Education and Emerging Technologies

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Case Study 1: Technology Landscape Review

Industry

There are over 130,000 K-12 schools in the United States alone, serving well over 50,000,000 students (Riser-Kositsky, 2020), and those numbers are rising at an accelerating rate as the population of the US increases and more families have access to public education. With the rising student population comes an increase in average class sizes—which are already high with most states averaging more than 20 students per class—as existing schools are required to teach more and more students. Amid a global pandemic, teachers with no background in tech are expected not only to teach their course material but teach students and parents how to use new technology as well.

The education industry serves a disparate group of people each with their own specific needs and demographics. Students make up the vast majority of the customers of the education industry and come from diverse backgrounds, with the majority of students being non-white. Teachers and principals, who are often the primary driver of technology adoption, are a much less diverse group, the overwhelming majority of which are white and over forty years old (Riser-Kositsky, 2020). These differences in demographics, cultural backgrounds, and socioeconomic status make the wide adoption of technologies difficult.

K-12 public education has historically been very averse to change and the adoption of new technologies due to budgetary constraints, the regulatory systems in place, and the need to train teachers, parents, and students on new technologies before they can be fully adopted. While some school districts are capable of adopting new technologies more easily due to local laws and their location, most districts across the nation are using outdated technology in nearly

every facet of education. With the ongoing battle against COVID-19, these shortcomings of the

education industry's technology have come into the forefront of the discussion, with a large

majority of surveyed parents expressing worry that their students are not learning adequately

due to the shortcomings of existing remote learning technology (Roberts, 2021).

Technology Landscape

5G

5G is the newest generation of wireless network technology coming online currently. It

is a new protocol which requires the deployment of multiple new networks across a low-, mid-,

and high-band frequencies, but is expected to offer top speeds up to ten times higher than the

previous network technology, 4G. In addition to the raw speed benefits, 5G is most notably said

to offer much greater bandwidth, which will enable many more devices to be connected to a

single network access point without causing congestion (Duffy, 2020). Many new technologies

are set to be built upon the capabilities of 5G, enabling faster streaming and more reliable

connections.

One technology banking on the adoption of widespread 5G is Nvidia's GeForce Now, a

game streaming platform which uses powerful, centralized computers to stream fast, high-

definition games to customers on their home computers and consoles. GeForce Now currently

allows for game streaming to nearly any device, but with 3G and 4G network technology mobile

devices can rarely offer the high-speed reaction times that many games need to be played

effectively. Nvidia has begun partnering with telecom companies across the world and allowing

those companies to run GeForce Now edge servers within their burgeoning 5G networks,

enabling customers with 5G-enabled devices to access the full benefits of the network's speed

for game streaming (O'Donnell, *GeForce Now...* 2021).

Wide adoption of 5G network technology that holds up to the expectations of 5G is not

likely to happen within the next half-decade due to the need for both companies and customers

to upgrade their existing, functional hardware. Though wide adoption is far off, early-adopters

and customers with high-speed and high-bandwidth needs will be able to take advantage of this

new technology in the coming years to boost their productivity and provide features and

services unheard of on slower 3G and 4G networks. Dense urban areas, where network

congestion is high and the coverage area is relatively small, will be the first to fully adopt the

capabilities of 5G, since more customers can be served with a smaller investment by telecoms

companies (O'Donnell, *Economic Analysis...* 2021).

Distributed Cloud

Distributed cloud technology, which has been coming online over the past few years, is the

expansion of the current cloud technology model to layer customer-owned hardware and

maintenance with service-owned software and features. This edge-distribution of cloud

services differs from the current mode of cloud technology where all cloud services are hosted

and run on geographically disparate hardware owned and maintained by the cloud services

provider (Craven, 2020).

The adoption of true distributed cloud technology will have a plethora of benefits to customers

and companies. One benefit is that the distribution of cloud services will allow companies to

more easily combine the benefits of different cloud service providers' products within one edge

node to take advantage of services that would otherwise be difficult to integrate or have high latency due to the need to bound between multiple cloud service locations (Pluim, 2020). Another benefit is that, with the adoption of in-house hardware management, companies and governments which would otherwise be unable to take advantage of popular cloud services due to privacy concerns could use these services while still guaranteeing that the servers meet strict regulations.

With the growth of the current distributed cloud technology and the newer truly distributed cloud technology, the number of companies and products that rely on some form of cloud technology will grow greatly. More apps and services are choosing to adopt a serverless model and rely on cloud technology to deliver the infrastructure that previously would have required an in-house server or database. The expansion of what services can be deployed locally on in-house servers and interchanged between providers will help to create better and more reliable products for companies and customers.

AR/VR

Versions of augmented reality (AR) and virtual reality (VR) devices and software have been coming online for the past decade, but the price point and lack of useful functionality have invariably been a downfall in breaching mass market adoption. The games industry has long been the primary developer and use-case for these devices, driving consumer demand by offering new and unique gameplay experiences, but the industry is slowly shifting towards more use in education and training in the coming years as the prices of devices continue to lower (Rubin, 2019).

One of the newer adopters of AR/VR technology is in consumer experience. Companies from IKEA to Wayfair are equipping their cell phone applications with the ability to use AR to allow customers to see how furniture items would look in their own homes without ever having to go to the store (Sandel, 2020). In-store and app-based virtual dressing rooms are another emerging technology that relies on AR hardware to supplement the shopping experience for consumers by removing much of the hassle and allowing customers to easily swap between colors and styles of clothing on the fly (Sullivan, 2017).

As VR headset and AR glasses become more widespread and popular, due to either the decreased cost of new technology or increased demand from the gaming sector, more and more business will likely begin to adapt their current offerings to include more tailored experiences through VR and AR (Marr, 2020). Especially as the world faces an ongoing pandemic and population densities reach new highs, fully VR experiences are expected to come online that enable experiences and encounters that would otherwise be impossible due to space limitations or health concerns.

Remote Learning Tools

The educational crisis exposed by the explosion of COVID-19 in the United States has led to the adoption of a wide variety of learning tools, technologies, and methods by some schools and parents. While most schools in the US are struggling during the pandemic with engaging students and keeping up attendance rates, schools that are early adopters of remote learning platforms and technologies are seeing much better results on average. Dozens of these tools

have sprung from the fringes of education into the forefront of remote learning as more

schools are forced to adopt new technologies.

ClassDojo is a remote and in-person learning platform that has been around since its initial

inception in 2011 but has recently become more popular due to the pandemic. This service

allows students, teachers, parents, and administrators to communicate and socialize as well as

issue assignments and send documents. This platform helps to keep students engaged and keep

parents in the know about how their children and the school are progressing from week to

week (Lockett, 2020).

Gamification and microlearning are two more methods which remote learning tools are adopting with

rising frequency as more learning shifts online (VILLAUMBROSIA, 2020). Gamification, adding game

design elements and mechanics to a non-game, can be used to effectively incentivize students to focus

on completing work better than standard methods. Microlearning, condensing coherent lessons into

short, usually sub-15-minute chunks, is being adopted by more and more remote learning platforms and

schools to make asynchronous learning fit the schedule and attention span of students.

Remote learning options and tools are an older technology, but still have a lot of room to

improve. This capacity for growth is fueled by the need for remote learning tools to account for

a larger and larger numbers of permanently remote students, as well as the constraints and

limitations of school districts both financially and technologically.

Conversation Intelligence

Conversation intelligence is the application of AI algorithms and machine learning to

voice and text conversations. These conversations can either be between two human

participants, where the algorithms can be run in real-time or run against a recording of the conversation, or between a human participant and an AI chatbot. AI and machine learning can help companies better respond to customer needs based on hundreds of factors from intonation and speed of speech to spelling and grammar mistakes in text chats, using advanced algorithms that make use of prior conversations and AI training.

One company making use of advanced conversational AI is a Boston-based software company called Cognito. Cognito's software is used by over-the-phone sales companies to help better engage potential-customers by tracking both verbal and non-verbal cues and making predictions about the most likely sales outcome (Wu, 2020). These algorithms track everything from pitch to cadence and compares it against prior conversations in order to detect changes in the customer. Cognito's technology can increase empathy during sales calls by acting as a coach or guide to salespeople in real-time based on how the customers are responding.

Another company using conversational AI is Chicago-based Accenture, which has developed a conversational AI called Memory Lane that uses Google smart-speakers in order to supply both companionship and stimulation to the elderly. Elderly people are often isolated from society, either in care homes or alone at home, and Memory Lane was designed to provide them engagement by asking them to tell their life story (Fearn, 2019). Memory Lane asks daily questions of its users about their past experiences and life story and compiles their answers into a personalized database. These auto-biography databases can then be compiled into professionally edited biographies or podcasts, so that future generations can learn first-hand accounts of their relatives.

Conversational intelligence and AI will continue to develop as time goes on, especially as more brick-and-mortar businesses transition to a hybrid or online-only model and require more customer service to be done without the face-to-face element. This technology has the potential to revolutionize how customer-service personnel and salespeople interact with their customers, as well as how automated services interact with their users. Instead of responding with canned answers or scripted responses, conversational AI can make decisions based on how the user is speaking by gauging their emotional state and respond appropriately.

Analysis

Many of the aforementioned emerging technologies could have a massive impact on the education industry from both the teacher and student perspectives. New trends in wireless communication protocols and remote learning technology will help students, teachers, and parents more effectively communicate and enable more effective distance learning. Distributed cloud technology might allow school districts to take advantage of cloud computing resources that previously were disallowed due to local and national regulations. The adoption of augmented and virtual reality technology in schools and at home might increase the efficacy of teaching certain lessons and enable students to engage with topics and locations that are otherwise not feasible. Strides in conversational AI might help teachers, students, and teachers communicate more effectively by eliminating language barriers and enabling more empathetic interactions.

The global adoption of 5G will enable schools at the forefront of educational technology to provide further support for classes on technology and the adoption of connected devices in classrooms and at homes which support students and teachers. Smartboards, interactive displays, and in-class conferencing technology can enrich classrooms by allowing teachers to use new forms of instruction and

presentation than previously possible. Schools that adopt a 1:1 computer policy have seen mixed results based on their implementation but introducing students to technology early better prepares them for the post-school world. During the COVID-19 pandemic, with the number of students being taught from home and the existing school infrastructure being stressed, many districts lost more than four weeks of school due to technological limitations (Lockett, 2020). The advancement of 5G will allow both in-class and remote education to be furthered by enabling teachers and students to make use of more smart devices.

Augmented and virtual reality advancements will open the possibility for students and teachers to engage with topics on unprecedented levels. Guest speakers and field trips are expensive and can be fully out of reach for schools in lower-income areas. The wider adoption of VR and AR technology, which will likely reduce the price point greatly, would allow school districts which would otherwise be unable to take part in these activities, due to financial or geographic limitations, to purchase AR and VR devices, allowing teachers to guide students on lessons virtually that would be impossible to achieve otherwise. AR devices might also be adopted to supplement existing lesson plans by providing additional context and interactive elements to lessons.

Conversational intelligence and AI technology might help teachers, students, and parents communicate more effectively with one another both in person and remotely. There is a large disparity between the background of most students and most teachers, which can often make communication difficult. This is further compounded by the number of students who are first generation immigrants to the United States, which makes communication between parents and teachers frequently difficult or outright impossible. Strides in conversational AI algorithms and the adoption of more conversational intelligence technology could lead to more effective and empathetic communication between teachers, students, and parents, especially during times of remote education.

The education industry is historically very slow to adopt new technology and methodology due to the preponderance of older educators in the industry, local and national regulations based on historical data, and ever-tightening budgets for school districts. While unlikely to have any large, sudden impact on education in the United States, many of the current emerging technologies will likely serve the education industry well far in the future when they are adopted.

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