Zoom Out: How the COVID-19 Pandemic and The Ensuing Implementation of Virtual Learning Has Affected The Learning and Social Abilities of School Children

A Research Paper submitted to the Department of Engineering and Society

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Partial Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

Thomas Mossburg

Spring 2023

On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

Advisor

Bryn E. Seabrook, Department of Engineering and Society

COVID-19 and The Rise of Virtual Meetings

There is no fear like the fear of realizing that a microphone was not muted when it was supposed to be. Before March 2020, this fear would be somewhat irrational; how often are people in situations when they are speaking into a microphone with a mute toggle? Nowadays, with Zoom and other online meeting platforms becoming as ubiquitous as the computers that host them, it has become second nature to first check if the camera is on, and then if the microphone is hot. The coronavirus pandemic changed the world forever, but one of the most impactful changes to society is the rise of Zoom and other online meeting platforms taking the place of in-person classroom instruction. Much of this change is positive: a technologically dynamic classroom gives the opportunity for more students to learn in ways that better suit them. However, the drawbacks are also hard to ignore. During the two-plus-year long pandemic, the vast majority of children fell behind in their schooling while they and their instructors figured out the best way to carry out their curricula. Children need the same social interaction and community building that all humans do. Most of all, the across-the-board access to the technology necessary to learn in the post-pandemic, hybrid learning world is far from equitable. How is the shift from in-person schooling to online learning impacting both the future education and the social skills of schoolchildren?

This paper incorporates Documentary Research Methods to help with the analysis of the research question. Among the sources used and referenced are books, journals, websites, and miscellaneous psychological sources. The research in this paper is organized chronologically. The analysis will begin with a contextual overview of the role that technology played in the classroom before the pandemic struck in 2020, and then will continue with how school

administrators adapted to maintain educational progress, and finally the long lasting ramifications of hybrid learning in schools.

Contextualizing Technological Aids In The Classroom

The main groups of people that have been affected by the technological shift in education are schoolchildren, school administrators, teachers, and parents. Schoolchildren, many in preschool when social development is crucial, were rightfully barred from playdates and playgrounds with friends (*Social Development, 2021)*. Modern society is filled with a short news cycle and a shorter attention span. Eventually, enough time is going to pass and school children are going to be unable to rightfully attribute the pandemic as an impetus for a stunting of social growth as they continue to grow into adults and working people.

The paper aims to analyze how the pandemic-initiated increase in popularity of telecommunications as a means of general communication has changed academic landscape and the sociability of schoolchildren. The main methodology used is documentary research methods, which helps contextualize the understanding of the context of the use of telecommunication technology before and after the pandemic. During the research phase, the main keywords used when searching are “hybrid work,” “Work From Home,” “changing social skills,” “communicating across generations,” and “Zoom and the educational system.” This paper consists of a before-and-after analysis of primary and secondary schooling, and then a look into how the differences in socio-economic background has disproportionately affected those who are disadvantaged.

The use of computers and technology-aided education had been slowly rising since the 2010s. However, since the coronavirus pandemic began in 2020, this slow rise turned into a

jarring acceleration. And while there are many positives to be gleaned and taken advantage of with increased technology in the classroom, not all students are benefitting from the increase in gadgets, and some students still do not have access to them at all. It is the duty of school administrators to address and consider all demographics and learning styles of their students when considering the future of complex technologies as a part of school curricula.

Virtual Meetings as a Paradigm Shift

The COVID-19 pandemic initiated a paradigm shift in society that has caused people to intrinsically change how they interact with the world and each other. Originally defined by philosopher of science Thomas Kuhn in 1962, a paradigm shift is a foundational change in the way that a particular field of thought is treated in society (Kuhn, 2015). Kuhn argues that the process by which a scientific discovery is made and then eventually adopted into society can be traced with the following cycle: Pre-Science, Normal Science, Model Crisis, and Model Revolution. The Pre-Science section occurs when there is a question that is lacking an answer, some phenomenon in the universe that society is trying to understand but has not yet. The Normal Science part of the cycle is the point in time when there are theories that exist are accepted, and scientists try and defend a given theory from any possible anomalies/challenges to the validity of the theory. Normal Science takes up much of the time of the Paradigm Shift Cycle. The Model Crisis section of the cycle is when the anomalies/challenges to a given theory become unsurmountable and that theory gets rejected. It becomes clear that the current understanding of the world is faulty, and scientific discovery is needed to recreate basic theories. Next is Model Revolution, when a new Paradigm is created and accepted, and science continues on within a society with this new paradigm (McLeod, 2020).

Historically, a paradigm shift occurred when scientific discoveries came to light that changed society's literal understanding of the world. An example of this type of paradigm shift would be Copernicus discovering his heliocentric view of the universe; before, scientists thought that Earth was at the center of the universe, but the new Copernican way of thought cause a paradigm shift that changed society's perspective (*Paradigm Shift*).

In modern times, a paradigm shift does not need a massive scientific discovery in order to exist. A change in thought can be considered a paradigm shift if it consists of "a radical change from previous prevailing attitudes that forms the basis of a new orthodoxy (Masterclass, 2023)." The idea of a paradigm shift continues to be a framework that scientists use to view the world. To give another example, in the twentieth century during the industrial revolution, production and manufacturing boomed in the United States. And with that boom in production also came a boom in greenhouse gases and other pollutes. As scientists began to realize the effect that the increased industrial capacity was beginning to have on the environment, a paradigm shift occurred and society began to pay attention to its carbon footprint (Masterclass, 2023).

The paradigm shift framework is applicable to the pandemic in many ways, and it is an apt lens to study society's shift to a virtual/hybrid working and schooling environment. However, the theory is not without flaws. Scholars argue that the biggest flaw in Kuhn's Paradigm Shift Framework is the linearity with which he presents his argument. For example, Nikola Tesla had accurate idea about the possibilities and widespread adoption of wireless communication technology, among other technological advancements, that would not actually come into fruition until far after his death in 1943. Despite his presenting of accurate theories of how the world can and possibly could operate, the advancement of such technology did not follow Kuhn's proposed cycle due to external factors (Adams, 2017).

Results and Discussion

Technology in the Classroom, Pre-Pandemic

Before the pandemic, technology had a place in modern American education. To give a simple example, despite the fact that it is widely argued that students learn and retain more information when taking handwritten notes as opposed to typing them out, more and more students have been turning to a laptop or a tablet as their note-taking medium of choice (Miraldi, 2003). The reason for a rise in popularity of electronic note-taking is seemingly simple: it is easier to type than it is to write, and in an education system that necessitates feeding as much information as possible in not-enough time, this speed is important. Another example is the notion of "Flipped Learning." Defined as using video lectured or technologically guided readings to shift the learning process "from the group to the individual," Flipped Learning was becoming increasingly popular in American classrooms in the 2010's (Talbert, 2017). The benefits of Flipped Learning were mixed. In some contexts (e.g. for some students or in some subjects) Flipped Learning was more beneficial than others. The main advantage to Flipped Learning was the freedom of the teacher to then focus on what each individual student needed in order to succeed, as opposed to a general lecture to a group of students learning different things at different rates (Lo and Hew, 2017).

For the purposes of this research, though, it is important to note that at this time, in the 2010s, the introduction of technology into modern classrooms was at least experimental and at most a helpful aid. Students still had the opportunity to take notes on paper. There were built in times for students who did not benefit from Flipped Learning to approach the instructor to get what they needed to succeed in school. There were opportunities to engage with technology as

much as was needed, and disengage with technology when necessary. Then, the coronavirus pandemic altered this process completely.

Technology was no longer optional. For children of all ages, the options were: adapt to online learning and stare into a screen all day, or be unable to learn and advance academically for the following two years. In other words, there was no option. Virtual learning was being thrust into the foreground, and the technologies that had been piloted for the previous decade were being called into action.

Technology in the Classroom as a Paradigm Shift

Typically, when a paradigm shift has occurred in history, is has been due to a technology or increase in knowledge that changed the way that society understood the world. The cotton gin and the assembly line to being the industrial revolution and change the way that the world manufactured goods and accelerated the world economy into the 20th century. Einstein's research led to a better understanding of space and time and black holes allowing scientists to more accurately research the universe, in addition to his theory or relativity allowing scientists to initiate quantum mechanics as a field of study (*Masterclass, 2023).* The COVID-19 pandemic, however, was a different kind of paradigm shift. Certainly the given examples had their relative stimuli that gave cause to their research in the first place, but none have a clear-cut line of demarcation that can be pointed to as the main reason for the beginning of the paradigm shift. When COVID-19 halted most business operations, existing technologies that could possibly be used in an attempt to keep business flowing were repurposed to do so.

When Thomas Kuhn established the idea of a Paradigm Shift in this publication *The Structure of Scientific Revolutions,* he created "The Kuhn Cycle" (Figure 1). The central idea

behind The Kuhn Cycle and the Paradigm Shift as a whole is that scientific advancement does not occur through a basic increase in understanding of the world. There are steps between the status quo of knowledge and the future ability to adequately wield said knowledge in a productive way.

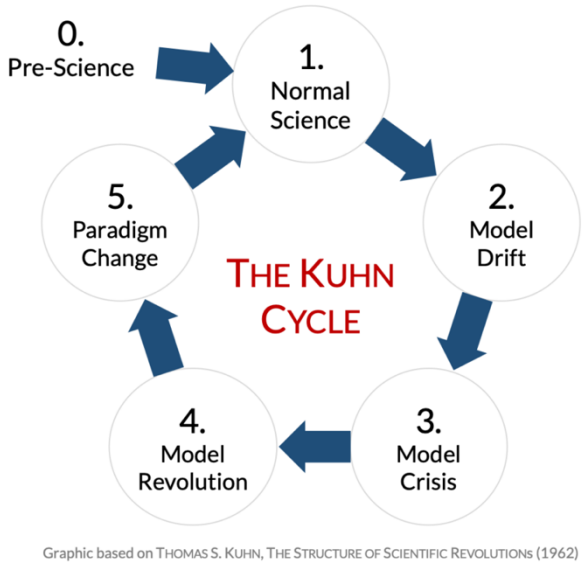

Figure 1: Visualization of The Kuhn Cycle

In the context of the education system, the Normal Science-Model Drift stages occurred when more assistive technologies came out (such as the previously discussed tablets, laptops, video lectures to create Flipped Learning, etc.). The landscape in the late 2010s was one of contentment with a general desire to find more effective ways of pedagogy. Where the accelerated inclusion of technology in classrooms breaks from the typical Paradigm Shift mold is the Model Crisis and Model Revolution stages of the Kuhn Cycle. When COVID-19 became prevalent enough to keep people at home in March of 2020, there was no real time for any "uneasiness." There was no time for deliberation about the efficacy of virtual/hybrid work environments; they were necessary in order for any sort of progress to ensue, and so they came to be. But even so, throughout the first months of the pandemic, online meeting platforms and other

hybrid work adjustments were seen through a lens of "making the best of what has been given." The quality of work and the comfort at which that work was completed was second grade. In the first months of the pandemic, these angsty feelings describe the Model Crisis and Model Revolution phases of the Kuhn Cycle (Kuhn, 2015 and Ramsay, 2022).

What remains to be fully understood, and what it still being adjusted to, is the last phase of the Kuhn Cycle, the Paradigm Change. During the Paradigm Change, individuals within a society reach the oft-mentioned, but never fully understood, "new normal." The game has changed, the goal posts have shifted, so what does success look like? How can students, working professionals, everyday people in their social circles, adapt to the new paradigm to continue making progress in their own individual fields?

Ramifications of The Pandemic in The Behavior of Schoolchildren

Within the education system, the answer to that question lies in flexibility. Educators must lay out a plan and a curriculum that can support students that learn better with technology aids, and students that learn effectively in a traditional lecturing classroom environment. The optimal solution likely lies in between the pre-pandemic, exclusively pen-and-paper structure, and the mid-pandemic style of only (a)synchronous lectures and remote assignments. Reframing the role of technology in classrooms away from something that overcomplicates all processes, or as the all-or-nothing crux, and beginning to view technology as a tool to aid in lectures is key to maintaining an efficacious learning experience (*Innovative Teaching,* 2021).

And the incorporation of technology has a lot of work to do. Students everywhere really struggled during the pandemic to adjust to remote or hybrid learning. According to a study performed by Center for Education Policy Research*,* in Fall 2021, American students in low-poverty districts that learned remotely lost approximately 13 weeks of education; that number

rises to 22 weeks when looking at high-poverty districts. Put another way, students that stayed remote only received between a quarter and a half of their expected education in the 2021-2022 school year (Kane, 2022). Of course, making up for the lost time in the pandemic does not lie solely on creative use of hybrid learning aids. There are broader systemic conversations to be had about fixing the modern education landscape; however, it is clear that the pandemic was an impetus for a quick and severe nosedive in student performance, while also providing an opportunity to innovate and improve how students learn. While hybrid learning aids may not fully make up for lost time for the students that struggled while in quarantine, they could improve the effectiveness of broader teaching methods.

Switching to the impact that remote learning has had on the general sociability of school children, the effects are real and are making the lives of educators harder and harder. In an interview with NPR, a teacher of younger children had this to say about the behavior of her students:

> I teach 4-year-olds. And to be honest, this year has been a very challenging year. What I've seen in my 4-year-old students - a lot of anger, a lot of irritability, a lot of lack of impulse control, be it with their words, with their hands. I've seen a lot of oppositional defiance. It's really concerning. And I really do think this has to do with, you know, the pandemic. I think whatever the parents were going through, you know, in 2020 - something has happened because I'm seeing really a big disconnect in the young children that I'm teaching today.

The lack of social structure and activity during the pandemic has greatly increased the angst and behavioral volatility of children. Educators now feel compelled to spend lesson time, which is vital to catch students up on what they missed while still making some progress, on things such as kindness and compassion (Contreras, et. al., 2023).

The mental health decline in children during the pandemic has become a crisis. The American Academy of Pediatrics, the American Academy of Child and Adolescent Psychiatry,

and the Children's Hospital Association declared the phenomenon a national emergency in late 2021. Younger children are exhibiting serious behavioral issues, and an increase in bullying has been observed in older schoolchildren (Vestal, 2021). It is easy to sit back and look through the pandemic from a point of view that now, in 2023, it is over, and it is time to look for the silver linings and try to glean any sort of positive takeaway, and it is important to do so. But it is equally, if not more important, to focus in on the issues that are persisting now in the academic arena. It is undeniably true that the technological paradigm shift currently happening in terms of technological aids being used in the classrooms is a positive thing for the future of pedagogy; but, the kids that were forced to endure the "trial period" of those technologies during long periods of isolation when they were given no other opportunity to interact with the world are suffering, and will continue to suffer as a result.

Inequities in Access to Technology

It would be naïve to look at the coronavirus pandemic and how it affected schoolchildren, and not address the fact that virtual learning necessitates some technological infrastructure at home for the students. Before even examining the efficacy and ability for an online lecture to adequately disseminate information, those lectures need to be able to be accessed by ALL students. In order for an online, synchronous lecture to occur and be reliably attended by students, those students need laptops, stable internet connection, and a location quiet and distraction-free enough to be able to hear and see what is happening in a lesson. According to a survey conducted by *Education Week,* areas with higher poverty have lower access to synchronous virtual lectures, and they are more greatly hindered by access to technology than the comparative low poverty areas (Herold, 2022).

The lack of access to the technology necessary for virtual learning presented a very difficult challenge to be overcome by administrators. For affluent school districts, the answer is simple: provide all children in need with district-funded laptops that have internet access. The children can use the laptops for the academic period as necessary, and then return them afterwards. For the less fortunate districts, though, giving all students relatively expensive laptops is not a plausible solution. Thus, school administrators are faced with a dilemma: do they try and keep their already-backup virtual curriculum on course to try and buoy the education of the children who have access, while leaving those without access behind? Or do they dilute the curriculum of all students down to the point where all students can receive the same, albeit far lesser, education? In Los Angeles, in 2020, administrators chose the latter. In an effort to keep everything equitable, administrators attempted to hold synchronous lectures, they attempted to have take-home assignments to keep some sort of constant flow of learning, but they also attached very little weight on those assignments in terms of a final grade, to avoid punishing those without access (*Inequity, 2020)*.

There is a problem with this strategy, though. Leaving the children without access behind is an option that should never have been considered, and it was not. But, by creating a system where there is essentially no means of evaluation, there is no way to differentiate those who are advantaged and those who have little access to the necessary tools. The kids that are advantaged enough to have the necessary access to technology are also more likely to have other resources at their disposal besides a typical school lesson plan to maintain their leaning progression. Thus, the disadvantaged population is yet still being left behind. Those children who do not have a laptop or internet access should have been met with extra support, special attention to make sure that

despite the circumstances, they were not going to lose any more weeks of school than they should be.

This is a particularly important point to make given the context of the paradigm shift. On the other side of the pandemic, as more and more schools transition to virtual or hybrid learning as a standard means of teaching, the population of children without technology access still exists. They have fallen behind their advantaged peers, and now are met with a new normal in which they will continue to progress slower than their peers as a result of limited access to technology.

Takeaways From Technology And How To Get The Most Out Of High-Tech Tools

The presence of technology in classrooms is here to stay, and it offers many benefits and a lot of upside if used correctly. However, those benefits and that upside will not be conveyed without a proper understanding of each and every student in the classroom. Some students need some additional community building and social activities to feed the human desire for connection that is so important to fulfill in school-aged children. Perhaps most important of all, any advantages that technology could possibly bring to academia will all be for naught if students from all socioeconomic backgrounds are not considered. If the new paradigm is not equitable then it will turn in to the old paradigm, and quickly.

Some of the drawbacks and limitations to this research are just how new it all is. The pandemic began three years ago (as of this writing), in March 2020. Many people are still feeling the effects of "long-COVID," and many immune-compromised people still do not feel comfortable being in crowded public places. It is easy to consider society in 2023 a "post-pandemic," but for a not-insignificant portion of the population, that is not true. Given the immediate recency of the issue at hand, compelling research is still being performed, compiled, and published.

Works Cited

Contreras, Gus, et al. “Covid's Impact on Classrooms Will Linger and Must Be Addressed, According to Teachers.” *NPR*, NPR, 2 Feb. 2023, https://www.npr.org/2023/02/02/1153936515/covids-impact-on-classrooms-will-linger-and-must-be-addressed-according-to-teach.

Herold, B. (2022, October 21). *The disparities in remote learning under coronavirus (in charts)*. Education Week. Retrieved March 22, 2023, from https://www.edweek.org/technology/the-disparities-in-remote-learning-under-coronavirus-in-charts/2020/04

Kane, T. (2022, May 22). *Kids are far, far behind in school*. The Atlantic. Retrieved March 12, 2023, from https://www.theatlantic.com/ideas/archive/2022/05/schools-learning-loss-remote-covid-education/629938/

Kuhn, T. S. (2015). *The Structure of Scientific Revolutions*. The University of Chicago Press.

Lo, C. K., & Hew, K. F. (n.d.). *A critical review of flipped classroom challenges in K-12 education: Possible solutions and recommendations for future research*. Research and practice in technology enhanced learning. Retrieved March 22, 2023, from https://pubmed.ncbi.nlm.nih.gov/30613253/

Miraldi, R. (2003). *The Pen Is Mightier: The Muckraking Life of Charles Edward Russell*. New York: Palgrave Macmillan.

Opinion | failure in the virtual classroom. The Wall Street Journal. (2020, June 21). Retrieved March 22, 2023, from https://www.wsj.com/articles/failure-in-the-virtual-classroom-11592776152?ns=prod%2Faccounts-wsj

Paradigm shift definition: 6 examples of paradigm shifts - 2023. MasterClass. (n.d.). Retrieved March 22, 2023, from https://www.masterclass.com/articles/paradigm-shift-explained

Ramsay, K. (2022, March 10). *Paradigm shifts and the Thomas Kuhn cycle*. Achology. Retrieved March 11, 2023, from https://achology.com/paradigm-shifts-and-the-thomas-kuhn-cycle/

Talbert, Robert (Associate professor), & Ebook Central - Academic Complete (2017). *Flipped Learning: A Guide for Higher Education Faculty*. Sterling, Virginia: Stylus Publishing, LLC.

Vestal, C. (2021, November 9). *Covid Harmed Kids' mental health-and schools are feeling it*. COVID Harmed Kids' Mental Health-And Schools Are Feeling It | The Pew Charitable

Trusts. Retrieved March 13, 2023, from https://www.pewtrusts.org/en/research-and-analysis/blogs/stateline/2021/11/08/covid-harmed-kids-mental-health-and-schools-are-feeling-it

Why innovative teaching in a post-pandemic classroom matters. Independent School Management | Advancing School Leadership-Enriching The Student Experience. (2021, December 16). Retrieved March 12, 2023, from https://isminc.com/advisory/publications/the-source/why-innovative-teaching-post-pandemic-classroom-matters

Adams, A. (2017, January 22). *Objections to Kuhn's theory of scientific progression - hektoen international*. Hektoen International - An online medical humanities journal. Retrieved February 5, 2023, from https://hekint.org/2017/01/22/objections-to-kuhns-theory-of-scientific-progression/

Coate, P. (n.d.). *Remote work before, during, and after the pandemicquarterly economics briefing–Q4 2020*. Remote Work Before, During, and After the Pandemic. Retrieved February 3, 2023, from https://www.ncci.com/SecureDocuments/QEB/QEB_Q4_2020_RemoteWork.html

Farrell, C. (2020, May 12). *How the coronavirus punishes many older workers*. PBS. Retrieved November 3, 2022, from https://www.pbs.org/wnet/chasing-the-dream/stories/how-coronavirus-punishes-older-workers/

Godfrey, R. (2020). Grandpa's Lessons on Surviving a Quarantine and Life. US: Ruthie Godfrey Books.

Kuhn, T. S. (2015). The Priority of Paradigms. In *The structure of Scientific Revolutions*. The University of Chicago Press.

MacLeod, K. E., Cole, B. L., & Musselwhite, C. (2022, June). *Commuting to work post-pandemic: Opportunities for health?* Journal of transport & health. Retrieved February 5, 2023, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9074865/#:~:text=The%20COVID%2D 19%20pandemic%20eliminated,m ay%20be%20a%20 permanent%20change.

Mcleod, S. (2020, May 1). *Thomas Kuhn - Science as a paradigm*. Thomas Kuhn Paradigm Shift - Simply Psychology. Retrieved February 5, 2023, from https://www.simplypsychology.org/Kuhn-Paradigm.html#:~:text=Thomas%20Kuhn%20%2D%20Science%20as%20a%20Paradigm,By%20Dr.&text=Thomas%20Kuhn%20argued%20that%20science,someone%20proposes%20a%20new%20theory.

Paradigm shift definition: 6 examples of paradigm shifts - 2023. MasterClass. (n.d.). Retrieved February 3, 2023, from https://www.masterclass.com/articles/paradigm-shift-explained

Paradigm shift. Teaching and Learning Resources. (n.d.). Retrieved February 3, 2023, from https://www.tutor2u.net/psychology/topics/paradigm-shift#:~:text=Examples%20of%20paradigm%20shifts%20are,relativity%20and%20to%20quantum%20physics.

Social Development in preschoolers. HealthyChildren.org. (2021). Retrieved October 26, 2022, from https://www.healthychildren.org/English/ages-stages/preschool/Pages/Social-Development-in-Preschoolers.aspx

Strawser, M. G., Smith, S., & Rubenking, B. (2021). Multigenerational Communication in Organizations: Insights From the Workplace. New York, NY: Routledge.