
Editorial: Agent-based simulation to transform a society with good sense of adopting mitigation measures in containing virus spreading

Editorial

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Since the outbreak of a coronavirus called SARS-CoV-2 or COVID-19, businesses and societies across the world have been negatively impacted due to the necessary adoptions of various stringent policies, such as lockdowns, quarantines and travel restrictions from region to region and time to time. The world economy suffered a big loss. The World Bank reported that the world's gross domestic product fell by 3.2% in 2020 (World Bank, 2022). Today we clearly understand that the COVID-19 pandemic has substantially transformed the world. For example, organizations and communities around the world have invested heavily in digitizing their workforces and corresponding work and living environments to accommodate their changing needs at work and at home.

On one hand, the COVID-19 pandemic has disrupted the world for years, resulting in the largest global economic crisis in more than a century (World Bank, 2022). The pandemic negatively impacted all aspects of society, including education, green energy transition and poverty tackling around the world. On the other hand, organizations have learned that digital transformation can truly enable them to allow people to work from home to help mitigate the spreading of the COVID-19 or the like and better serve customers regardless of their locations and time. After three years of the pandemic, the world begins to find that the end of the pandemic is in sight although a milder and endemic COVID-19 might be here to stay. Ironically, the learned digital transformation lesson helps facilitate the pace of its adoption in organizations and societies, which has in fact been accelerated recently given that businesses and societies have been fortunately benefited from the transformation during the COVID-19 pandemic.

The literature has published a variety of studies exploring how digital technology has been adopted in transforming people's lives at work and at home (Qiu, 2014; Sandrone, 2022). To better serve our readers in the digital transformation community, this journal would like to call for more studies focusing on digital transformation's impact on all aspects of society. As a seminal example, this editorial column shows an interesting study from our research group over the pandemic period, i.e. a specific example of the adoption of digital technology in facilitating people's understanding of unexpected phenomena and adapting to new social behavior in the school setting.

Face coverings were not recommended when the COVID-19 started its outbreak in the US in March 2020. At that time, experts did not know individuals with COVID-19 could spread the virus before symptoms appeared. The situation that many people with COVID-19 were



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even asymptomatic and contagious was not fully understood. Today, we have learned much about the virus. Public health and social interventions, like school closure, work from home, travel restriction, social distancing, restaurant and bar capacity limits, gathering ban, face covering, quarantine and shelter-in-place, as non-pharmaceutical mitigation measures have been considered the great choice of “weapons” to combat COVID-19 before a COVID-19 vaccine or effective treatment becomes widely available.

Scientific studies of mitigation policy responses to COVID-19 have been done in many countries and regions, revealing that these mitigation measures have effectively slowed the community spread of COVID-19 (Qiu, Wang, & Gong, 2021). In fact, wearing face masks in public becomes one of scientific basics in helping fight the virus spreading (Eikenberry *et al.*, 2020). As we witnessed, both national policies and basic scientific education helped significantly curtail the spread of COVID-19. We now understand that the above-mentioned nonpharmaceutical mitigation measures are still effective even after COVID-19 vaccines and effective treatments become widely available. For example, public health professionals continue to encourage people to wear face masks whenever a new more contagious COVID-19 variant becomes dominant in some communities.

In retrospect, we definitely learned good lessons. When a government failed to institute appropriate public health policies, then basic scientific education to develop people’s good sense could play a decisive role in combatting the spreading of a virus. Studies indicate that a high percentage of the westerners have no tradition of wearing face masks (Kemmelmeyer & Jami, 2021), which was considered as a norm or common sense. But most of them would wear face masks if they were educated with proven scientific basics (or enforced to comply with enacted public health intervention policies). As time goes, this newly learned behavior could be slowly embedded into the culture of a society and gradually become new common sense in the society.

Common sense that is usually considered as sound, practical judgment on daily life’s matters is frequently shared by a lot of people in a society. It has been slowly and traditionally learned from life experience and frequently gets inherited by people from generation to generation in the society. Common sense is thus considered as a natural ability for people to make good judgments and behave in a practical and sensible manner. However, sometimes common sense could be wrong under certain circumstances because it is unnecessarily rational or scientific when simply learned from life experience. This is particularly true when people are in an unprecedented situation, such as fighting the COVID-19 pandemic or any future infectious virus.

Promisingly, developing updated common sense and cultivating good sense can be currently accelerated through modern education, which is critical when certain common sense under circumstances seems different from the norm or lacking a scientific support. Using the COVID-19 pandemic as an example, we explored an approach to facilitating people’s good sense development in a k-12 school setting through digitalized education.

We started with an overall study on how data-driven modeling could be applied to facilitating public health intervention policymaking when a public health crisis arises (Qiu *et al.*, 2021). We then implemented an agent-based simulation model to demonstrate that different mitigation measures would have different consequences in terms of containing virus spreading using the COVID-19 as an example. Mitigation measures include wearing face masks, social distancing and quarantine. The model allows users (e.g. teachers, staff, students and parents) to configure their own configurations to learn the corresponding outcomes respectively, which mocks the real-life situations when different public health intervention policies are enacted by a school administrator. Interestingly, users could easily compare the results with the reality during the COVID-19 pandemic time. As a result, with the development of good sense of adopting effective mitigation measures in fighting the spreading of the COVID-19 virus, they would be more willing to comply with the enacted policies at school.

Once COVID-19 vaccines became available at the end of 2020, we immediately included the inoculation parameter in our model and reengineered our intuitive simulation model

based on the classic and well-known Susceptible-Exposed-Infected-Recovered (SEIR) model (Carcione, Santos, Bagaini, & Ba, 2020). Given that mutated COVID-19 viruses and the effectiveness and durability of vaccines would be new challenges over time, we aimed to make the tool available for all potential users, including policymakers from different societies or communities. An interactive tool thus must be developed with scientific rigor. Therefore, SEIR was the best choice for developing such a visualization tool that would help users to develop good sense of fighting any infectious virus (Abdulrahman, 2023).

F1 As shown in Figure 1, a school environment of 12 different classrooms was created. A little circle represents a person. Rectangles with the numbers, 1 to 12, represent different class modules taught in different classrooms, while rectangle 13 (i.e. the right bottom quarter in Figure 1) represents a cafeteria. Students could take up to eight different modules a day, which approximately followed a real-life school schedule in the US. In addition to having a typical school setting configuration, the reengineered simulation model could be configured using different choices of mitigation measures, which could be essentially aligned with the virus transmission rate, recovery time, inoculation rate and asymptomatic rate in real life when different rigid or mild policies were instituted. As indicated in the left side in Figure 1, adjusting those slides would allow users to choose a configuration to reflect a given real life situation. When the simulation runs, individuals move around the classrooms and the cafeteria based on their own daily schedule. A little circle would change its color that is defined in Figure 2. Figure 2 mainly shows the numbers of accumulated exposed, infected and recovered persons, respectively along with the days the configured school has been simulated. The education tool is interactive, intuitive and informative.

As mentioned at the very beginning, this short editorial aims to call for more explorations on digital education, in particular by leveraging the recent advances in data visualization

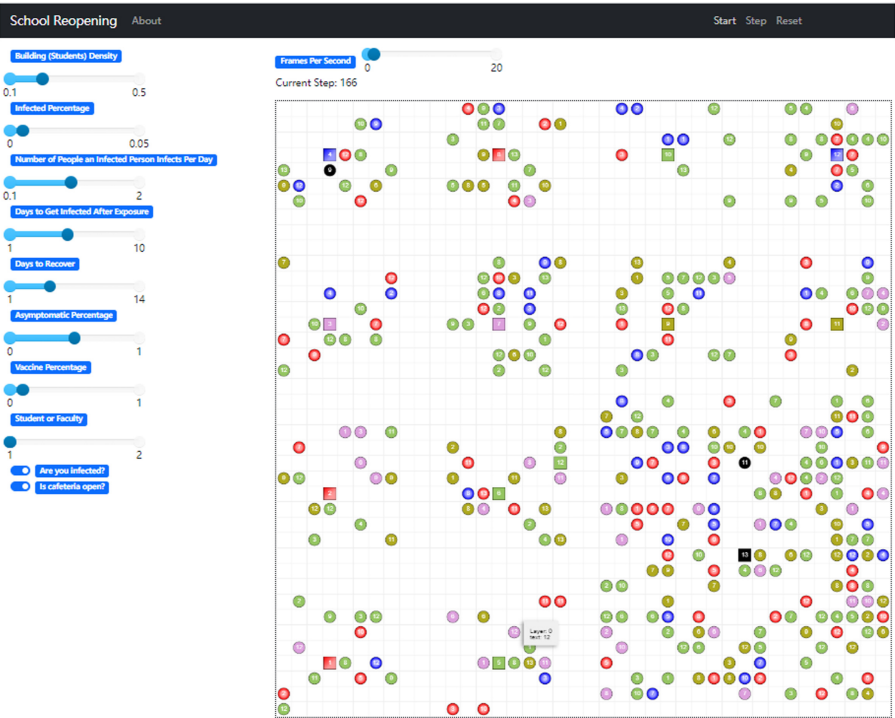
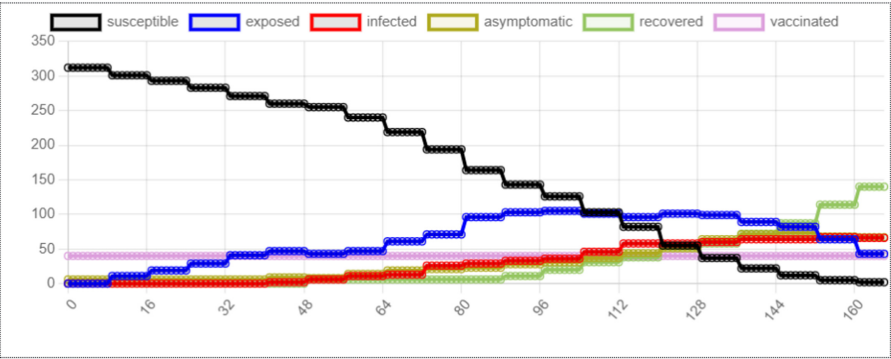


Figure 1.
Configurable model
and its visualized
school setting

Figure 2.
An example of the
outcomes of a
simulation run

N: 358, S: 2, E: 43, I: 66, A: 67, R: 140, V: 40 after 20 school days!!



technologies, including augmented reality (AR) and virtual reality (VR) and metaverse (Sandrone, 2022). Through digital transformation, AR/VR and metaverse digital technologies help bridge the digital and physical worlds while substantially enriching people’s life experience over the Internet or the like.

In summary, this editorial aims at providing a simple example that could help intrigue more studies of investigating the effective process of good sense development in a variety of situations. More broadly, the research topics and findings related to the human and social development driven by the accelerated digital transformation around the world will be especially welcomed by this journal and the community of digital transformation.

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