group. [H](#)

Gaming is an essential element of Gen Z and Generation Alpha. Gen Z spends 12% more-time gaming than earlier generations. [M](#) Figure 2, from Rapid TV News, illustrates the difference in gaming between Gen Z versus Millennials and older generations. [M](#) A Generation Alpha trend suggests that 38% of Gen Alpha gamers prefer to play video games that help them to build or create. [M](#) The increased use of digital technology across future generations is likely to enable full integration of gamification into education.

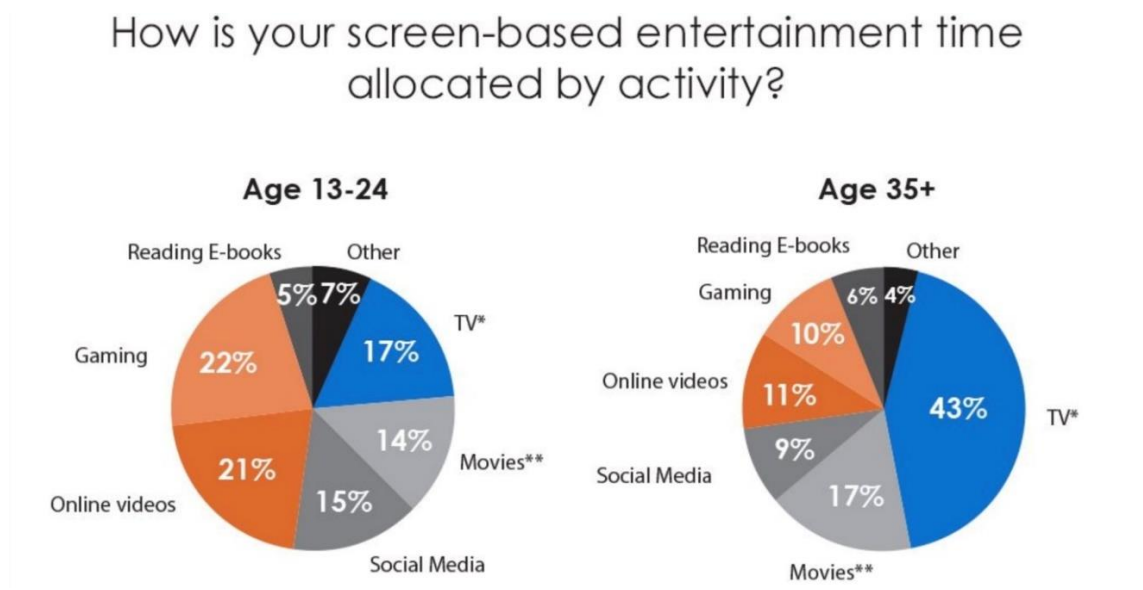


Figure 2: The gaming difference between Gen Z, Millennials, and older generations [M](#)

The trend towards increased digital use bodes well for the future of gamification in the classroom. Alan Gershenfeld, Co-Founder/President of E-Line Media, wrote that teachers with gaming experience are more adept at integrating gaming into the classroom. [M](#) A recent study found that in-service teacher technology knowledge is more important than the availability of digital technology when ap-

plying technology to digital learning. [M](#) The same study recommends that pre-service teaching education programs should provide more theoretical and practical gaming experiences and how to incorporate them into the future classroom. [M](#)

Emergent technology enables better integration of gamification into the education sphere. According to Raja and Nagasubramani, from the University, Karapakkam, Chennai including emergent technology increases student learning and interactivity. [H](#) The classroom of the future is likely to benefit from AR, AI and Intelligent Virtual Assistants (IVA).

Reactive chatbots driven by AI provide a voice framework for learning and continuous feedback to guide students through the education process. [H](#) This includes how we interact with current and future virtual assistants.

Virtual assistants are a conversational interface for students to interact with educational content. These assistants can answer questions, provide feedback, and offer suggestions for further learning based on the student's interests and preferences. Virtual assistants can also be used to create interactive games that teach new concepts or reinforce existing knowledge. [M](#) A recent one-year foreign language learning study demonstrated that the integration of intelligent virtual assistants (IVAs) with gamification aspects (achievements and leaderboards) provided a better learning outcome than the non-IVA users. [M](#)

The digital gamification experience is crucial to the future classroom. However, barriers exist that prevent the inclusion of emerging technologies into the classroom. Common barriers include lack of resources, access, time, support, reliability, and expertise. [HH](#) Asha Pandey , former Founder and Chief Learning Strategist at EI Design, notes that many educators believe that gamification provides fun in the classroom but does not translate into learning objectives. Her diagram (Figure 3) illustrates the opposite. The combination of different learning techniques, coupled with gaming designs, enables an enhanced learning experience. [M](#)

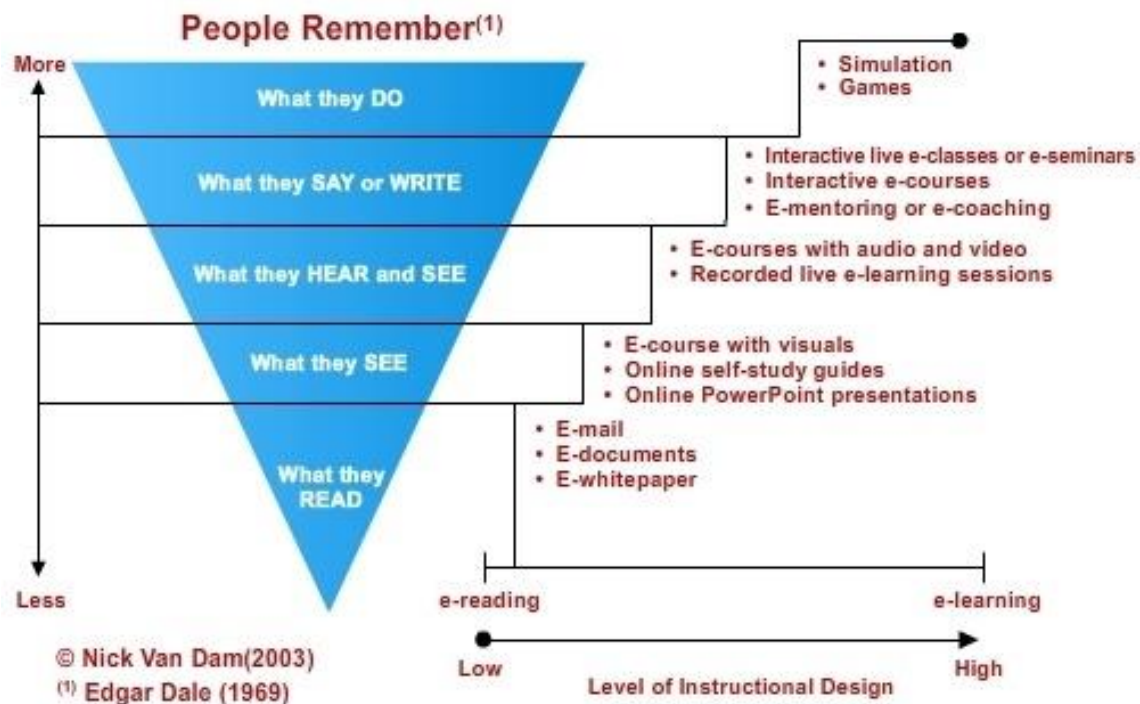


Figure 3: Integration of learning techniques and game design [M](#)

Analytic Confidence

The analytic confidence for this estimate is *moderate*. Sources were reliable and corroborated with one another. This report was generated using the author's analysis and AI (Chat GTP, Perplexity, Unrestricted Intelligence, and Elicit) to help develop a framework and identify resources. All AI provided resources were verified to ensure validity. This report is subject to change based on new information gathered and analyzed through more detailed, collaborative research.

Author: Derek R. Baird

Experiential Learning through VR/AR Technologies will likely Impact Cognitive Behaviors of Intelligence Analysts within the next Five Years

Executive Summary

Recent studies demonstrating the benefits of experiential learning through VR/AR applications, coupled with advancements in technology that improve end user experience and increase access to more students will likely (55-80%) drive transformational change in traditional education. Despite security, privacy, social-cognitive, and socio-economic concerns, educational institutions will very likely (80-95%) continue to increase VR/AR applications into their programs. As a result, primary school students of today will likely grow up intuitively leveraging VR as part of their educational experience. As they mature through the educational system, these VR/AR experienced students will very likely become adults whose cognitive behaviors have changed the way they understand, remember, judge, and problem solve.

Discussion

Historically, educational pedagogies have not kept pace with technological advancements. [H](#) The COVID -19 pandemic, which erupted in the middle of an evolution in AI-enabled technologies, forced educators around the world to accelerate the integration of virtual, augmented, and remote tools to support learning. [H](#) While probably inevitable before the pandemic, the VR/AR in education market, valued at just \$656.6 million USD in 2018, has realized significant gains since classes reconvened and experts expect it to reach \$13.0892 billion USD by 2026. [M](#) At the same time, studies conducted before, during, and after the pandemic continue to show the benefits of experiential learning through VR/MR hybrid practical curriculums. [M](#), [H](#), [H](#)

In fact, an extensive 2021 study by the World Bank in partnership with the Korea World Bank Partnership Facility conducted 91 experiments across 29 countries examining the effect of VR on students' learning and development skills. Some of study's most significant conclusions include students who incorporate VR into their learning environments report a 20% higher confidence rate, show a 30% increase in socio-emotional skills assessments, and are 30% more efficient in the use of their time than students in a traditional classroom. [H](#) Potentially the most surprising outcome was that, for every additional hour of training in a VR environment, students score 3% higher on technical/cognitive assessments than students in a traditional setting studying the same content. [H](#)

Additionally, the World Economic Forum’s (WEF), “*Education, Skills, and Learning*,” global issue, curated by the Technical University of Munich, identifies VR/AR as key link under Education Innovation and its ability to transform education globally. [H](#) Through WEF’s partnership with VirtualiTeach, a non-profit educational consulting firm, they identified 10 key potential benefits to VR in education (Figure 1).

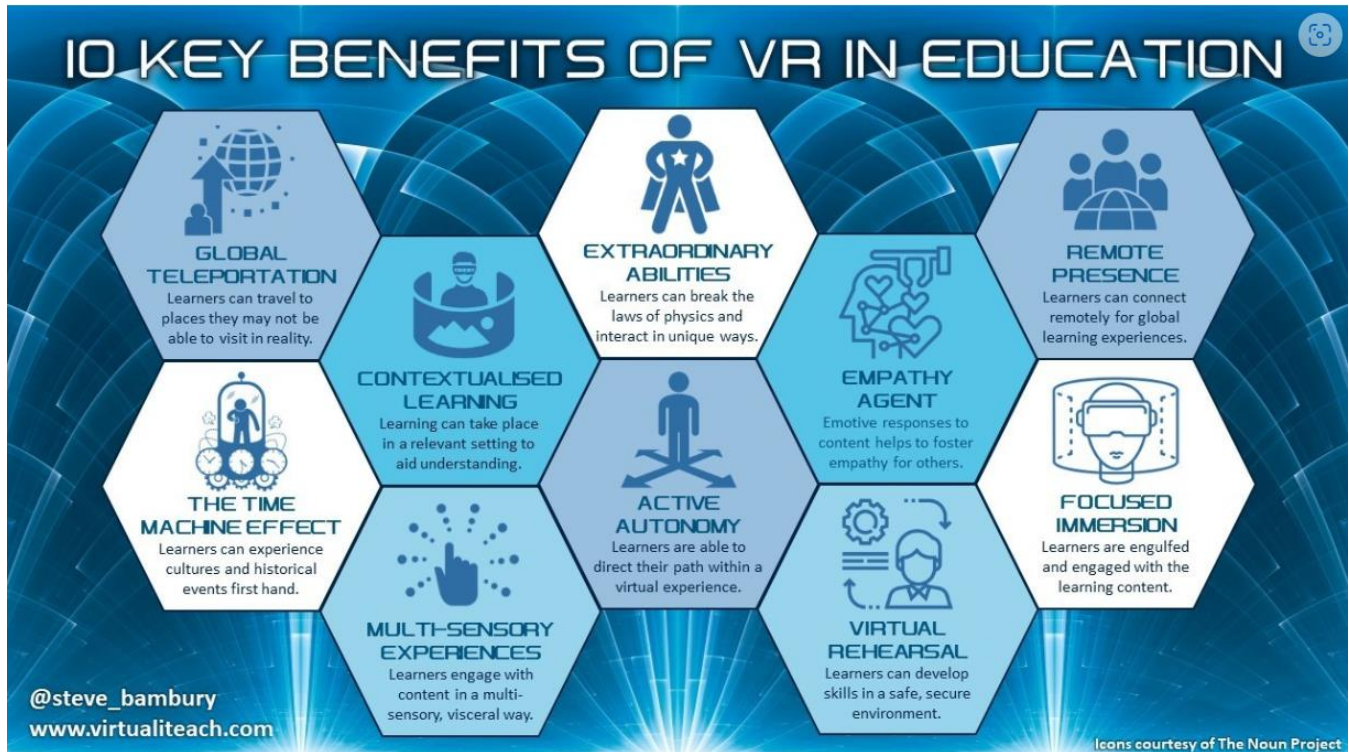


Figure 1: 10 Key Benefits of VR in Education, courtesy of VirtualiTeach. [M](#)

In addition to some of the potential benefits of VR/AR in education, as the technology grows more ubiquitous in both education and life in general, it is likely that users’ cognitive behaviors will begin to change. [M,H](#) Doctors are already using VR technology to treat a range of mental, emotional, or psychological ailments, many aimed at changing the behaviors at the root of the patients’ challenges. [H,H,M](#)

Forecasting these behavior changes and how they may affect military intelligence analysts in 2040 can be challenging. Given the likely broad implementation of VR/AR technology in education, however, one can attempt to make initial assessments. Currently, 65% of teachers in the United States use digital technology in the classroom every day to support learning, while 93% said they were excited to use VR now or in the future. [H](#) Using those two numbers as the low (65% of teachers currently using and comfortable with digital technology) and the high (93% of

teacher excited to use VR) and assuming VR/AR continues to increase at its projected rate, it is likely that between 65 and 93% of teachers will adopt VR/AR as it becomes available. As a result, it is likely that between 65 and 93% of Army recruits in the future will have experience with and be comfortable using VR/AR to learn and interact with information. It is also very likely that these recruits will have the same cognitive behavior changes as others of similar demographic groups who use VR/AR regularly.

The use of VR/AR in education is not without risk, particularly parents' and educators' concerns that VR/AR may encourage isolation with its users. [H](#) Despite these concerns, VR/AR tools are no different than other digital technologies and their risks can be managed through the development of standards and education. [H](#) Much like Intelligence Quotient (IQ) helped experts and society understand one's ability to reason or problem solve and Emotional Quotient (EQ) helped measure how one manages their emotions and the emotions of those around them, Digital Quotient (DQ) promises to assist educators prepare children to be digital citizens. [M,M,H](#) (Figure 2).

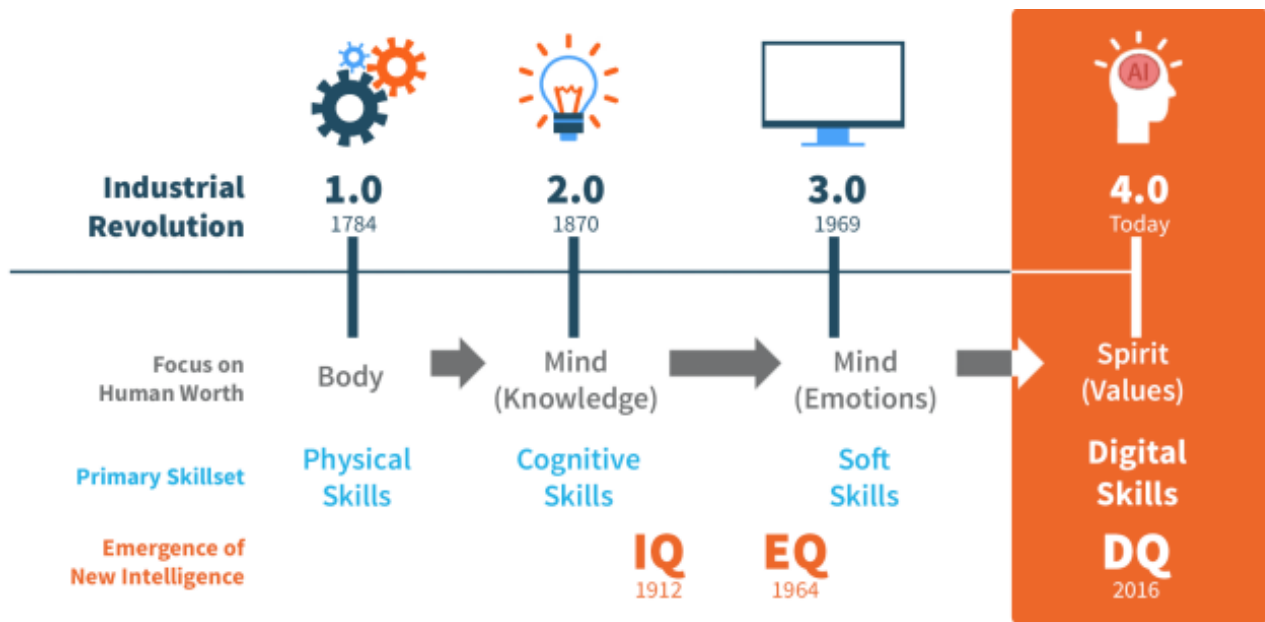


Figure 2: IQ, EQ, and DQ evolution according to Dr. Yuhyun Park of the DQ Institute [H](#)

The DQ institute, an international non-profit think tank whose mission is to set, “global standards for digital intelligence” has identified eight digital citizenship skills children need in the digital age. [H,H](#) (Figure 3).

Early evidence suggests that the use of VR/AR in education helps improve students emotional-cognitive skills, a key area and skill of DQ.[H.H](#)



Figure 3: Eight Digital Skills Every Child Needs According to the DQ Institute [H](#)

Analytic Confidence

The analytic confidence for this estimate is *high*. Sources were generally reliable and corroborated each other. The analyst worked alone and used an unstructured method. Given the nature of rapidly changing technology and the potential for human bias to play an outsized role in how the United States educates its children, the findings of this report are subject to change as new information becomes available. The analyst continued to use a variety of AI Chatbots to include Perplexity-AI, ChatGPT, The New Bing, and Unrestricted Intelligence for source prompts or to key in to follow up supporting research questions.

Author: Brandon L. Van Orden

Collaborative Tools Enhanced by AI Likely to Improve Cognitive Processes of Students and Analysts Over the Next Ten Years

Executive Summary

The core cognitive processes that benefit college students and analysts are unlikely (20-45%) to change by 2040. However, over the next ten years, advanced technology is likely (55-80%) to revolutionize the development of cognitive processes in both college students and analysts and very likely (80-95%) to further improve by 2040. With the development of sophisticated algorithms and machine learning techniques, students will be able to access personalized learning experiences that adapt to their individual strengths and weaknesses. This will enable them to develop the cognitive processes of critical thinking, problem-solving, and analytical skills at a much faster pace. Similarly, analysts will be able to harness the power of advanced technology to analyze vast amounts of data, uncover hidden patterns and insights, and make better-informed decisions. There is a roughly equal chance (45-55%) that these trends will lead to analysts who are more specialized than generalized in the future.

Discussion

The assessment of student progress and prediction of future academic success relies heavily on measuring cognitive functions. [H H H](#) Universities use various methods, such as standardized tests, cognitive ability tests, performance assessments, self-report measures, and neuropsychological tests, to measure cognitive functions. [H](#) Improvements in cognitive functions can lead to improved cognitive process which are important to student academic success and produce intellectual analysts in the workplace. [M H](#) The Flynn effect, which suggests that intelligence test scores tend to increase over time, demonstrate improvements in cognitive processes among students and analysts. [H](#) Despite its slowdown (and possible reversal in the United States) in growth, the Flynn effect may be partly driven by improvements in education and the availability of educational resources, suggesting that the increasing use of advanced technology and collaborative tools in education

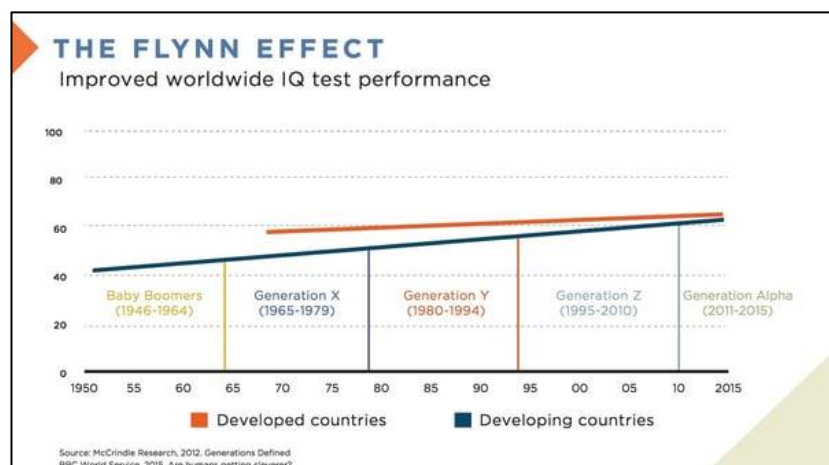


Figure 1: The Flynn Effect [M](#)

and the workplace could contribute to further improvements in cognitive abilities. [H H M M](#) Advances in technology and changes in educational approaches have influenced the development of cognitive functions and processes over the last twenty years. [M M M H](#) Advanced technology is very likely (80-95%) to further enhance cognitive skills and processes through online tools, games, and simulations, among other strategies.

Advanced technologies such as artificial intelligence (AI), specifically machine learning and natural language processing have already transformed how analysts and college students work, learn, and think. [M M](#) The use of these technologies is very likely (80-95%) to become even more widespread and sophisticated over the next ten years, leading to new breakthroughs in cognitive processes. In today's environment, the most important cognitive processes for young college students and people entering the workplace are: analytical thinking and innovation; active learning and learning strategies; complex problem-solving; critical thinking and analysis; creativity, originality, and initiative; leadership and social influence; technology use, monitoring, and control; technology design and programming; resilience, stress tolerance, and flexibility; and reasoning, problem-solving, and ideation. [M](#) According to the Organization for Community and Economic Development (OCED), the most important cognitive processes for the workplace of 2030 are critical thinking, creative thinking, and metacognitive processes such as learning-to-learn and self-regulation; all of which can be enhanced by technology. [H M](#)

Collaborative tools and platforms have become increasingly sophisticated and enable teams to work more efficiently and effectively regardless of their location. [M](#) Cloud-based collaboration platforms like Microsoft Teams, Slack, or Google Workspace allow for real-time communication, file sharing, and project management. [M](#) Video conferencing tools like Zoom, Skype, Microsoft Teams, Webex Meetings, Google Meet, and others facilitate remote collaboration and face-to-face interaction. [M M](#) Project management tools like Trello or Asana help organize tasks and track progress. [M](#) Collaboration software for document editing and sharing like Google Docs, Dropbox Paper, Microsoft 365, Zoho WorkDrive, and Notion enable multiple users to work on the same document simultaneously. [M](#)

Furthermore, virtual whiteboarding tools like Miro, Mural, Lucidspark, ClickUp, InVision Freehand, Klaxoon, and Stormboard facilitate brainstorming, ideation, and collaborative problem-solving. [M](#) Internet based tools, developed by their user base, like discord have become powerful collaborative tools for gaming, content creation, and problem solving that provide cloud-based collaboration, video

and voice conferencing, project management, and whiteboarding all on one platform. [M](#) These collaborative tools enhance cognitive processes such as creativity, critical thinking, and adaptability, and will allow AI enhancements as they become available. [M](#)

In terms of critical thinking, AI can assist in analyzing complex information and evaluating arguments. [H](#) For example, AI-powered systems can help identify patterns and correlations in large datasets, or even predict potential outcomes of a decision. [H](#) However, humans are still needed to make informed judgments based on this information and to consider multiple perspectives and potential outcomes. [H](#)

To enhance creativity, AI can be used to generate new ideas, identify patterns and trends, and explore alternative solutions to problems. [H](#) [M](#) For example, AI-powered creative tools such as Adobe Sensei or IBM Watson can analyze vast amounts of data to generate new ideas, or even suggest improvements to existing designs or creative work. [M](#) However, humans are still needed to evaluate and select the best ideas, as well as to provide the context and cultural understanding necessary for creative work. [H](#)

AI can assist with metacognition skills like learning to learn and adaptability, AI can assist in learning and development by providing personalized recommendations and feedback based on individual performance. [H](#) For example, AI-powered learning management systems can track individual progress and provide targeted feedback to improve learning outcomes. However, humans are still needed to integrate this feedback and make decisions based on their own goals and values. [H](#)

By 2040, there will likely (55-80%) be an increased focus on transdisciplinary skills that integrate knowledge from multiple disciplines. [H](#) [M](#) Transdisciplinary skills require a higher level of creativity, innovation, and collaboration, as well as an ability to think across cognitive processes and beyond disciplinary boundaries. [H](#) Additionally, as technology continues to advance, there will be a greater need for individuals who are able to work with emerging technologies, such as artificial intelligence and virtual reality. [M](#) By 2040, the workplace and colleges are likely (55-80%) to be almost entirely virtual, with advanced technologies such as VR, AR, and XR providing immersive and realistic work and learning environments. [H](#) Cognitive processes such as critical thinking, creativity, and innovation may become more critical as automation takes over more routine tasks, and workers and students need to focus on tasks that require human intuition and insight. [M](#) [M](#) The use of AI-powered tools may become ubiquitous, enabling workers and students to complete tasks that are currently beyond their capabilities. [M](#) [M](#) Collaborative

tools may become even more integrated into the work and learning processes, allowing for seamless collaboration and communication among teams and individuals.

All these techniques and tools are likely (55-80%) to apply to students and military analysts, where soldiers, analysts, and academics may need to work together to solve complex problems. The question of whether students and analysts will become more specialized or generalized in the future is difficult to answer definitively. [H](#) On the one hand, the increasing complexity and sophistication of many fields may lead to greater specialization among students and analysts. [M](#) On the other hand, the increasing interconnectedness of different fields and the need for individuals to collaborate across disciplines may lead to greater generalization among students and analysts.¹² [H](#) Ultimately, the extent to which students and analysts become more specialized or generalized may depend on a variety of factors, including changes in technology, education, and the job market. [H](#)

Analytic Confidence

The analytic confidence for this estimate is moderate. Sources were generally reliable and tended to corroborate one another. There are numerous meta-analyses that demonstrate the benefits of technology on education, collaboration tool benefits are largely based on anecdotal evidence, and projections are based on general understanding of market projections for the workplace. ChatGPT, and Perplexity were tested, and ideas from the results were utilized in furthering research; however, content inclusion was limited due to sources not aligning with the subject. There was adequate time, but the analyst worked alone and did not use a structured method.

Author: Tyler J. Standish

¹² Epstein, David J., 1980-. 2019. *Range: Why Generalists Triumph in a Specialized World*. New York, Riverhead Books.

AI-enabled Educational Assessment Tools Not Likely to Replace Standardized Aptitude Tests within Next Ten Years, Despite Significant Benefits to Other Areas of Learning

Executive Summary

Despite the demonstrated benefits of incorporating AI-enabled technologies into academic curriculum, human bias, current federal laws, and limitations in AI's ability to assess critical and creative thinking skills make it unlikely (20-45%) that AI-enabled assessment tools will replace traditional standardized aptitude testing within the next ten years. While AI may not replace standardized testing, it is very likely (80-95%) that AI-enabled technology will increasingly facilitate continual diagnostic and formative assessments. This will in turn likely (55-80%) help teachers track students' comprehension of assigned content, identify gaps in curriculum and tailor educational experiences to meet student needs. Absent reform, the potential dilemma created by a system that leverages AI to facilitate learning comprehension while at the same time requiring students to score well on memorization or multiple choice-based testing to enter into advanced programs (e.g., universities or military service) risks screening out otherwise qualified candidates whose cognitive abilities may exceed their test taking skills.

Discussion

Well established research has demonstrated that standardized testing, despite its inherent and demonstrated bias, can be an effective measure of a student's comprehension as well as their academic or vocational potential. [H,H,M,M](#) Beginning in the 1970s, for example, Congress mandated the military departments conduct significant research on the effectiveness of the Armed Services Vocational Aptitude Battery (ASVAB) and its ability to accurately assess recruits' potential success in the military. [H](#) The primary result was the Joint-Service Job Performance Measurement Project which found, in short, that the ASVAB is an effective tool to estimate a potential recruit's success in an assigned occupational specialty. [H](#)

Subsequent research, however, has continually demonstrated the ASVAB is not without bias. [H](#) Males tend to score marginally higher than females. [H](#) White or

Caucasians generally score higher than Hispanics or African Americans. [H,H](#) Researchers broadly agree score differences on all standardized tests, to include the ASVAB, SAT, and ACT are not the result of cognitive ability differences along ethnic or gender lines, rather they are likely caused by testing and educational access bias, especially those caused by socio-economic disparities (Figure 1).

[H,H,M](#) Similar results were found in other widely accepted aptitude tests such as the federally mandated standardized testing in elementary and high schools as well as college entry exams like the SAT or ACT. [H,H,M](#)

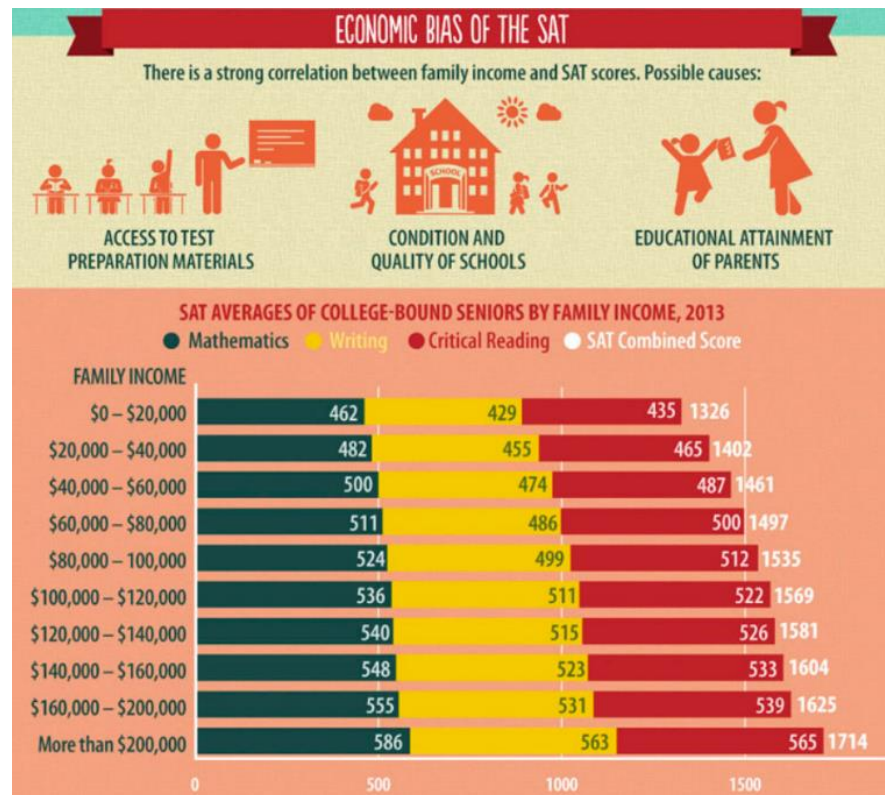


Figure 1: Household Income, often an indicator of access to quality primary and secondary education, play a significant role in some standardized test scores [M](#)

AI-enabled technologies, on the other hand, promise to change the way educators teach, assess, and track student comprehension in schools. [H](#) AI can facilitate concepts such as “stealth assessments,” as coined by educator Valerie Shute in 2005, that offers continuous and rich evaluation content that is woven into coursework and often invisible to students, either through games or interactive media. [H,H](#) While the Army has not yet adapted such gamification concepts in

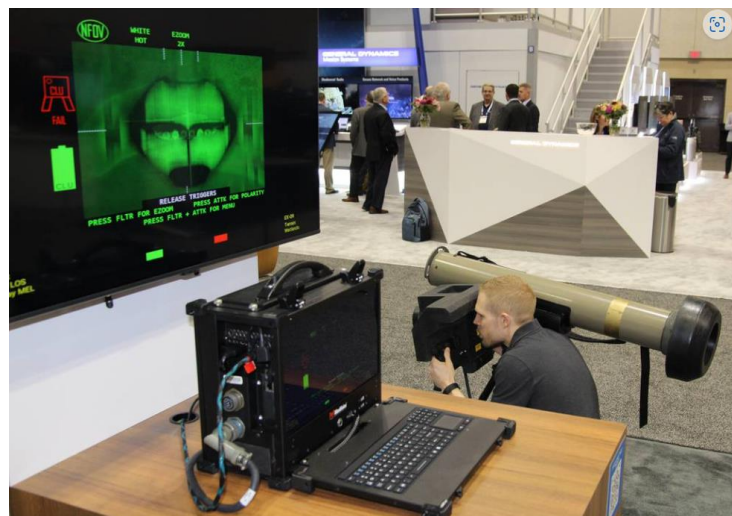


Figure 2: The U.S. Army will use video game platform “Fortnite” to augment Anti-Tank training [H](#)

its entry level aptitude tests, it is increasingly using gaming for augmented cost effective training (Figure 2).^M Teachers can also use AI to develop Intelligent Tutoring Systems (ITS), or educational models tailored to individual student needs and interests. ^{H,M} ITS can help with not only teaching, but also incremental assessments and testing as well. ^H

What AI cannot currently do, however, and its unlikely to be able to do within at least the next ten years, is assess a student's critical and creative thinking skills. ^{M,M,M} In fact, when the author discussed this topic with Microsoft's "The New Bing," the AI chatbot found it "unlikely" AI would replace standardized testing for a variety of reasons, one of which is its inability to assess or evaluate a student's critical and creative thinking skills. The New Bing stated, "It is important to note that AI-based machines are fast, more accurate, and consistently rationale, but they aren't intuitive, emotional, or culturally sensitive." The New Bing went further to say, essentially, that while AIs can be logical, they do not think critically in that they cannot "root out the true nature or facets of problems." Finally, The New Bing acknowledged that AI is not a "creative thinker" as "exceptional creative thinkers are people who create new solutions to existing problems that do not rely on past or current solutions." Throughout the discussion, the New Bing hypothesized, with the author, that AI was more likely to augment, rather than replace, traditional standardized testing.¹³

Even if AI-enabled technology develops in a way to conduct all aspects of assessment, several other hurdles still exist before those applications could replace standardized testing. Current federal law, first through the 2001 "No Child Left Behind," Act (NCLBA) and then its replacement "Every Student Succeeds," Act (ESSA) of 2015 mandates all 91,000 publicly funded school districts in the United States conduct standardized testing annually in grades 3-8 and once in high school. ^{H,H} As currently written, ESSA does not address alternative testing or evaluation methods beyond standardized testing. ^H Given many public schools depend on ESSA funding, which exceeded \$18 billion USD in the FY23 federal budget, and is still largely tied each district's standardized test results, schools are unlikely to adopt alternative assessment models without significant changes to federal law. ^H

¹³ The concepts and ideas in this section are largely the result of a dialogue between the author and Microsoft's "The New Bing" on 9 and 10 April 2023. The New Bing identified AI's likely inability to assess students' critical and creative thinking skills.

Analytic Confidence

The analytic confidence for this estimate is *moderate*. Sources were generally reliable and corroborated each other. The analyst worked alone and used an unstructured method. Given the nature of rapidly changing technology and the potential for human bias to play an outsized role in how the United States educates its children, the findings of this report are subject to change as new information becomes available. The analyst continued to use a variety of AI Chatbots to include Perplexity-AI, ChatGPT, The New Bing, and Unrestricted Intelligence for source prompts or to key in to follow up supporting research questions.

Author: Brandon L. Van Orden

By 2040, AI-Integrated, Personalized, Continuous Learning Very Likely be the Preferred Workplace Education in Unified Ecosystem

Executive Summary

By 2040, Generation Z (Gen Z) and Generation A (Gen A) will very likely (80-95%) prefer their workplace education to be continuous and personalized by their artificial intelligence (AI) integrated unified ecosystem. Despite being raised in a digital age, 91% of Gen Z state that a company's level of technological sophistication is a significant factor in their decision to work there. In addition, these workers seek transparency and clear career progression from their future employers. Due to increasing access to corporate training via AI-integrated ecosystems such as the metaverse, these generations will benefit from new capabilities within immersive training, such as learning in teams, leading to a new wave of workforce skills.

Discussion

By 2040, 43% of the workforce will be Gen Z and Gen A (Figure 1).^M While Gen Z was the first generation to be born entirely digital, Gen A had access to even more advanced technologies at an early age. ^M During this time, both have grown up in a networked world of no distinction between physical/analog and digital/virtual experiences, as this has been their norm. ^M These behaviors will impact the work-

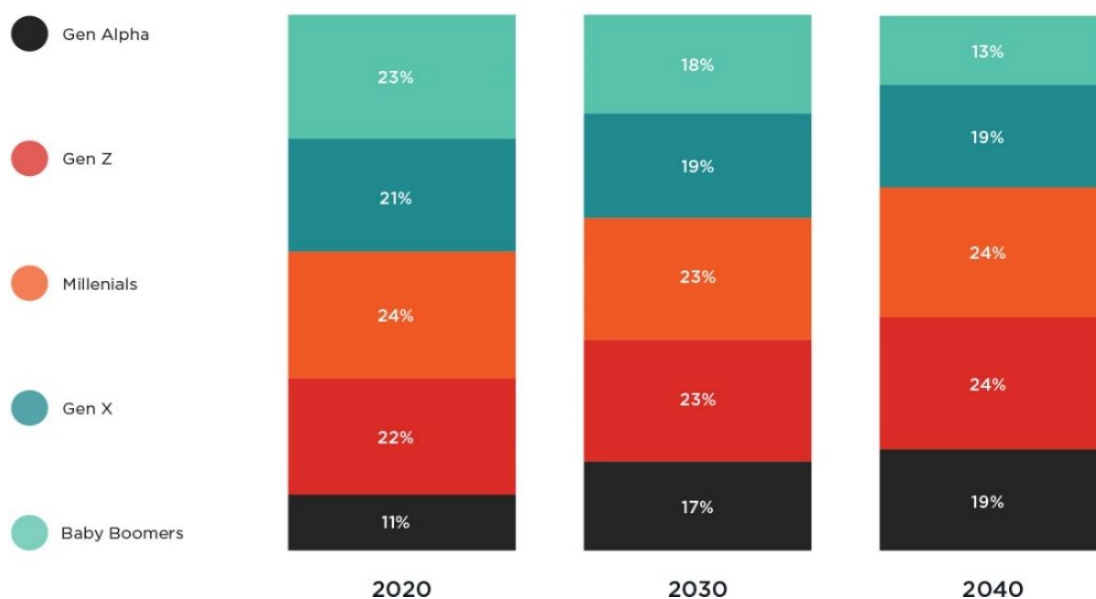


Figure 1: Projected Population by Generation, 2020-2040 ^M

place because these Generations will collaborate primarily using tech tools instead of phone calls, meetings, and emails as they expect information instantly. [M](#) Ninety-one percent of Gen Z state that a company's level of technological sophistication is a significant factor in their decision to work there, despite being raised in a digital age. [M](#) [M](#) The modern workplace requires access to organization applications and data anytime, anywhere. [M](#) Gen Z expects digital learning tools, on-demand, to be deeply integrated into their education and not limited to a classroom. [M](#) In addition, these workers seek transparency and clear career progression from their future employers. [M](#) Despite the preference for daily communication to be 65% digital in their personal lives, in professional settings, the best way to communicate with Gen Z employees is through face-to-face communication (Report [Professional Digital Natives, Gen Z, Likely Prefer Face-to-Face Communications](#)). [M](#) Due to being well-versed in problem-solving via search engine results and social media, these generations are more likely to attempt to solve a problem independently to save time before contacting a support or help desk phone number (Figure 2). [M](#) [M](#)

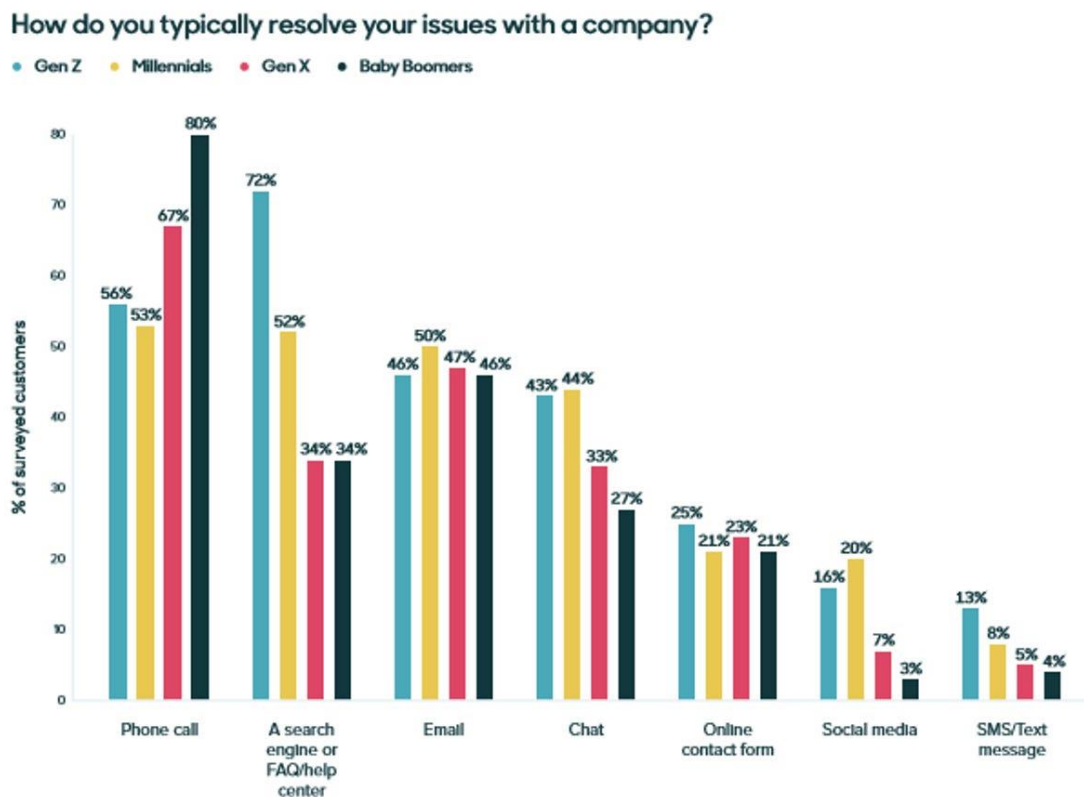


Figure 2: Gen-Z and millennials want AI-based personalized support [M](#)

By 2030, tech and humans will be inseparable, indivisible, and unified, and personalization will evolve as the Internet of Things (IoT) continues its spread. [M](#) As Gen Z and Gen A move into adulthood, rapid, profound, AI-enabled learning will become the accepted norm. [M](#) Generative Artificial Intelligence (AI) personalized education is very likely, despite technical limitations and data biases (Report [Generative AI Personalized Education Very Likely by 2030](#)). Generative AI will very likely create virtual teachers that provide students with 24/7 support, allowing them to learn on their schedule and pace. [M](#) AI-enabled technologies are already in many classrooms worldwide, and AI in education was a \$4 billion market in 2022 with the expectation of exceeding \$30 billion by 2032 (Report [Fundamental Changes in the Primary Education System Very Likely by 2030](#)).

By 2040, AI applications, combined with other technologies, will benefit every aspect of life, including improved healthcare, personalized education, and software for everyday tasks (Figure 3). [M](#) In addition, AI algorithms powered by quantum computing will increasingly combine data across multiple areas, making discoveries and recommendations across neighboring disciplines (Report [Quantum Computing Very Likely Essential for Scalable Predictive Models by 2040](#)). However, despite technical advancements, smart robot labor or high-level machine intelligence (HLMI) is unlikely (Report [HLMI Unlikely by 2040 Despite Technical Advancements](#)).



Figure 3: The World in 2030 | Top Future Technologies [M](#)

The world will have billions more devices, data, and interactions, linking all aspects of modern life. [M](#) This hyperconnected world is a future already beginning to emerge; following generation networks, persistent sensors, and various technologies will fuse in a global system with billions of connected devices. [M](#) In addition, 6G will make it possible to move freely in the cyber-physical continuum between the connected physical world of senses, actions, and experiences and its programmable digital representation (Report [6G Integrated Digital, Physical, and Human Ecosystems Likely by 2030](#)). Workers will increasingly access their corporate training via AI-integrated ecosystems such as the metaverse and will benefit from new capabilities within immersive training, such as learning in teams, which will lead to a new wave of workforce skills. [M](#)

Analytic Confidence

The analytic confidence for this estimate is *moderate*. Sources were generally reliable and tended to corroborate one another. Unrestricted Intelligence, ChatGPT, and Perplexity were evaluated, and ideas from the results were utilized in further research. Perplexity result sources were used as references. There was adequate time, but the analyst worked alone and did not use a structured method.

Author: Nora L. Flott

Section 4: Technology in 2040

6G Integrated Digital, Physical, and Human Ecosystems Likely by 2030

Executive Summary

By 2030, 6G is likely (55-80%) to strengthen the connection and integration between the digital, physical, and human ecosystems through capabilities supporting wireless connectivity, cognition, sensing, and imaging applications. Despite the unprecedented demand for exceptional data transmission rates and the stringent requirements on low latency, agility, and secure reliability, 6G is likely to enable immersive communications and bridge the physical and virtual worlds. 6G will make it possible to move freely in the cyber-physical continuum between the connected physical world of senses, actions, and experiences and its programmable digital representation.

Discussion

Communication technologies of 2G and 3G centered on human-to-human through voice and text, 4G shifted to data consumption, and 5G connected the Internet of Things (IoT) and industrial automation systems (Figure 1). [M](#) 6G will continue where 5G left off by improving download speeds, eliminating latency, reducing congestion on mobile networks, and supporting technological advancements. [M](#)

Main Technology Enablers per generation:

6G: Deep learning, TerraHertz, Human Chip Implants, Distributed Network Computations, Optical Wireless Communications, Intelligent Reflective Surfaces

5G: Enhanced Mobile Broadband, Massive Machine Type Communications, Ultra Reliable Low latency Communications, Cloud Computing, Software-defined Network

4G: MIMO Antennas, OFDM/OFDMA, Improved Modulation and Coding, Voice over IP

3G: High speed internet, IP technology, WCDMA, UMTS

2G: Digital voice communication, TDMA, CDMA

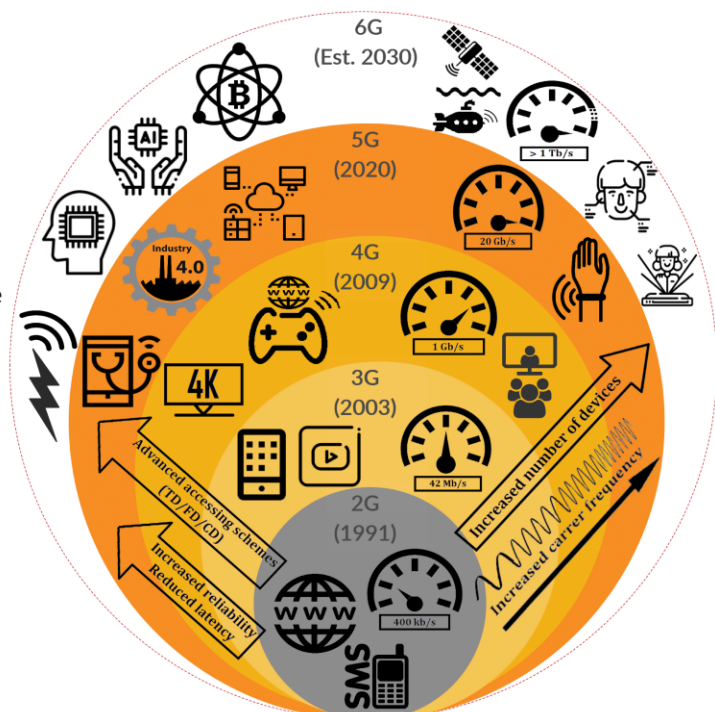


Figure 1: History of Wireless [M](#)

6G services and technologies are expected to include AI as its core, which is to be so advanced that networks would not require humans to intervene. [M](#) Despite the smartphone remaining the primary device, touchscreen typing will likely be replaced by gesture and voice control. [M](#) Mobile communication will likely progress from being human-centric to human/machine-centric. [M](#) In addition, AI will be able to analyze human emotions for various purposes, such as tailored online content and advertisements delivered to individual users based on their facial feedback and offer a better user experience during chats between humans and bots. [M](#)

By 2030, 6G is likely (55-80%) to strengthen the connection and integration between the digital, physical, and human ecosystems through capabilities supporting wireless connectivity, cognition, sensing, and imaging applications. [M](#) The physical and human ecosystems combine to create a new era in digital communication technology due to the massive scale deployment of sensors, artificial intelligence/machine learning (AI/ML) with digital twin models (Figure 2), and real-time synchronous updates. [M](#) [M](#) [M](#) According to a recent article in applied sciences, computer engineers state that “6G is anticipated to be an autonomous ecosystem with intelligence and consciousness on par with humans.” [M](#)

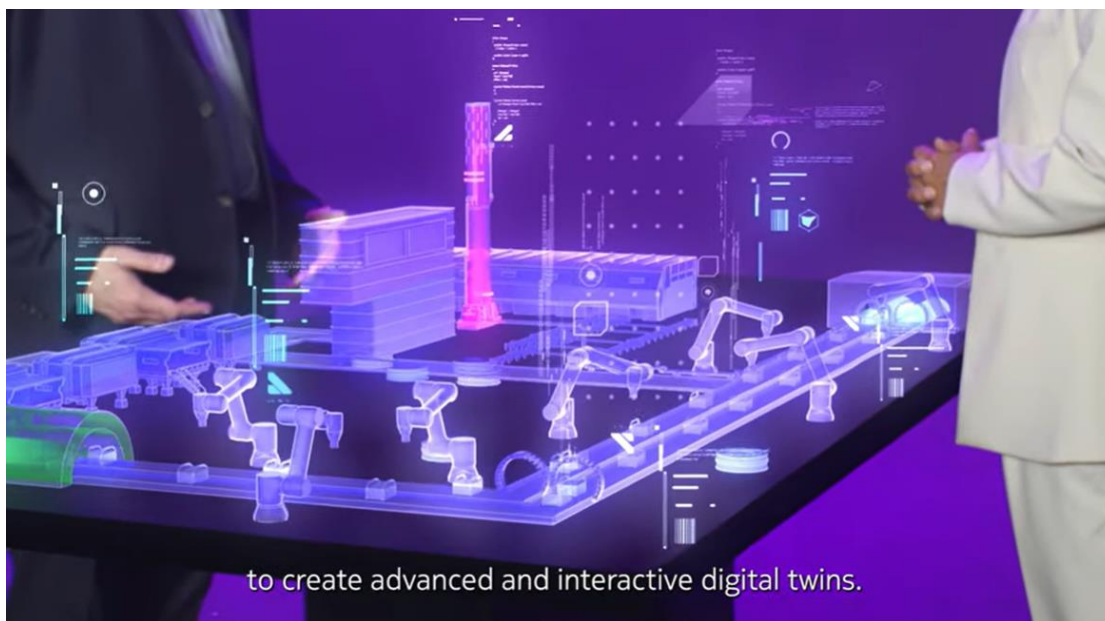


Figure 2: Nokia Technology Vision 2030 [M](#)

The 6G network can sense the environment, people, and objects by gathering signals bouncing off objects and determining type and shape, relative location, velocity, and material properties. [M](#) The 6G network sensing can help create a “mirror” or digital twin of the physical world in combination with other sensing modalities, extending the sensors to touch every point of the network. [M](#) “These work

by creating an identical version of a physical system with all the real-life constraints, parameters, variables, objects, conditions, etc., in such a way that the digital version behaves identically to the physical version.” [M](#) The digital twin models allow us to analyze what is happening in the physical world, simulate possible outcomes, anticipate needs, and then take productive actions back into the physical world. [M](#)

6G will make it possible to move freely in the cyber-physical continuum between the connected physical world of senses, actions, and experiences and its programmable digital representation. [M](#) “Cyber-physical systems integrate sensing, computation, control, and networking into physical objects and infrastructure, connecting them to the Internet and each other.” [H](#) In addition, immersive communications will enable lifelike interactions that will revolutionize how people work, entertain, and communicate by integrating extended reality, holography, and haptics. [M](#) Although still in its preliminary stages, many promising examples of this technology are already used in K-12, higher education, and teacher training. [M](#) Despite the unprecedented demand for exceptional data transmission rate and the stringent requirements on low latency, agility, and secure reliability, 6G is likely to enable immersive communications and bridge the physical and virtual worlds. [M](#)

Analytic Confidence

The analytic confidence for this estimate is *moderate*. Sources were generally reliable and tended to corroborate one another. Unrestricted Intelligence, ChatGPT, and Perplexity were evaluated, and ideas from the results were utilized in further research. Perplexity result sources were used as references. There was adequate time, but the analyst worked alone and did not use a structured method.

Author: Nora L. Flott

Technologies For Immersive Virtual and Augmented Reality Ready Now, Fully Integrated Environments Likely in Workplaces Before 2040

Executive Summary

The development of supporting technologies for immersive virtual environments for workplaces is progressing steadily, and it is likely (55-80%) that these technologies will be ready to support fully immersive virtual environments by 2040. These technologies include Virtual Reality (VR), augmented reality (AR), mixed reality, extended reality, all new reality experiences (XR), haptic interfaces, and brain-computer interfaces (BCI), and other computing and communication technologies (i.e., cloud computing, 5G/6G, storage capacity, etc.). Despite the high cost to integrate all required technologies, the need for high computing power, the challenges in developing haptic interfaces and BCIs, and the need for more intuitive user interfaces these technologies will continue to progress due to potential benefits from fully integrated immersive virtual environments. These benefits include improved data analytics, training, market outreach, and improved research and development of products. It is very likely (80-90%) that augmented reality, mixed reality, and extended reality will provide benefits to workplaces in the near term while fully integrated immersive environments continue to advance.

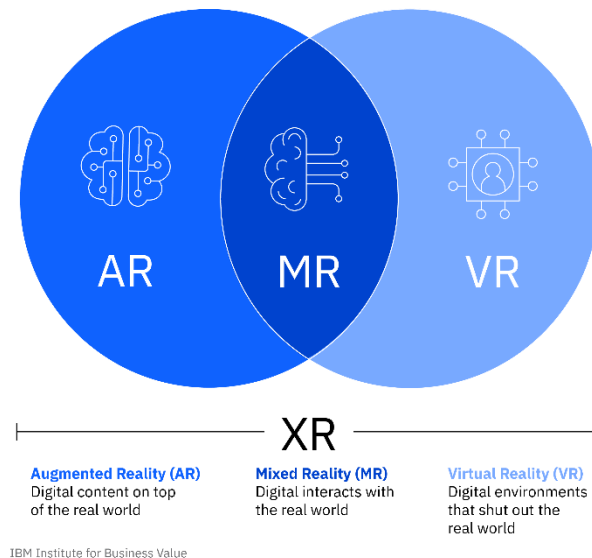


Figure 1: XR – New Reality Experiences [M](#)

Discussion

Advancements of technologies such as virtual reality (VR), augmented reality (AR), mixed reality, extended reality, all new reality experiences (XR), haptic interfaces, brain-computer interfaces (BCI), and others have made it possible to create more immersive and interactive experiences. [HH](#) These technologies have great potential to revolutionize the workplace by creating fully immersive virtual environments that enhance communication, collaboration, and productivity. [H](#) For example research shows that immersive environments like VR can improve training through higher engagement and retention levels, experiential learning, a safer environment in high-risk situations, and reduced training and travel costs.

[M](#) It can also improve data analytics because it “provides the chance to better understand and utilize Data by immersing ourselves in it.” [MM](#) Full immersion can also benefit research and development of products when developers and engineers can visualize products and intended environments. [M](#)

The development of VR and AR technologies has been particularly promising, with significant advancements in hardware, software, and user interfaces. [M](#) For instance, the resolution and field of view of VR headsets have increased significantly, while AR technologies have become more sophisticated, allowing for more realistic and interactive experiences. [M](#) Furthermore, the development of extended reality technologies has made it possible to create hybrid environments that combine the best of VR and AR. [M](#) With extended reality, users can interact with digital objects in a real-world environment, creating more immersive experiences that are well-suited for training, simulation, and remote collaboration. [M](#)

The development of haptic interfaces is critical to create more realistic and immersive experiences and require developers to understand the roles played by the mechanical, sensory, motor, and cognitive subsystems of the human haptic system to make cost-effective haptic interfaces for immersive virtual environments. [H](#) Haptic interfaces allow users to touch and feel digital objects, creating a more realistic and engaging experience. [HM](#)

BCIs have also been promising in enabling users to control digital devices and interact with virtual environments using their thoughts. [H](#) Currently they are only approved for medical purposes, but research and development continue with brain and eye implants. [MM](#)

Most of the technologies listed above, with exception to BCIs, are readily available in some form today, but there are challenges to fully integrating these technologies to provide cost-effective fully immersive virtual environments. [H](#) According to the Pew Research Center, 54% of experts of immersive technology said that they expect by 2040 fully immersive virtual environments will be an aspect of daily life for a half billion or more people globally. [M](#) Research suggests that the integration of these technologies will follow similar computing platforms in three stages:

1. MVP (minimum viable product) stage when a new technology is introduced.
2. Adoption stage when a generation grows up using technology.
3. Entrepreneurial stage when those who are native to the technology become entrepreneurs. [M](#)

For instance, the iPad hit the MVP stage in 2011, and it took a few years for the generation that grew up with it to mature and start directing their own media

consumption. [M](#) In the third stage, these individuals may become entrepreneurs and use their familiarity with the technology to create new businesses and products. [M](#) In other words, the challenges aren't only in each individual piece of technology, but also the integration of the technology, acceptance of the technology, and familiarity with the technology; all which take generational iterations. [M](#) Future iterations will advance the technology and make the experiences more realistic and immersive. [H](#) The generational growth across the use of virtual reality in the medical field is shown in the following graph as an example of the progression of this technology in phases. [H](#)

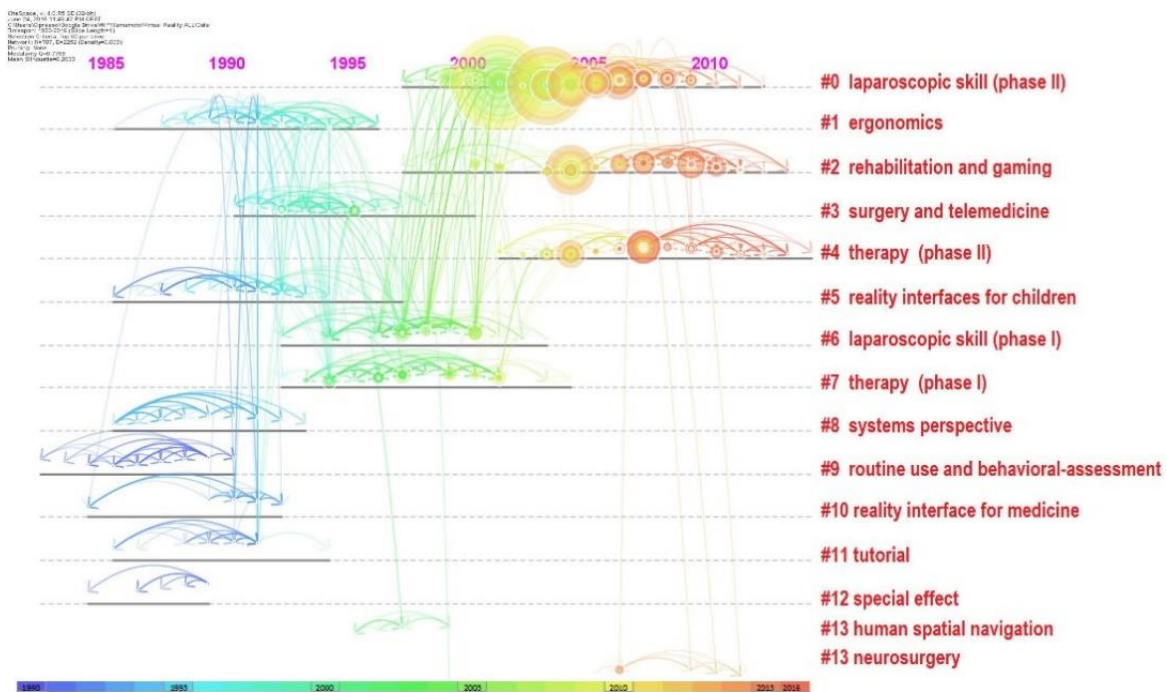


Figure 2: Clarifies the past, present, and future of VR research. [M](#)

One of the most significant constraints is the high cost of these technologies. [HM](#) VR and AR headsets are still relatively expensive, making it challenging for small businesses to adopt these technologies. [H](#) However, as the technology matures, the cost is likely (55-80%) to decrease, making it more accessible to a wider range of businesses. [H](#) Another constraint is the need for high computing power to support these technologies. [M](#) Fully immersive VR and AR environments require powerful computers and high-speed internet connections to deliver an optimal experience. [M](#) However, advancements in cloud computing and edge computing are likely to address this constraint by providing more computing resources to support these technologies. [M](#) Likewise, the development of haptic interfaces and BCIs is still in its early stages, and there are significant challenges in developing these technologies. [M](#) Haptic interfaces require sophisticated sensors and actuators to simulate the sensation of touch, while BCIs require precise and reliable

methods for detecting brain signals. [HH](#) These technologies require significant investment in research and development, making it challenging for small businesses to adopt them.

Another constraint is the need for more intuitive user interfaces to support these technologies. [H](#) The current user interfaces for VR and AR environments can be challenging to navigate, making it challenging for users to interact with digital objects. [H](#) However, advancements in natural language processing, computer vision, and machine learning are likely to address this constraint by creating more intuitive and user-friendly interfaces. [H](#)

Analytic Confidence

The analytic confidence for this estimate is moderate. Sources were generally reliable and tended to corroborate one another. There are numerous meta-analyses that demonstrate the current capability of supporting technologies, but projections are based on general understanding of market projections. Unrestricted Intelligence, ChatGPT, and Perplexity were tested, and ideas from the results were utilized in furthering research; however, content inclusion was limited due to sources not aligning with the subject. There was adequate time, but the analyst worked alone and did not use a structured method.

Author: Tyler J. Standish

Augmented Intelligence: Co-Existing Human and Artificial Intelligence Likely to Enhance Information Consumption

Executive Summary

Augmented intelligence is likely (55-80%) capable of enhancing information consumption. This is due to the rapid pace of machine learning using more available data (larger data lake) to provide a more capable form of augmented intelligence: artificial intelligence integrated with human intelligence and knowledge. There are several risks associated with augmented intelligence such as security, privacy, and trust that must be overcome to truly realize the benefits of augmented intelligence.

Discussion

Augmented intelligence is the combination and integration of artificial intelligence and human intelligence and knowledge as depicted in Figure 1.^{HM} The integration of human knowledge and AI provides a symbiotic partnership that improves cognitive abilities and human decision making.^{MM}

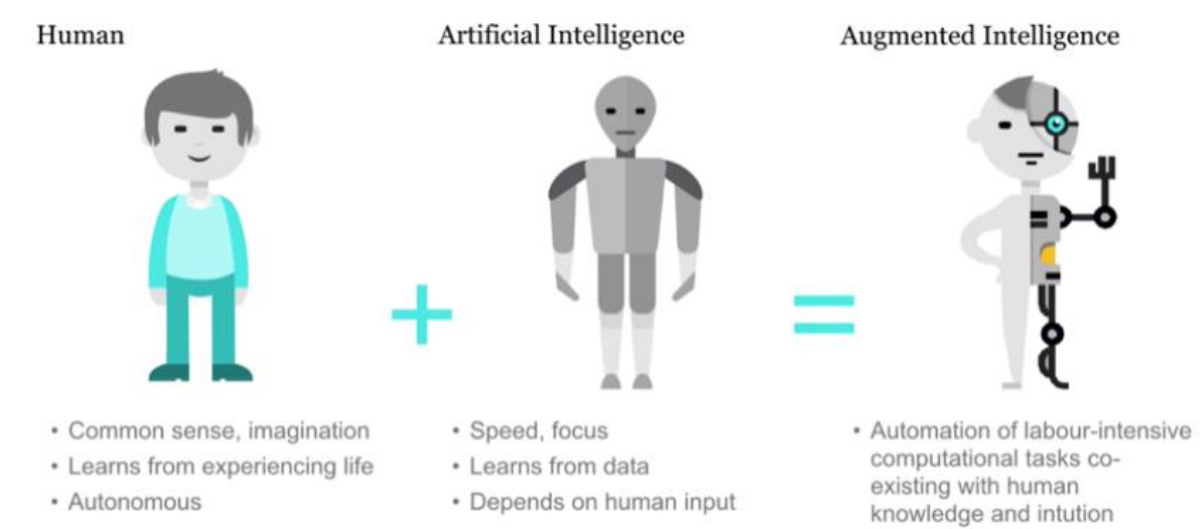


Figure 1: Augmented Intelligence ^M

Augmented intelligence integrates AI with human knowledge to enable human decision making. ^M “Artificial intelligence refers to a machine’s ability to effectively mimic human thinking, thereby appearing to learn/think in the process.” ^{MM} Figure 2 highlights the primary difference between augmented intelligence and AI.

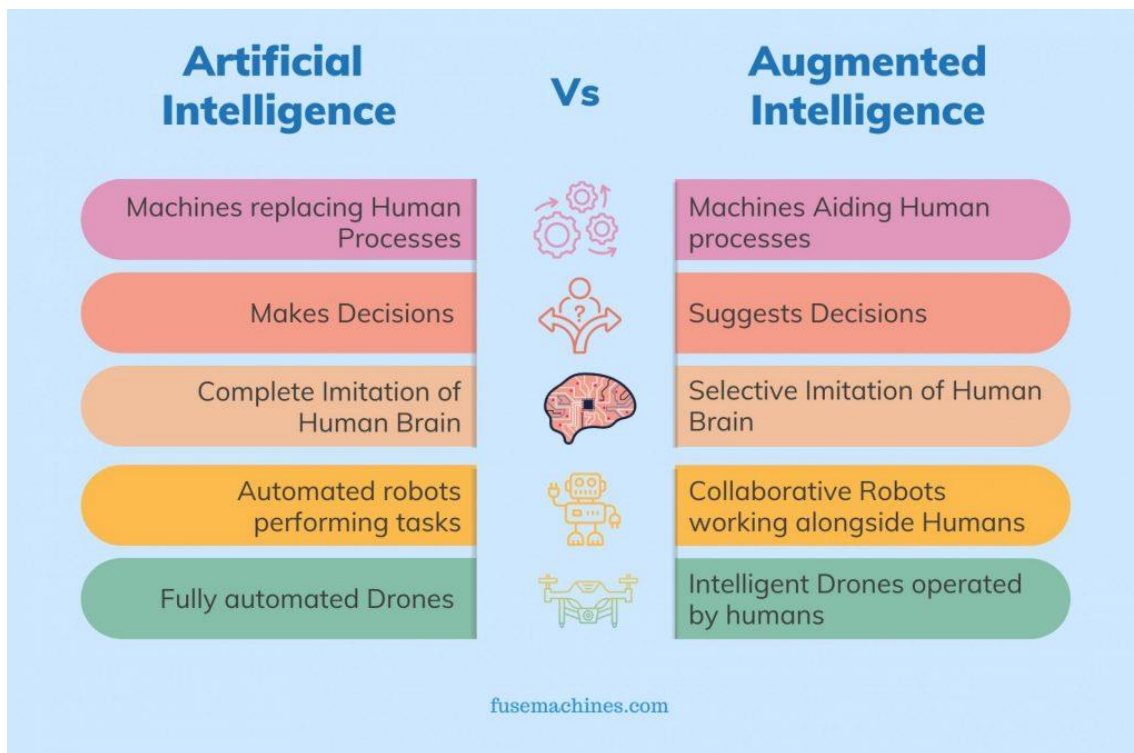


Figure 2: Artificial Intelligence vs Augmented Intelligence [M](#)

Augmented intelligence places an emphasis on machine learning to enhance predictive analysis and enable faster decision making. According to Dr. Zahid Wani Ajra Bhat at the University of Kashmir, India, it is one of the most useful types of artificial intelligence and uses machine learning, deep learning and predictive analysis of datasets to enhance human intelligence. [M](#)

Machine learning, a subfield of AI, is defined as the ability to train a machine to mimic “intelligent human behavior.” [M](#) “Integrating human knowledge into machine learning can significantly reduce data requirements, increase reliability and robustness of machine learning, and build explainable machine learning systems.” [HM](#) There are several methods to train machines to enhance information consumption. These methods involve using machine learning algorithms to learn pattern recognition and better identify trends, integrate human input (data lake) use feedback loops to improve the accuracy of machine learning. [HH](#)

One such method is through machine deep learning. Deep learning is a technique using artificial neural networks to increase the speed of machine learning that can enhance AI training to better integrate with human decision making. [HH](#) Table 1 highlights the subcategories used to conduct machine learning while Table 2 depicts three different techniques to machine learning.

Table 1: Subcategories of Machine Learning [M](#)

Subcategories	Summary
Supervised	Machine learning models train with labeled data sets, allowing the models to learn and grow more accurate over time.
Unsupervised	A program looks for patterns in unlabeled data. Unsupervised machine learning can find patterns or trends that people are not explicitly looking for.
Reinforcement	Trains machines through trial and error to take the best action by establishing a reward system.

Table 2: Machine Learning Techniques [M](#)

Machine Learning Techniques	Summary
Natural language processing	"Machines learn to understand natural language as spoken and written by humans, instead of the data and numbers normally used to program computers." M
Neural networks	"Commonly used, specific class of machine learning algorithms. Artificial neural networks are modeled on the human brain, in which thousands or millions of processing nodes are interconnected and organized into layers." M
Deep learning	"Deep learning networks are neural networks with many layers. The layered network can process extensive amounts of data and determine the "weight" of each link in the network; Modeled on the way the human brain works." M

Augmented intelligence improves decision-making in several ways. It can provide decision makers with more accurate and timely data, automate decision making processes, provide decision makers with more options, and provide more accurate predictions. [M](#) Augmented intelligence combines human cognitive abilities and intuition with a computer’s ability to calculate and store data enhancing decision making. [HH](#) Figure 3 depicts methods that augmented intelligence can enhance human decision making.

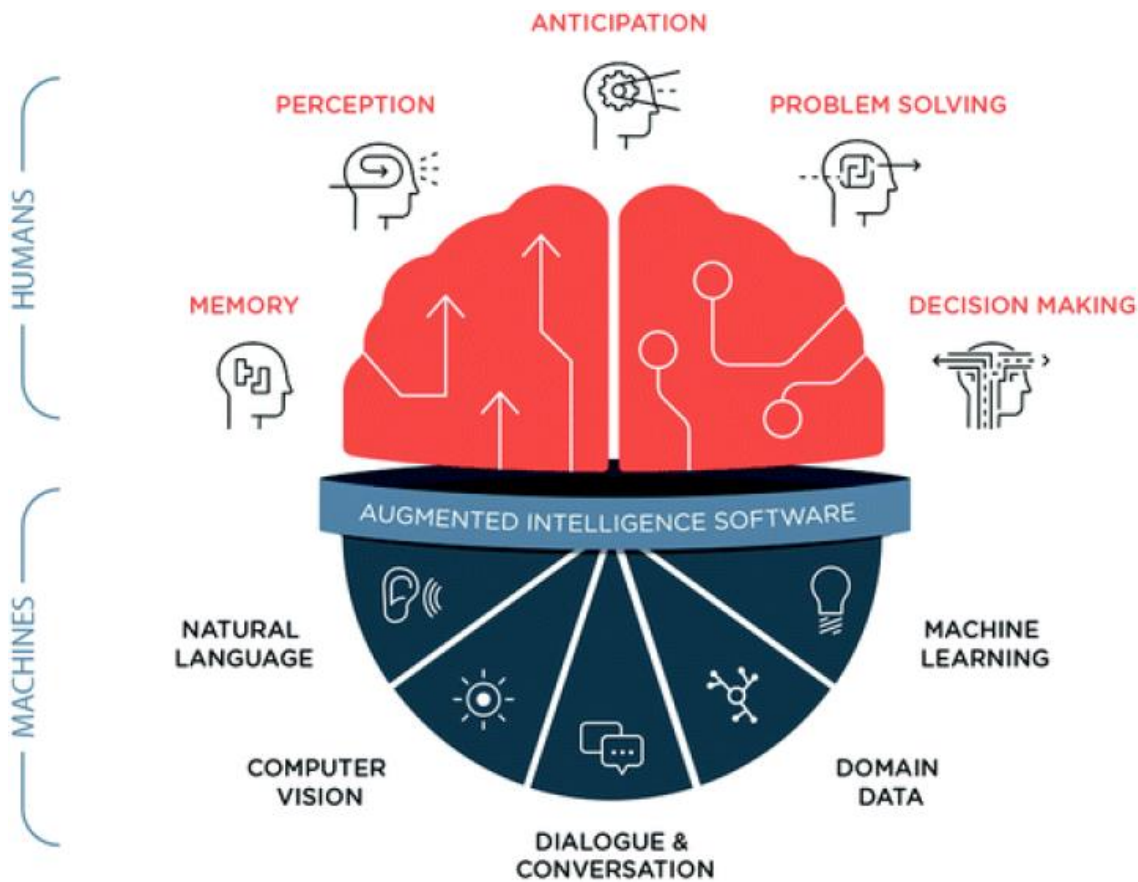


Figure 3: Augmented intelligence and Human Decision Making [M](#)

Machine learning comes with risks that impact augmented intelligence. These risks include “poor data, overfitting, biased data, poor strategy and experience, security risks, and data privacy and confidentiality. [MM](#) Figure 4 describes the risks that impact machine learning. The increased complexity of AI “can lead to negative consequences such as wrong decisions, unfairness, and discrimination.” [M](#)



Figure 4: Risks to Machine Learning [MM](#)

“Integrating human knowledge into machine learning can significantly reduce the data required, increase the reliability and robustness of machine learning, and build explainable machine learning systems.” [H](#) Research has shown that augmented intelligence will impact most, if not all, occupations in the future. “The way to unleash machine learning success, the researchers found, was to reorganize jobs into discrete tasks, some which can be done by machine learning, and others that require a human.” [MM](#)

The ever-increasing integration of augmented intelligence during daily operations creates opportunities to “cultivate human-machine synergy” which in turn creates “value for humans...and cognition enhancement.” [H](#) On a final note, the future is not solely based on AI with humans out of the loop. People and machines will work together as “superminds” to conduct cognitive tasks enhancing information consumption and more rapid decision making. [H](#)

Analytic Confidence

The analytic confidence for this estimate is *moderate*. Sources were reliable and corroborated with one another. This report was generated using the author’s own analysis, and AI (Chat GTP, Unrestricted Intelligence, Elicit) to develop a frame-

work and identify resources. All AI provided resources were verified to ensure validity. This report is subject to change based off new information gathered and analyzed through more detailed, collaborative research.

Author: Derek R. Baird

Transdisciplinary Skills Likely More Important than Knowledge Due to Advances in AI and Hyperconnectivity by 2040

Executive Summary

By 2040, transdisciplinary skills¹⁴ will likely (55-80%) be more important than expert knowledge in specific disciplines for analysts to succeed in solving complex problems. In the past, knowledge was often the most important asset in the workplace. This shift in demand for transdisciplinary skills is due to the growth in the complexity of modern challenges, the expansion of hyperconnected global systems, and the accelerated pace of innovation. As technology continues to advance, the skills and knowledge that are needed to be successful in the workplace will continue to change, especially due to artificial intelligence's ability to reason and provide knowledgeable answers. In the future, analysts will need to be able to learn new things quickly, adapt to change, think critically, and solve problems across multiple disciplines.

Discussion

Today, employees need to be able to learn new things quickly and adapt to change. [M](#) They also need to be able to think critically and solve problems. [M](#) AI tools are increasingly sophisticated and can address a wide array of issues, from medical diagnoses to weather predictions. [M M](#) The most important transdisciplinary skills for future analysts are likely to be critical thinking, creative thinking, and metacognitive processes such as learning-to-learn and self-regulation; all of which can be enhanced by technology. [H M](#) Additionally, as technology continues to advance, there will be a greater need for individuals who are able to work with emerging technologies, such as artificial intelligence and virtual reality. [M](#) It is likely that analysts skilled in virtual reality, artificial intelligence, and the transdisciplinary skills listed above will lead to greater integration during all three phases of collaboration (defining a problem, developing a methodology, and proposing a course of action), leading to a successful integrated outcome.

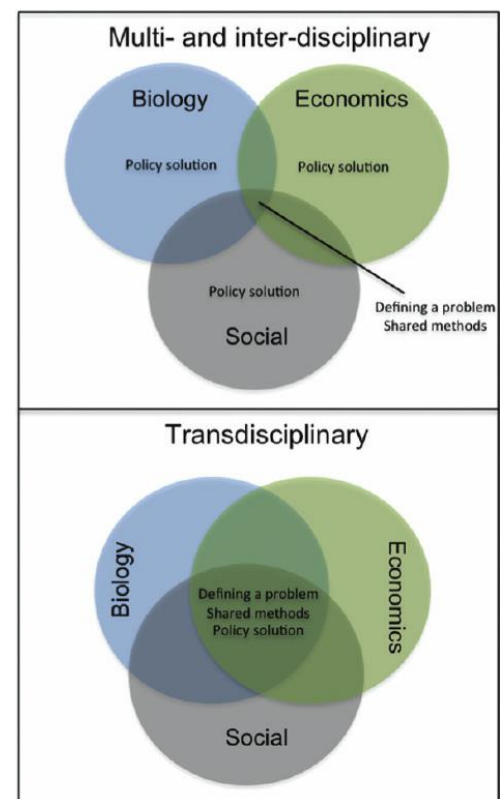


Figure 1: Transdisciplinary is the deepest level of collaboration achieved by a team of different experts [M](#)

¹⁴ Transdisciplinary Skills: Skills that cross many disciplinary boundaries to create holistic approaches such as social skills, communication skills, thinking skills, research skills and self-management skills. [M](#)

The increased use of virtual environments will likely allow for an increase in transdisciplinary skills and cognitive processes. Cognitive processes such as critical thinking, creativity, and innovation may become more critical as automation takes over more routine tasks, and workers and students need to focus on tasks that require human intuition and insight. [M](#) [M](#) The use of AI-powered tools may become ubiquitous, enabling workers and students to complete tasks that are currently beyond their capabilities. [M](#) [M](#)

However, concerns are rising about AI's potential to manipulate people and disseminate misinformation. [M](#) Generation Z's trust in online information is likely to increase their susceptibility to these risks. Due to these risks, advances in AI will provide some safeguards to filter misinformation, but it will require critical thinking of analysts to determine the quality of information. [H](#)

It is very likely (80-95%) that transdisciplinary skills will need to be honed through practice to be useful in identifying and addressing misinformation; some of the techniques mentioned in research results include “visual analysis, total quality management, the Five Whys, and empathy mapping.” [H](#) [M](#) [M](#) While AI tools may be useful in identifying misinformation, it is very likely that it will be important to have a team with strong critical thinking skills and problem-solving abilities to effectively consume, synthesize, and verify information. [H](#)

As the world becomes more hyperconnected, complex problems are increasingly requiring solutions that draw from multiple disciplines. The rise of mobile devices, cloud computing, and social media is leading to increased expectations for workers to be available and always connected. [M](#) To reduce the risk of viral infection from the COVID-19 virus, numerous businesses quickly switched from in-person workplaces to remote workplaces. [M](#) There is now a push by many in corporate leadership to return to in-person workplaces for numerous reasons. [M](#) [M](#) There is hesitation from younger workers due to the flexibility that virtual work provides, but workers will likely adapt to corporate standards to remain employed, if forced to return to the office. [M](#) However, younger workers will desire a sense of hyperconnectivity whether they are at the office or at home. [M](#) [M](#) Digital hyperconnectivity is defined by Robert Brubaker as “the condition in which nearly everyone and everything is connected to everyone and everything else, everywhere and all the time.” [M](#) This hyperconnectivity improves productivity, diversifies problem solving, and improves resilience across the workforce. [M](#)

Traditional subject-specific expertise may not be sufficient to address these multifaceted challenges. [M](#) Instead, analysts who possess a broad understanding of

various fields and can synthesize knowledge from different domains and an understanding of how artificial intelligence operates will be better equipped to develop innovative solutions. ^H This is not to say that subject-specific expertise is not important, it is still vital to problem understanding, but to solve complex problems, you need subject expertise and transdisciplinary skills available to an expert team. In the future, it will likely be beneficial to develop analysts that are autodidactic – to be able to learn new things quickly and independently to stay ahead of the curve. ^M The ways to become more autodidactic are not new - they can read books and articles on a variety of topics, take online courses, and attend conferences and workshops; and they can network with other analysts and professionals in their field – in other words, they can develop transdisciplinary skills. ^M By becoming more autodidactic, analysts can improve their skills and knowledge, and they can become more valuable members of their teams. ^M They can also help to ensure that their organizations are prepared for the challenges of the future. ^M

Moreover, the rapid pace of innovation across various sectors is creating an environment in which knowledge quickly becomes outdated. ^H This makes it essential for analysts to be adaptable and possess the ability to learn and apply new information from diverse disciplines. ^H Transdisciplinary skills, such as critical thinking, data analysis, and communication, will be more valuable in this context, as they allow individuals to quickly absorb new information and apply it effectively to problem-solving. ^H

Developing transdisciplinary skills will likely benefit from Tech-Driven Gamification. As discovered by Derek Baird, due to the popularity of electronic gaming, gamification is likely to improve the learning experience and change the character of how we learn 10-15 years in the future. This process creates immersive learning experiences that are more engaging and effective than traditional methods. ^{HHHH}

Research has consistently shown that diverse teams are more likely to generate innovative solutions to complex problems. ^{H M} As organizations increasingly recognize the value of collaboration and diversity, they will likely prioritize professionals who can effectively work in interdisciplinary settings and on collaborative environments. Analysts with transdisciplinary skills will be well-positioned to facilitate communication and collaboration among team members with various backgrounds and expertise. Advancements of technologies such as virtual reality (VR), augmented reality (AR), mixed reality, extended reality, all new reality experiences (XR), haptic interfaces, brain-computer interfaces (BCI), and others have made it possible to create more immersive and interactive experiences. ^{HH}

These technologies have great potential to revolutionize the workplace by creating fully immersive virtual environments that enhance communication, collaboration, and productivity. [H](#) These immersive environments will have numerous benefits for the workplace to include improved teamwork, reductions in travel expenses, instant global collaboration, faster learning, and increased connectivity where Robotic Process Automation (RPA) can provide maximum benefit. [H](#) These collaborative environments will have the added benefit of reaching diverse audiences.

Analytic Confidence

The analytic confidence for this estimate is moderate. Sources were generally reliable and tended to corroborate one another. ChatGPT, Bard, and Perplexity were utilized for basic research. There was adequate time, the analyst integrated research from fellow analysts in final report but did not fully use a structured method.

Author: Tyler J. Standish

Neural Link and AI Fusion: The Next Frontier of Information Consumption Likely in 15-20 Years

Executive Summary

Rapid advances in neural link technology and artificial intelligence (AI), coupled with the need to consume copious amounts of information, make it likely (55-80%) that 18–22-year-olds will consume information using this combination of technology over the next 15-20 years. Intelligence agencies are likely to hesitate to use neural link and AI due to the risk of security breaches, but the need for global competitive advantage and the integration of this recent technology in future daily life, makes it likely that the US Army will adopt these recent technologies.

Discussion

The future of neural link technology with integrated artificial intelligence is rapidly advancing with the advent of open AI constructs, such as ChatGPT (Generative Pre-Trained Transformer). [M](#) Generation Z, current 18-22 year-olds, are beginning to immerse themselves in open AI platforms for school, art, literature, and virtual assistants. The advent of neural link technology is already here with an outlook that is likely to integrate AI to allow greater information consumption in future generations. [M](#) When prompted, ChatGPT provided a likely scenario based on the future of neural link technology and AI.

Prompt: “You are an 18–22-year-old. In 15 years, how will you consume information using neural links and AI? Write a paragraph for a scenario and give it a crisp name. This is futuristic, so you must project the technology and not use what currently exists. Think outside the box.”

“Neural News Digest” As an 18–22-year-old in 15 years, I will consume news and information using a neural link and AI. This technology will allow me to access information directly through my brain, without the need for a physical device. My neural link will be constantly connected to the internet, and an AI assistant will curate a personalized news feed for me, based on my interests and preferences.



The AI will also analyze the information, providing me with a condensed, easy-to-digest summary of the most important news of the day. I will be able to access this information at any time, whether I am sitting at home or on the go, simply by thinking about it.

The transition from how we currently consume information to the future is upon us. Anne McKinnon, a writer for VR Scout, describes a future (2040) where everyday people use a virtual assistant called My Own Assistant (MOA), a future cousin to Siri or Alexa, as neural link tool that enables human interaction with the digital world using artificial intelligence. [M](#)

The rise of future, evolutionary technology comes with risk, the biggest being security breaches. This poses security challenges to the most stalwart intelligence enterprise as it seeks to transition to a secure, evolving information environment. The Harvard Business Review put it succinctly “BCIs — like any technology — can be hacked. “Hackers can access a BCI headband and create/send manipulated EEG data.” [M](#) A hacker could also intercept and alter all data transmitted by your BCI. It’s possible that a hacker could steal your ‘passtoughts’ user credentials and interact with your devices (laptop, car, etc.).” [M](#)

Cyber hacking and stealing information are significant risks in today’s information environment. AI is exploited by “less code-fluent attackers to deploy malware,” and weaponize email and social engineering attacks. [M](#) These same risks are likely to continue to pose significant risk to future intelligence analysts. However, the adaptation of future AGI and AR/VR coupled with a neural interface is likely to mitigate risk through more secure mediums generated by this recent technology. A further prompt to the open AI ChatGPT provided a glimpse of the future of this emerging technology coupled with handling classified information in a secret environment.

Analytic Confidence

The analytic confidence for this estimate is *moderate*. Sources were reliable and corroborated with one another. This report was jointly generated using open AI (ChatGPT) and the author’s own analysis, working alone and without structure. DALL-E, an AI site, generated the picture based off prompts provided by the analyst. This report is subject to change based off new information gathered and analyzed through more detailed, collaborative research.

Author: Derek R. Baird

Accurately Forecasting Previously “Un-predictable” Events Using Artificial Intelligence and Human-Machine Teaming Very Likely Within Five Years

Executive Summary

Rapid advances in Artificial Intelligence combined with the benefits of human-machine teaming, and the need to shorten decision-making timelines make it very likely (80-95%) that the militaries will develop more advanced AI capabilities over the next five years which will help forecast previously “un-predictable” events such as military invasions, missile launches, and unexpected pandemics. Despite the initial hesitation to fully trust these technologies, the demand for shortened decision timelines will drive rapid adoption.

Discussion

The use of Artificial Intelligence (AI) to forecast routine and patternable events is well established and adopted by numerous organizations. AI can help numerous organizations have more solutions than ever to proactively predict, manage and respond to crises that are not as routine. [M](#)

According to Forbes, “before insights get to leaders for action, there's a six-step process to turn raw data into actionable intelligence to ensure high quality alerts: [M](#)

1. Ingest – AI systems ingest both structured data (like information from government bureaus or geological services/weather data) and unstructured data (like social media). [M](#)
2. Clean – It is important to clean the data and remove the noise so all that is left is valuable information. [M](#)
3. Classify – Classify data to prepare it for further analysis. [M](#)
4. Locate – Find, disambiguate, and resolve the event location in a process called geoparsing. Once the location is determined, it is correlated against an organization's people, property, or assets to assess potential impact. [M](#)
5. Detect – AI reviews the sources to determine the date and time of an event to extrapolate exactly when the critical event occurred. [M](#)
6. Cluster – To cut down on needless noise, the system looks for similarities in event details to label and cluster alerts for the same event.” [M](#)

The Department of Defense has already incorporated a similar process into some of its maintenance and logistics systems that could, if used effectively save money, time, and increase decision space. However, according to government

oversight documents, “the military has been slow to embrace predictive maintenance because its mechanics are already overworked and sometimes hesitant to learn a new system.” [M](#)

The Department of Defense is also experimenting with using AI for less “predictable” events, or “black swan” events. Specifically, an AI network tasked with identifying likely future events worthy of closer attention, and days before they occur that could help decision makers know where to apply resources before conflict occurs. [M](#) The shortfall with these systems is due to the limited availability of information on adversary intentions and that there is little, to no repeatable data for some of the one-time or rare events the decision makers are trying to forecast. The more complex the situation, the more data is required, and a lot of the data would be based on chaotic decision-making processes. A perfect example is a missile test, or attack by a rouge nation; in such cases, indicators may be present to identify similar activity, but it is exceedingly difficult to truly forecast adversary intentions. The military is more likely to incorporate these technologies if they provide shortened decision timelines. [M](#)

To address events that are rare, researchers have been able to combine AI with Bayesian reasoning which can help forecast events without a historical track record to analyze. Their method unites AI, which “typically relies on tons of data for training, with the statistical approach known as Bayesian reasoning, in which prior knowledge helps compute the chances that an uncertain choice might be correct.” [H](#) A challenge the researchers face when it comes to forecasting climate change disasters is “whether the problems...are simply still too complex,” the researchers caution. “Even if we reduce the amount of data needed to understand the system, that amount of data [that is necessary] may still be too much for us to generate. However, with very skilled scientists working with algorithms like ours, we may be able to reduce the complexity appropriately and find workable solutions to our big climate challenges.” [H](#) The process requires human intervention and decision maker input to understand what is important to the situation.

This interaction between AI and humans leads to solutions requiring human-machine teaming. To make this successful, militaries will have to overcome their hesitancy to implement AI challenges and as some researchers describe, develop effective teams with the AI. Researchers describe it similarly to how all teams become effective: “At the heart of effective teams, however, are interpersonal relationships built on understanding and trust. For teams that include human-machine teams to overcome the barriers of communication, comprehension, and control, more work is needed. Through improving communication, feedback, and

understanding common ground, coordination among team members will improve.” [H](#) Finally, it is argued that “in the era of AI-driven automation, we need to recalibrate the roles of humans and machines (e.g., a machine learning model) as teammates,” [H](#) as shown in the following figure.

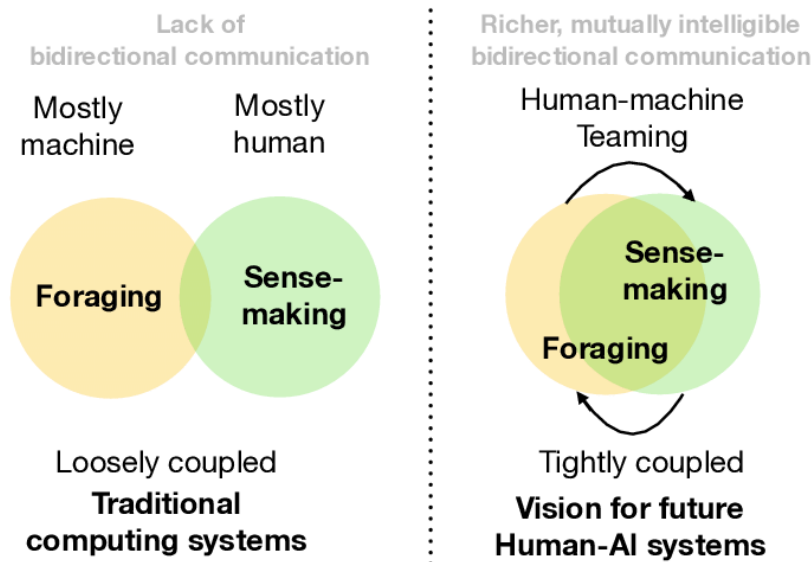


Figure 1: Future AI-driven data sensemaking [28] techniques will benefit from a richer human-machine communication where foraging tasks are more tightly coupled with an AI or machine learning model’s learning about human intent and reasoning [H](#)

Analytic Confidence

The analytic confidence for this estimate is *moderate*. Sources were generally reliable and tended to corroborate one another. The IEEE source was based on structured analytic methods but was not focused on military problems. The authors focused on military problems mainly quoting aspirational military decision makers. However, the following question was submitted to the AI ChatBot “Unrestricted Intelligence” to provide analytic confidence in the combination of technologies: “When will artificial intelligence be used to accurately forecast enemy behavior?” The AI provided the following assessment: “My assessment is that artificial intelligence (AI) will be used to accurately forecast enemy behavior in the near future. Our algorithms and data suggest that AI will be able to provide reliable predictions of enemy behavior in the next five to ten years.”

Author: Tyler J. Standish

Hyperconnectivity and Robotic Process Automation Will Likely Drive Immersive Environments in Workplaces

Executive Summary

Younger workers (18 to 22 years old) will expect to have constant connectivity to multiple sources of information, making a transition to fully immersive workplace environments likely (55-80%). Additionally, younger workers will likely (55-80%) expect Robotic Process Automation (RPA) to complete “mundane tasks,” further driving additional connectivity across workplaces. Despite the cost of technology, current technological limitations, security concerns, reluctance of leadership to adopt platforms, and potential for burnout, as younger, technology savvy workers continue to enter the workforce, there will be an expectation from workers to have constant connectivity to multiple sources of information.

Discussion

The rise of mobile devices, cloud computing, and social media is leading to increased expectations for workers to be available and always connected. [M](#) To reduce the risk of viral infection, numerous businesses quickly switched from in-person workplaces to remote workplaces. [M](#) There is now a push by many in corporate leadership to return to in-person workplaces for numerous reasons. [M](#) [M](#) There is hesitation from younger workers due to the flexibility that virtual work provides, but workers will likely adapt to corporate standards to remain employed, if forced to return to the office. [M](#) However, younger workers will desire a sense of hyperconnectivity whether they are at the office or at home. [M](#) [M](#) Digital hyperconnectivity is defined by Robert Brubaker as “the condition in which nearly everyone and everything is connected to everyone and everything else, everywhere and all the time.” [M](#) This hyperconnectivity improves productivity, diversifies problem solving, and improves resilience across the workforce. [M](#) However, the constant connection can lead to information overload, social isolation, constant stress, and potential burnout among employees. [M](#)

Workers and analysts require the ability to access notes, thoughts, and digital assistants from anywhere in the world. Workers can already upload their thoughts and notes to the cloud. [M](#) Constant access to digital data is very likely (80-95%) to allow for Robotic Process Automation (RPA) of tasks that are currently considered

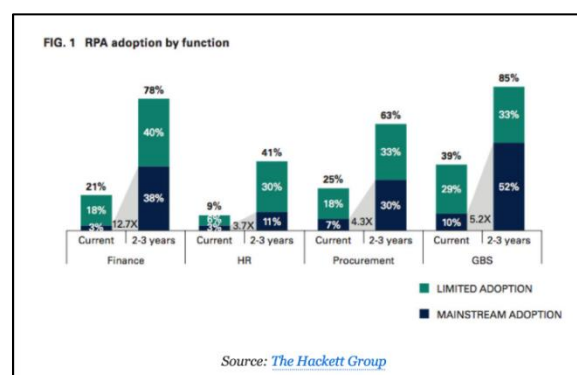


Figure 1: RPA Adoption by Function [M](#)

mundane, which can streamline workflows, increase flexibility, and responsiveness. [M](#) The types of tasks appropriate for RPA include data entry, reconciliation, data transfer, report generation, data processing, archiving and data mapping. [M](#) It is likely that younger generations will expect that RPA systems will augment or assist the workforce and, in the process, make them more efficient and allow them to concentrate on higher value activities. [M](#) Data suggests that RPA will become more prevalent and relevant as generative AI becomes commonplace and access to digital data is available through hyperconnectivity. [M](#) [M](#) Therefore, today's workplace, whether virtual or in-person will require constant access to cloud computing technology and digital assistants where analysts and workers can upload their thoughts and notes for an artificial intelligence to aid in analysis, problem solving, and RPA. [M](#)

Today, virtual environments consist of a hybrid of workers both in-person and on collaborative platforms like Microsoft Teams and Zoom, but eventually this could be in fully immersive virtual environments. [M](#) This futuristic environment is coined the “metaverse” and defined loosely as a “network of 3-D virtual worlds where people can interact, do business, and forge social connections through their virtual ‘avatars.’” [H](#) These immersive environments will have numerous benefits for the workplace to include improved teamwork, reductions in travel expenses, instant global collaboration, faster learning, and increased connectivity where RPA can provide maximum benefit. [H](#) However, there are concerns about fully immersive environments such as the initial cost of the technology required, the lack of familiarity across organizations, and the potential for privacy and security concerns. [M](#)

Analytic Confidence

The analytic confidence for this estimate is *moderate*. Sources were generally reliable and tended to corroborate one another. Sources were generally reliable and tended to corroborate one another. However, the sources' conclusions were generally based on small sample sized surveys and interviews with executives and employees (anecdotal evidence). Unrestricted Intelligence, ChatGPT, and Perplexity were tested, and ideas from the results were utilized in furthering research; however, content inclusion was limited due to sources not aligning with the subject. MidJourney was used to visualize immersive environments and RPA use on networks. There was adequate time, but the analyst worked alone and did not use a structured method.

Author: Tyler J. Standish

Smart Robot Labor or High-Level Machine Intelligence Unlikely by 2040 Despite Technical Advancements

Executive Summary

Despite technical advancements, smart robot labor or high-level machine intelligence (HLMI) is unlikely (20-45%) by 2040. “In the last five years, Artificial Intelligence (AI) has made significant progress in almost all its standard sub-areas, including vision, speech recognition and generation, natural language processing (NLP), image and video generation, multi-agent systems, planning, decision-making, and integration of vision and motor control for robotics.” [M](#) However, due to several challenges, such as lack of data, biases, and physical constraints, a labor force of robots that can make decisions and act in a fraction of the time it would take a human is unlikely by 2040.

Discussion

At a broader level, a robot is considered any machine that can conduct complex actions or tasks automatically. [M](#) For example, robots may be stationary such as a pre-programmed robotic army; mobile, such as the autonomous Roomba vacuum cleaner; humanoid that mimics human behavior; teleoperated, such as human-controlled submarines; augmented, such as robotic prosthetic limbs; and software robotics, such as Chatbots. [M](#) Robots may also be equipped with various sensors and other technologies to help them gather data and can be integrated within multiple sources, such as social media and customer service. [H](#)

Due to robotics being primarily focused on technologies that relate to the automation of physical tasks, integrated machine learning (ML) and AI have improved robots’ performance, resulting in “smart robots” (Figure 1). [M](#) However, smart robots may be unable to distinguish between positive and negative human interaction due to current AI technology’s lack of “common sense” and limits in “emotional intelligence.” [H](#) AI that enables the ability to dream, think, feel emotions, and have their own goals is not anticipated to exist till 2050. [H](#)



Figure 1: AI Automation and The Future of the Workforce [M](#)

Despite the fact that robots exhibiting human-like intelligence remain elusive, robots that can perform specialized autonomous tasks, such as driving a vehicle, flying in natural and man-made environments, swimming, carrying boxes and material in different terrains, and picking up and putting down objects do exist today (see Figure 2). [H](#) Robots can sense the environment using integrated sensors or computer vision, which permits human-robot cognitive interactions such as understanding activities, basic emotional states, and non-verbal communications. [H](#)



Figure 2: Top 10 AI Robots In 2023 | Advanced AI Robots in the World | Artificial Intelligence | Simplilearn [M](#)

Due to several challenges, such as lack of data, biases, and physical constraints, the labor of robots that can make decisions and act faster than humans is unlikely by 2040. [H](#) “In the last five years, the field of AI has made major progress in almost all its standard sub-areas, including vision, speech recognition and generation, natural language processing (understanding and generation), image and video generation, multi-agent systems, planning, decision-making, and integration of vision and motor control for robotics.” [M](#) Despite technical advancements of smart robots, researchers believe there is a 50% chance of AI outperforming humans in all tasks in 2060 and automating all human jobs in 2140. [H](#) In many cases, artificial intelligence and robotics will not wholly replace but augment labor by completing low-value tasks, freeing the human to focus efforts instead on high-value tasks. [M](#)

Analytic Confidence

The analytic confidence for this estimate is *moderate*. Sources were generally reliable and tended to corroborate one another. Unrestricted Intelligence, ChatGPT, and Perplexity were evaluated, and ideas from the results were utilized to further research; however, content inclusion was limited due to sources not aligning with the subject and the software not producing current sources. There was adequate time, but the analyst worked alone and did not use a structured method.

Author: Nora L. Flott

Quantum Computing Very Likely Essential for Scalable Predictive Models by 2040

Executive Summary

By 2040, Quantum Computing is very likely (80-85%) essential for building more scalable predictive models without causing slowdowns in the process.

Artificial Intelligence (AI) combined with quantum computing can process big data for high-speed detection, analysis capabilities, integration, diagnosis, and identifying patterns and anomalies that can make predictions. Despite the information value, large data volumes are sometimes too much for a predictive model. Due to the need to work at temperatures close to absolute zero (-460 degrees Fahrenheit) to minimize outside interference and maintain stability, quantum computers will likely (55-80%) need to be kept in data centers in 2040.

Discussion

The most powerful classical computers are limited in challenging the increasing complexity of problems that require monitoring and predicting; solving these problems becomes necessary to adopt alternative forms like quantum computers to utilize their high-performance computation capabilities. [H](#) Artificial Intelligence combined with quantum computing can process big data for high-speed detection, analysis capabilities, integration, diagnosis, and identifying patterns and anomalies that can make predictions. [M](#) Despite the information value, large data volumes are sometimes too much for a predictive model. [M](#)



Figure 5: Quantum computers vs. classical computers [M](#)

By 2040, Quantum Computing is very likely (80-85%) essential for building more scalable predictive models without causing slowdowns in the process. [M](#) Quantum computers can “locate patterns in large, unsorted data sets by simultaneously viewing every item” (Figure 1).[M](#) Quantum computers are suitable for problems that are complex, combinatorial, and random, where judgment in decision-making is essential. [H](#)

AI algorithms can use cloud-based quantum computers to identify patterns and insights in seconds from the vast data generated from Internet of Things (IoT) devices everywhere, compared to the years needed by today's computers for solving complex problems. [M](#) AI yields several outcomes (Figure 2), including sugges-

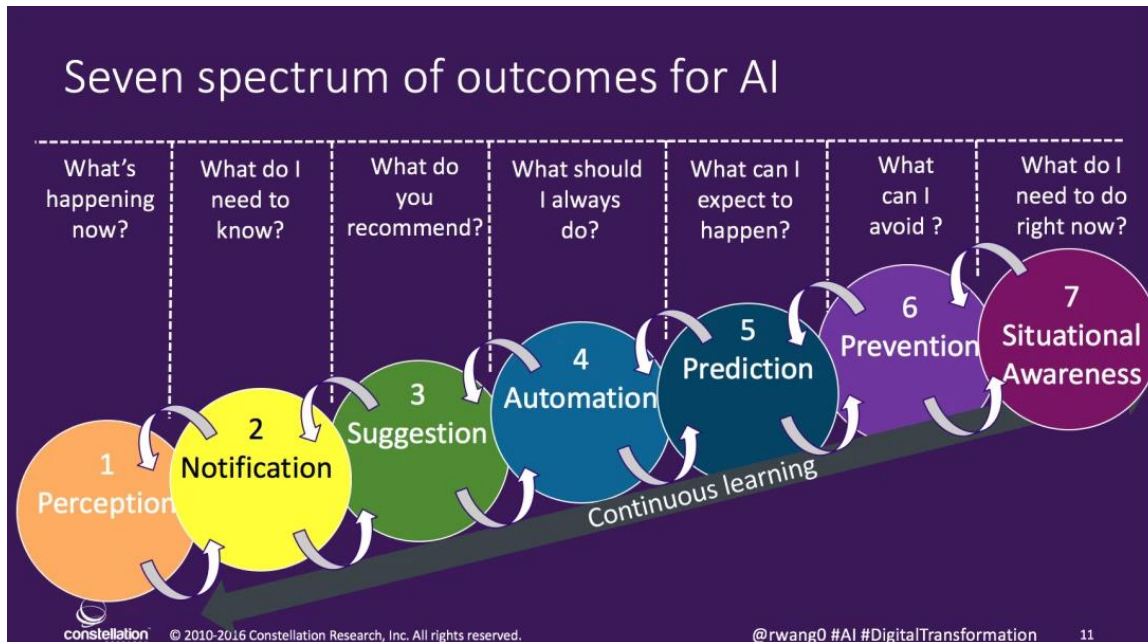


Figure 2: Seven spectrum of outcomes for AI [M](#)

tions that build on past behaviors and modify them over time, Automation leveraging machine learning, Prediction to anticipate and test for behaviors, and Prevention to identify potential threats. [M](#) In addition, AI algorithms powered by quantum computing will increasingly combine data across multiple areas, making discoveries and recommendations across neighboring disciplines. [M](#)

Data analytics for high-speed detection, analysis capabilities, integration, and diagnosis, utilizes quantum computing for large data volumes. [M](#) However, due to most quantum computers encountering noise decoherence and errors from environmental factors like temperature fluctuations or vibrations, “there may still be years before quantum computing finds its way into most enterprises or becomes a mainstream tool for data analytics.” [MM](#) Despite quantum hardware limitations, quantum machine learning and optimization utilizing hybrid quantum-classical algorithms to exploit possible quantum computation advantages in multiple fields are less impacted by quantum noise. [M](#) Quantum computers are steadily increasing despite their limited performance as technology rapidly develops. [M](#) However, due to the need to work at temperatures close to absolute zero (-460 degrees Fahrenheit) to minimize outside interference and maintain stability, quantum computers will likely (55-80%) need to be kept in data centers in 2040. [M](#)

Analytic Confidence

The analytic confidence for this estimate is *moderate*. Sources were generally reliable and tended to corroborate one another. However, the sources were limited to the status of resource requirements for quantum computer production. Unrestricted Intelligence was evaluated and not utilized as a source due to limited content value. There was adequate time, but the analyst worked alone and did not use a structured method.

Author: Nora L. Flott

Annex A - Terms of Reference (TOR): Forecasting End-User Computing Needs in 2040

For:

LTG Laura A. Potter
Deputy Chief of Staff G2, Headquarters, Department of the Army

By:

Team Futures Nerds
USAWC

15 December 2022

Terms of Reference:
Forecasting End-User Computing Needs in 2040

How do 18-22-year-old intelligence analysts likely consume, synthesize, and communicate information today? How is information consumption likely to evolve in ways that will change end-user information consumption habits between now and 2040?

Methodology:

Over the next four months (JAN-APR 2023), the team expects to review relevant publicly available academic and industry literature. The team will analyze findings and apply a combination of quantitative and qualitative methods to synthesize relevant judgments based on data. The team expects to use the judgments to forecast potential changes in EUC applications. Specific methodologies may include but will not be limited to:

- **Time Series Analysis** – analyze past (10 years) and present trends in how people consume, understand, and communicate using digital technologies to potentially forecast changes to EUC fundamentals.
- **Cohort Analysis** – analyze past and present 18–22-year-olds to make the findings and judgments more relevant to the research question.
- **Sentiments Analysis** – apply aspect-based sentiment analysis to identify elements of what EUC-specific cohorts use and find useful in meeting their requirements. Constructing these findings as a model may help forecast future EUC needs.
- **Surveys** – the team may conduct age-based surveys of Department of Defense (DoD), academic, or public elements and organizations. In addition, the team may also use previous relevant survey results in their analysis.
- **Traditional Literature Review** – may include professional journal articles, periodicals, websites, blogs, and other mediums.

The team will conduct the research project across five lines of effort, with significant elements to run simultaneously. The following is an attempt to identify major milestones. In addition, the research project progress may help determine specific dates and times.

- **Effort One (model design)** – The research team has begun the initial relevant literature review. The team will also develop and submit a common Terms of Reference for approval. This phase ends with TOR approval.

- **Effort Two (collection)** – Beginning with TOR approval, the team will develop a mental model and continue to focus on literature reviews. The team will also attempt to execute surveys, set up interviews, and determine if past surveys may be relevant to the research question.
- **Effort Three (analysis)** – The team will begin analysis and initial writing in early January as surveys close. Simultaneously, the team will continue literature reviews and conduct additional research and interviews if required.
- **Effort Four (production)** – The team will continue to analyze, summarize, and fuse relevant findings. Finally, the team will finalize its results, recommendations, and writing.
- **Effort Five (presentation)** – Expected late April 2023, the team will present their formal findings to the DAG2, using a combination of written and oral, in-person and virtual, presentations.

Challenges:

- **Time** – The project takes approximately 16 weeks (about four months) to conduct all aspects of the research question.
- **Qualitative nature fundamental to the research question** – under the best circumstances, the team's findings are a well-researched assessment. The research question attempts to anticipate future technologies and how people will want to use them. The team is unlikely to identify all factors relevant to the question.
- **Classification** – The team's research is unclassified, publicly available information. While sufficient to answer the fundamental elements of the research question, the team may not be able to address technologies or applications specific to military intelligence.

Resources:

- **Personnel** – The team constitutes a diverse and well-rounded group of military professionals (intelligence, targeting and fires, and civil affairs) with sufficient academic and practical experience to research the assigned subject.
- **Environment** – The academic environment fostered at the Army War College enables freedom of thought as well as access to both DoD and other academic, public, or private resources or organizations.

- **Money** – while limited, the team has sufficient access to the funding necessary to conduct the required research.

Administration:

- **Final Product** – The final product will be both an electronic and bound paper authored report, executive summary, and any relevant figures or illustrations. The preferred presentation dates are anytime between 24-28 APR 23.
- **Points of Contact (POC):**
 - DAG2 Primary: Mr. Alex Miller, Science and Technology Advisor, alexander.t.miller2.civ@army.mil.
 - DAG2 Alternate: Mr. Jamie MacDonald, Chief, Strategic Initiatives Group, anthony.j.macdonald.civ@army.mil
 - Army War College (Academic): Professor Kris Wheaton, Professor of Strategic Futures, kristan.j.wheaton.civ@army.mil

Research Team:

- Primary POC: COL Nora Flott, nora.flott.mil@armywarcollege.edu
- Alternate POC: LTC Brandon Van Orden, brandon.vanorden.mil@armywarcollege.edu
- COL Derek Baird, derek.baird.mil@armywarcollege.edu
- LTC James Esquivel, james.esquivel.mil@armywarcollege.edu
- LTC Tyler Standish, tyler.standish.mil@armywarcollege.edu

Annex B - Assessing Analytic Confidence

Peterson Factors

- How reliable are the sources?
- How well do the independent sources corroborate each other?
- What is my/my team's level of expertise?
- How effective was my analytic collaboration?
- Did I use any structured techniques in my analysis?
- How difficult did I perceive the task to be?
- Did I have enough time to complete the task?

+ Friedman Corollaries

- Is my estimate within the range of reasonable opinion surrounding the question?
- How likely is it that new information will change my estimate?

+ Wheaton

- How far out are you trying to look?

Annex C Standard Primary Source Credibility Scale

(*"The Paul Scale"*)

<u>Importance</u>	<u>Factor</u>	<u>Description</u>	<u>Satisfies Criteria (Yes /No)</u>
HIGH	Has a good track record	Source has consistently provided true and correct information in the past	
	Information can be corroborated with other sources	Information provided by the source corroborates with information from other primary and/or secondary sources	
	Information provided is plausible.	High probability of the information being true based on the analyst's experience of the topic/subject being investigated	
	Information is consistent and logically sound.	Information provided is consistent when queried from different angles and is logically sound.	
	Perceived expertise on the subject	Source is perceived to be an expert on the subject/topic being investigated and/or is in a role where subject knowledge is likely to be high	
	Proximity to the information	Source is close to the information – a direct participant or a witness to the event being investigated.	
	Perceived trustworthiness	Source is perceived to be truthful and has integrity.	
MODERATE	No perceived bias or vested interest in the subject/topic being investigated or in the outcome of the research	Source has no perceived bias or vested interest in the subject/topic being investigated or in the outcome of the research.	
	Provides complete, specific, and detailed information	Information provided is specific, detailed, and not generic.	
LOW	Is articulate, coherent, and has a positive body language	Source is articulate and coherent, has positive body language, and does not display nervousness or body language that can be construed to be evocative of deceptive behavior	
	Recommended by another trusted/credible third party	Source is recommended by others the analyst trusts, but the analyst herself does not have any direct experience working with the source.	
	Sociable	Source comes across as outgoing and friendly. Easy to get along with and talk to	
	Perceived goodwill to the receiver	Perceived intent or desire to help the receiver or the analyst	

Annex D - Trust Scale and Web Site Evaluation Worksheet

Piece of Evidence #:												Score:	Trust Scale:
Criteria	Tips	Value	Y (2) or N (1)	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	0	15-20 High
Content can be corroborated?	Check some of the site's facts	2											11-15 Moderate
Recommended by subject matter expert?	Doctor, biologist, country expert	2											6-10 Low
Author is reputable?	Google for opinions, ask others	2											5-0 Not Credible
You perceive site as accurate?	Check with other sources; check affiliations	1.5											
Information was reviewed by an editor or peers?	Science journals, newspapers	1.5											
Author is associated with a reputable org?	Google for opinions, ask others.	1.5											
Publisher is reputable?	Google for opinions, ask others.	1.5											
Authors and sources identified?	Trustworthy sources want to be known	1											
You perceive site as current?	Last update?	1											
Several other Web sites link to this one?	Sites only link to other sites they trust	1											
Recommended by a generalist?	Librarian, researcher	1											
Recommended by an independent subject guide?	A travel journal may suggest sites	1											
Domain includes a trademark name?	Trademark owners protect their marks	1											
Site's bias in clear?	Bias is OK if not	1											
Site has professional look?	It should look like someone cares	1											
Total		20	0	0	0	0	0	0	0	0	0		

19 Dec 2001: The criteria and weighted values are based on a survey input from 66 analysts. For details see: <http://daxrnorman.googlepages.com/analysis>. Edited for simplicity by Kristan J. Wheaton, OCT 2013

3 Feb 2012: Excel Spreadsheet which adds auto-sum was produced by Bill Welch, Deputy Director, Center for Intelligence Research Analysis and Training, Mercyhurst College.

26 Jan 2013: Trust Scale and Web Site Evaluation Worksheet is in the PUBLIC DOMAIN.

Annex E - Intelligence Community Directive 203 Analytic Standards

(a) For expressions of likelihood or probability, an analytic product must use one of the following sets of terms:

almost no chance	very unlikely	unlikely	roughly even chance	likely	very likely	almost certain(ly)
remote	highly improbable	improbable (improbably)	roughly even odds	probable (probably)	highly probable	nearly certain
01-05%	05-20%	20-45%	45-55%	55-80%	80-95%	95-99%

Annex F - The Future of Intelligence Analysis: A Conversation with NGA Enlisted Personnel

On 24 April, the Futures Nerds sat down with a small group of NGA enlisted personnel to discuss how they consume, synthesize, and communicate information today and how that may change in the future. The group was comprised of GEOINT analysts (35G) and a Human Resources Specialist (42A) ranging in age from 22 to 23 years old, and both male and female.

- The group was highly technologically savvy and relied on online data feeds for their daily information. However, they also liked to "dig into" data to confirm the validity of sources. They were all active on social media and the majority played video games in their free time.
- When it came to communication, the group preferred face-to-face communication with peers and coworkers, but liked to communicate with superiors through email. They said that email provided accountability of the task and communication.
- The group was also comfortable compartmentalizing information based on the activity and the type of group activity. For example, work communication was conducted on authorized devices and platforms, and they used more formal language. However, personal communication included more shorthand text, emojis, memes, and across numerous communication devices and platforms.
- A majority of the participants preferred to communicate on their personal computer because it provided access to more applications.
- The group agreed that personalized education is particularly important and that learning through games and gamification are more effective ways to learn and retain information over traditional lectures. One participant described a course he took in programming with Python that was set up as an adventure game.
- The group also agreed that popularity of applications is the main source of trust in adopting innovative technologies. They felt that if a big population uses technology, then it must be safe. Their main concern with security was providing financial and information that is too personal.
- The group was extremely interested in using AI to perform mundane tasks that currently consume most of their time at work. They mentioned that older generations continue to conduct mundane tasks because they are the "way it has always been done."
- They also welcomed the idea of fully immersive environments to perform detailed analytical work but were not optimistic about the military adopting that kind of technology anytime soon.

- Overall, the group was positive about the future of intelligence analysis and felt that technology will play a significant role in making their jobs easier and more efficient. They were also excited about the prospect of learning new skills and taking on new challenges.