Education in the times of Pandemic; A Retrospective Review

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Abstract

Although it seems as if social distancing is a new concept, the CDC previously issued similar guidelines for more typical flu prevention. Similarly, in 2007, guidelines were implemented to limit the transmission of swine flu in schools. As early as 1908, guidelines were proposed that included "segregation" of those with infectious Tuberculosis. Research exists about the pandemic impacts and the reactionary approaches adopted and implemented by schools and higher education globally, especially the countries that have experienced a pandemic in the last few decades, such as Ebola and SARS. For example, significant improvements have occurred since the 1918 Flu pandemic, especially within the realms of technology, such as the transition to electronic textbooks.

When considering how universities might respond to a pandemic regarding educating the students enrolled included but not limited to increases in class sizes, alternative delivery methods have been considered. A corollary to offset the impact of the pandemic would be closing the universities (historically observed). However, limited existing research provides insight into changes in course delivery, adoption/implementation of technological advancements, lessons learned from the countries impacted, and adoption and implementation of measures to smoothen the transition with the sudden pandemic outbreak. Engineering education must be at the forefront of technological improvements in education.

The study utilized a content analysis methodology to review existing research on pandemics and their effect on education globally. A variety of information exists from outside the United States, where government-level responses were required. The content analysis results and were overlapped to determine changes to curriculums based on the need for alternative course delivery. A comparison is made of previous teaching and learning methods versus those collected via survey during the Covid-19 pandemic.

Keywords

Education, Recession, Epidemic, Pandemic

Introduction

There has been much research on what happened during the recent global pandemic due to Covid-19 (McEntire at al. 2021, Naeem and Bhatti 2020, and Adhikari et al. 2021). In countries where an epidemic-level disease spread has not been recently seen, it may be difficult to imagine how they affect the education system. The CDC provides some guidance on the difference in the terminology of disease levels, but these definitions lack specificity. An epidemic is a sudden increase in cases, and an outbreak indicates a spike in cases in a limited geographic area. In contrast, a pandemic indicates an epidemic spread over several countries or even continents (CDC 2012). With previous epidemics and pandemics in the 20th century like Tuberculosis, Influenza, Ebola, AIDS, and SARS, the effects on the education system were limited. Prior epidemiology was much like early engineering, relying partly on what had worked in previous outbreaks like Cholera, Typhoid, and Yellow Fever (Murphy 2005 and Rosner 2010). Although there may be anecdotal evidence of why the United States education system did not see the major

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paradigm shifts in the past, it would be valuable to document the systemic changes that occurred which allowed the education system to respond as it did.

Although public education began in the United States before the 20th century, most of the minimum requirements for public education began to be codified between 1918-1930. The World Wars affected both public health and education policy. Not only did it become apparent that there was inequality in the level of education, but there were also health needs which were causing concern. The poor health and education systems were a national security issue. Nurses became more prevalent in schools just prior to the first world war (Cubberly 1919). In 1908 with a Tuberculosis outbreak in the United Kingdom, other concerns about ventilation and a healthy environment were also identified (Hays 1908). In 1918, every U.S. state finally had a minimum requirement for elementary education. Reflections on how quickly the education system in the U.S. has adapted to the Covid-19 pandemic should also consider that the current system is about 100 years old.

Public education was further codified and funded through the Partnership for Learning and Earning Act of 1968 and the Elementary and Secondary Education Amendments of 1969. Around the same time, computers became reasonably sized for use in public high schools. Within a few decades, typing classes became keyboarding classes as computers were integrated into the schools. With the high cost and size of computers, they were still separate from traditional classroom learning. With the advent of the inexpensive mobile phone in the 1990s, computing became accessible to everyone. This technological transition equates to transitions in education and the university. Technological advances were not limited to the internet. The 1990s also saw the advent of the SMART board or interactive whiteboard (Filipczak 1993), which has been widely incorporated into the classroom.

Correspondence studies started in the late nineteenth century (Wedemeyer and Childs 1961). Online education began shortly after computers became widely accessible in education. Engineering education research started reporting on online education in the 1990s. Early versions of online education were very static with limited dial-up internet access. As broadband internet became widely available in the late 2000s, university online courses also increased (Belo et al. 2014). As technology improved, education began to change as well. Hybrid course delivery methods can be seen in the early 2000s (Tripp 2003). As there are many ways to describe delivery methods that use both online and face-to-face (f2f) methods, like blended, hybrid, inverted, and flipped. The Mixed Instructional eXperience (MIX) taxonomy defines the portion of online versus f2f (Margulieux et al. 2016) and provides a framework of the methodologies currently in use as they overlap and continue to expand.

Although there are a variety of funding methods, education in the United States has been largely publicly funded at the state and federal levels over the last century. Public universities have received state and federal funding as well. During the same period, the United States moved from the Industrial Revolution into the Digital Revolution. As the 20th century turned into the 21st century, a series of wars, recessions, and epidemics, and pandemics occurred. With everything that happened in the century preceding Covid-19, was a paradigm shift already occurring? Was the paradigm shift in education occurring slowly, and Covid-19 was an impetus to rapid change? Is there a correlation? This research seeks to answer these questions while focusing on the United State education system.

Methodology

A literature review was performed on a variety of publication types and topics. The research question asks if a substantial change occurred in relation to the pandemic, not because of the pandemic itself, but rather due to many other changes in the education system. Additionally, did other paradigm shifts occur in education which also correlates to external changes? To identify why the education system was able to

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react quickly, a comprehensive review of education, health, and technological changes before the Covid-19 pandemic is necessary.

A timeline of events was created to identify trends in education in the last century. The timeline cross-references previous outbreaks, epidemics, and pandemics with responses in education. The timelines also consider other major changes occurring outside of education which then affected education. Other events include recessions, wars, and major changes to the United States educational system. Because international education varies widely, as do sizeable wars and economic changes, the review focuses largely on what happened in the United States. However, it is known that with the advent of the internet, broadband, and a 24-hour news cycle that information about world event occurrences and responses is available at our fingertips. Therefore, some international events, like diseases, are included in the timelines.

Discussion

A series of timelines were created and then overlapped to determine if a paradigm shift was occurring prior to the Covid-19 pandemic. The initial timeline indicates the various recessions and depressions in the United States prior to and including the beginning of Covid-19. The most recent occurrences are presented at the top of the graph. The graph lists recession events only and names associated with those economic events, which sometimes include the wars that preceded them. Not all recessions are shown, especially as this research is only interested in the United States. Further, some economic downturns were less than a year and are not included, like the brief recession from 1969-70 (NBER 2020). See figure 1. In the United States, since 1979, there has been a focus on limiting economic events through the Federal Reserve and adjusting interest rates (Federal Reserve Bank of San Francisco 2003), which partially explains the reduced length of recessions after the Great Depression.

After the Great Depression are two post-war recessions (Amadeo 2020), which also lasted longer than those post-1979. The United States encountered additional recessions, which may be in part due to federal policy but were also due in part to oil embargoes (Kalleberg and Von Watcher 2017 and Amadeo 2020). More recently are the Savings and Loan Crisis, the Dot-com Bust (or post 9/11 recession), and the 2008 Great Recession, which may be associated with the real estate bubble or banking crisis. Another recession is expected to be identified with the long-term shut-downs due to Covid-19. Previous research has shown an increase in return to the university, which is expressly a change in education, during a recession or economic downturn, specifically those of the 2000s, although the enrollment increase does lag behind the economic changes (Barr and Turner 2013).

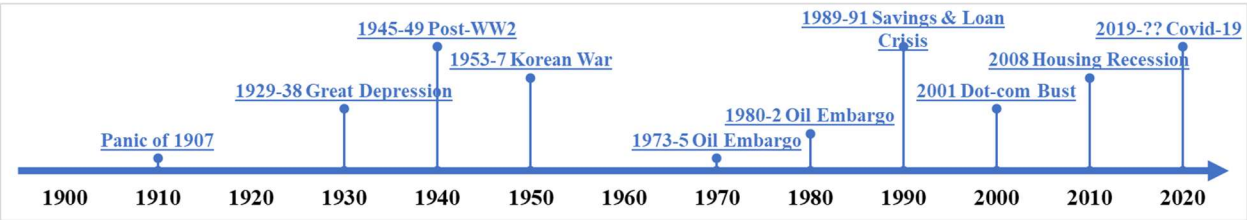

Figure 1 Recession Timeline in the Last Century (1900-2020)

To consider the history of epidemics and pandemics in the United States, an additional timeline was created. Some of the diseases did not make it to the United States but had international responses in education. Polio, also known as infantile paralysis, is not transmitted via the respiratory system. Although transmission outside the respiratory system should indicate that changes in schools were not required,

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multiple responses, including separation of the sick and school closures, were used (Meyers and Thomasson 2021).

Further, HIV/AIDS is shown while the interventions do not typically overlap with education due to the transmission method. As HIV/AIDS continues to affect persons worldwide, it would be remiss not to mention. HIV/AIDS is shown as one year but continues. Figure 2 illustrates the types of diseases which we have seen in the United States. Cholera, Crimean-Congo Hemorrhagic Fever, MERS, the Plague, and Smallpox are not included in the timeline. The timeline is not exhaustive but rather illustrates epidemic and pandemic level diseases in the United States. Of note is the large gap between the 1920s and the 1980s.

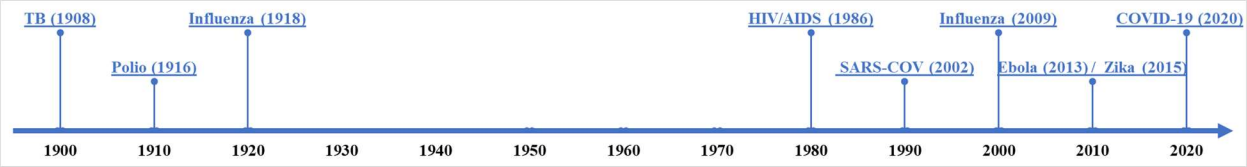

Figure 2: Pandemic Timeline in the Last Century (1900-2020)

Influenza vaccines have been available in the United States since the 1930s (Palache 1997). Initial vaccines for smallpox, diphtheria, and tetanus became available in the 1950s (Dudgeon 1980). A vaccine became available for Measles or Rubeola in 1963 (Phadke et al. 2016). Shortly thereafter, a vaccine was developed for Mumps in 1968 (Dudgeon 1980). In 1980, most states had regulations requiring vaccines for childhood diseases before school admission (Dudgeon 1980). The Chicken Pox or Varicella vaccine became available in the United States in 1995. Although Varicella is considered respirable transmission, the pox or legions are typically visible when transmissible (Abrevaya and Mulligan 2011). Although regulations had been put in place for vaccines as a requirement for school admission, in the early 2000s, it became apparent that vaccine hesitancy was creating localized disease outbreaks (Phadke et al. 2016). The most recent vaccine on the timeline is the Ebola Virus Disease vaccine, which became available in 2019 (CDC 2021).

When comparing the disease timeline (Figure 2) to the vaccine timeline, the gap in diseases is when vaccines become prevalent. Another note is the school requirements for vaccines which began in the 1980s. A timeline for vaccine integration into the education system is provided in Figure 3.

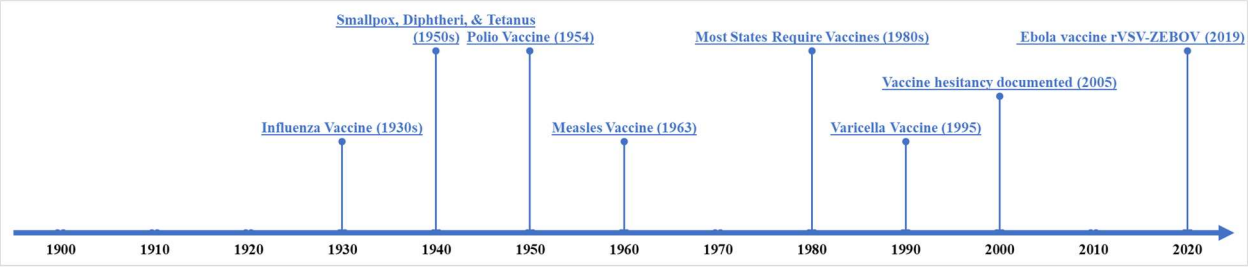

Figure 3: Vaccines Timeline in the last Century (1900-2020)

To determine how epidemic and pandemic disease affects education, a timeline of the education system in the United States was created. In this case, each event is shown with the same unit of time. This is because the changes were then used to inform future outbreaks as potential responses. Starting with the early 20th century and response to Tuberculosis, one of the most common interventions for schools was

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identified. In 1908, they were still dealing with a lack of air circulation, which was identified in addition to quarantine (Hays 1908). While trying out responses to Polio, separation or quarantine was tried, as was a delayed start to school. These changes and others led to lower educational attainment and may have been more likely to quit school (Meyers and Thomasson 2020). Similarly, the response to influenza outbreaks over time has been to close schools. The 1918 Flu response also included limits on large gatherings (Schwartz 2018). In Canada, masks were also required as an intervention for the 1918 Flu (Minenko 2021). A similar response was not identified in the United States.

The response to SARS includes temperature checks, which may partly be due to ear thermometers or the ability to take a temperature quickly (Chng et al. 2004). With the return of Influenza outbreaks in the 21st century, closures and masks return. In addition, like with SARS, data collection like temperatures were added. Hygiene, like hand washing, although having been attributed to health for years (Evans 1950) or even millennia, reappears as an intervention for Influenza. With Ebola and Zika, no notable additional interventions were identified (BBC News 2014 and McEntire et al. 2021). The Figure 4 graph also has a gap where education changes due to disease were limited, which can be correlated to vaccines.

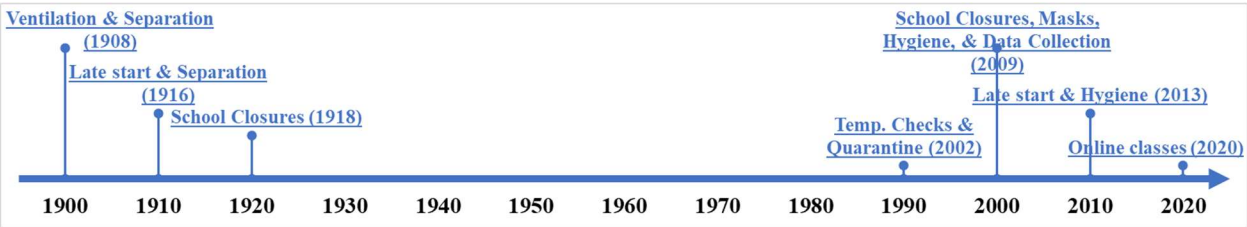

Figure 4: Education Response to Epidemics (1900-2020)

The last individual timeline considers educational responses that were occurring outside of disease response. The timeline shows one year per event, with multiple events happening at the same time as an increase in the bar size. Several items occur prior to this century, such as correspondence studies (Wedemeyer and Childs 1961), textbooks as a classroom standard (Lindley No Date), and chalkboards. At the beginning of the 20th century, the United States begins federal requirements for elementary education. In the late 1960s, about 50 years ago, the federal government focuses on the funding required education and secondary education (Partnership for Learning and Earning Act of 1968 and Elementary and Secondary Education Amendments of 1969).

In the 1980s, most states start requiring vaccines for admission to school, as shown in Figures 3 and 5 (Hinman 2002). This is an administrative response to vaccines becoming available in the 1950s and 1960s. Between the 1960s and 1990s, computers become available and start to be used in exclusive classrooms (Gianelli 1985). Technological advances allow for moving correspondence education to static or one-direction online education through dial-up internet access (Ball 1995). Smartboards then become available for a more technical interactive classroom (Filipczak 1993). Skype is another option that came into the forefront, allowing face-to-face video conferencing in 2003 (Tian and Wang 2010). In the 2000s, a hybrid approach to using online videos mixed with in-person content starts being used (Tripp 2003). With broadband being available to most education systems in the late 2000s, two-way video lectures can be used (Belo et al. 2014), as depicted in figure 5. All of these technological advances can be seen in public schools and at the university level

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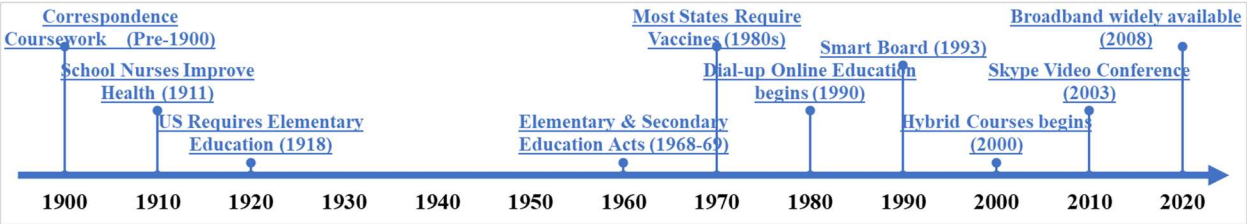

Figure 5: United States Educational Changes (1900-2020)

The timelines presented above are overlapped in the next figure in order to illustrate overall correlations. What becomes evident are the significant events which have affected the United States education system. The first events occur at the turn of the 20th century and through the 1918 Influenza pandemic. A second major event occurs in the 1950s to 1960s which coincides with the Korean War recession and the advent of vaccines. The third major event occurs with the digital or computing age. These changes supported additional changes to the education response to disease. This last major set of events lasts over 40 years, from the 1980s through the 2020s. It is the major changes in technologies which could be applied to the classroom which allowed education to adapt quickly to external changes. See combined timeline in Figure 6.

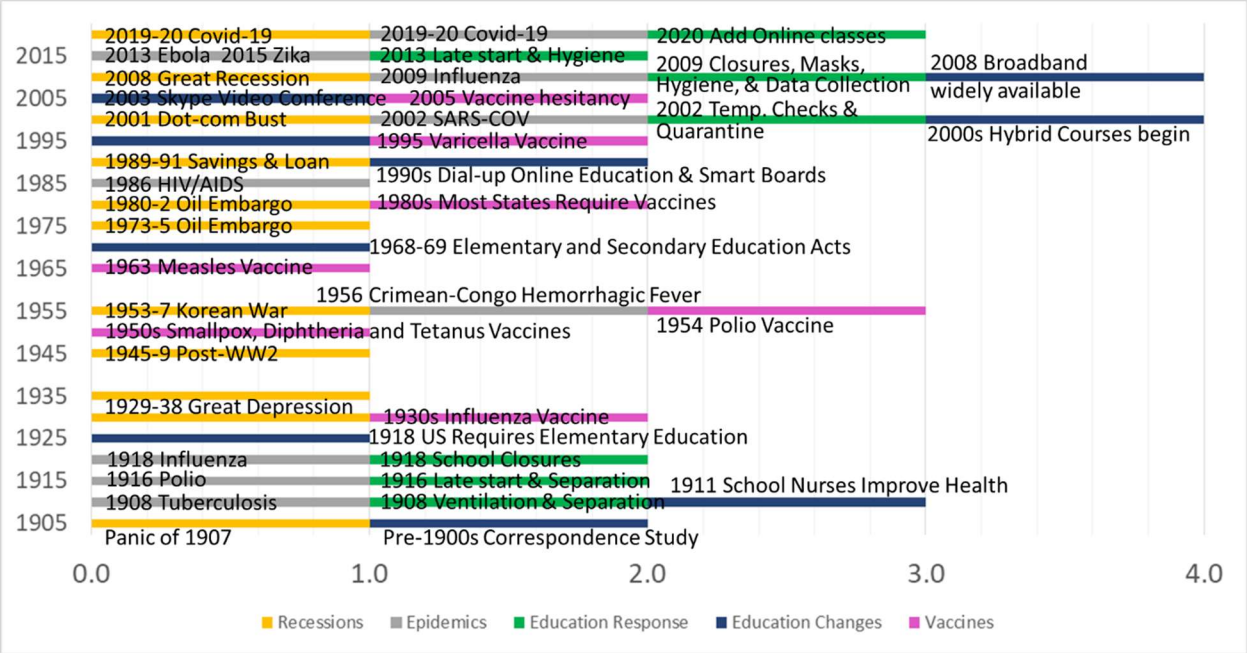

Figure 6: Correlation of Events Surrounding Changes in Education

Conclusion

Although it may seem obvious as to how education made the leap from our last pandemics to the current state of the system, outside forces also act on the United States education system. These external forces include worldwide research into epidemic and pandemic responses. Changes to how the education system responds to disease have come from changes in technology available. In reflection, it is also apparent that disease interventions have changed very little over time, with quarantine, isolation, hygiene such as hand washing, and masks reoccurring. New responses in education include quick read thermometers and data collection.

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The research questions were focused on the question of a possible paradigm shift. Although this paper does not review the percent of faculty who incorporated new technology into the classroom prior to Covid-19, the availability of new technology allows for a paradigm shift. If the shift was occurring slowly, the larger question is how fast does change occur in education. Only three significant changes occurred in the last 100 years, so this paradigm shift was most likely already occurring or about to occur. A correlation was identified. The research did not identify any causal relationships but did not set out to do so.

The next steps in the research should include a more extensive literature review, which might include a more in-depth analysis of other external forces which may have contributed to change. An additional thorough review of education literature for articles which illustrate the use of new technologies in the classroom would further support the paradigm shift.

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