School Virus Infection Simulator for Customizing School Schedules During COVID-19*

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***Abstract*—Even in the midst of the Coronavirus 2019 (the covid-19) pandemic, schools continuously strive to provide consistent education to their students. Teachers and education policymakers are seeking ways to re-open schools, as it is necessary for community and economic development. However, in light of the pandemic, schools require customized schedules that can address the health concerns and safety of the students considering classroom sizes, air conditioning equipment, classroom systems, e.g., self-contained or departmentalized. To solve this issue, we developed the School-Virus-Infection-Simulator (SVIS) for teachers and education policymakers. SVIS simulates the spread of infection at a school considering the students' lesson schedules, classroom volume, air circulation rates in classrooms, and infectability of the students. Thus, teachers and education policymakers can simulate how their school schedules can impact current health concerns. We then demonstrate the impact of several school schedules in self-contained and departmentalized classrooms and evaluate them in terms of the maximum number of students infected simultaneously and the percentage of face-to-face lessons. The results show that increasing classroom ventilation rate is effective, however, the impact is not stable compared to customizing school schedules, in addition, school schedules can differently impact the maximum number of students infected simultaneously depending on whether classrooms are self-contained or departmentalized. It was found that one of school schedules had a higher maximum number of students infected simultaneously, compared to schedules with a higher percentage of face-to-face lessons. SVIS and the simulation results can help teachers and education policymakers plan school schedules appropriately in order to reduce the maximum number of students infected simultaneously, while also maintaining a certain percentage of face-to-face lessons.**

https://github.com/satoshi-takahashi-lab/school-virus-infection-simulator

***Index Terms*—Virus Infection, COVID-19, Hybrid learning, Cohorting, School Scheduling**

I. Introduction

During COVID-19, schools have continuously strived to provide consistent education. Teachers and education policymakers are seeking ways to re-open schools, which is necessary for community and economic development.

The World Health Organization (WHO) states that schools should assess several elements when deciding to re-open schools. For instance, the epidemiology of COVID-19 at the local level, the benefits and risks to children and staff, and the capacity of schools/educational institutions to operate safely [1]. The benefits of re-opening school include not only educational effects but also social and psychological well-being, essential services, access to nutrition, child welfare, allowing parents to work, and so on [1].

To re-open safely, the WHO recommends several measures: wearing a mask, increasing the total airflow supply to classrooms, and maintaining physical distance between students [1]. However, school situations differ. Some schools do not have the budget to improve the total airflow supply. For instance, schools in developing or cold counties. Moreover, not all schools have sufficient classrooms or empty classrooms to maintain physical distance.

Many schools adopt cohorting and customizing school schedules [2], [3]. These refer to creating small groups of staff and teachers. The schools reassembled their schedules, divided students into several groups, conducted face-to-face lessons for one group, gave homework to the other groups, and conducted online classes. This operation allows students to maintain physical distance and keep the air clean without additional classrooms or air conditioners.

UNESCO organizes four types of school schedules, their risk of infection, and the pros and cons of education effects, school management, parents, and so on [4]. Moreover, school schedules can be customized in many ways, and their impact on education and reducing infectious risk are different. Teachers and education policymakers have to choose a school schedule from a wide variety of plans without the knowledge of the infection risk of the program.

Then, we propose the School-Virus-Infection-Simulator (SVIS) to simulate the spread of virus infection at a school according to the school schedule. SVIS can simulate airborne infection in several school situations. For example, the number of students and classrooms, and the performance of air conditioners. It can help teachers and education policymakers customize school schedules considering the infection risk and the percentage of face-to-face lessons.

In this paper, we introduce SVIS and demonstrate that it can evaluate the impact of several school schedules of self-contained and departmentalized classrooms from the viewpoint of the maximum number of students infected simultaneously and the percentage of face-to-face lessons.

II. Related Work

Many studies have modeled and simulated the spreading of COVID-19 caused by re-opening of schools; their targets are classified roughly into two types: outside and inside schools.

A. Outside School Model

Cruz [5] simulated re-opening school strategies in the São Paulo Metropolitan Area. These are re-opening schools with all students at once, following the São Paulo government plan, and reopening only when a vaccine becomes available. They used a stochastic compartmental model that included a heterogeneous and dynamic network. Gharakhanlou [6] simulate the spatio-temporal outbreak of COVID-19 with Agent-Based Model. They investigate the impacts of various strategies of school and educational center closures, heeding social distancing, and office closures on controlling the COVID-19 outbreak in Urmia city, Iran. Lee [7] simulated the outbreaks in the greater Seattle area and evaluated the effect of combinations of non-pharmaceutical interventions, such as social distancing, face mask use, school closure, testing, and contact tracing. Kim [8] modeled the COVID-19 transmission dynamic in Korea with the Susceptible-Exposed-Infectious-Recovered Model. Their model considers two age groups, children and adults, because their social behaviors are different. They estimated the effect of delaying re-opening schools in Korea. Chin [3] developed a national- and county-level simulation model considering school closures and unmet child-care needs in the US; they estimated the projected rate of unmet childcare needs for healthcare worker households.

B. Inside School Model

Zafarnejad [9] assessed school policy actions for COVID-19 using Agent-Based Simulation. They modeled a classroom as two-dimensional tiles and simulated the spread of COVID-19 quanta in a closed classroom environment. They compared the infection risks among several non-pharmaceutical interventions: class schedules, social distancing, ventilation, air filtration, surveillance testing, and contact tracing. Brom [10] modeled the interactions among pupils and teachers as a multi-graph structure with Agent-Based Simulation. They investigated the impact of several school schedule types and antigen and PCR test schedule types on reducing the spread. Ghaffarzadegan [11] developed a hypothetical university model of 25,000 students and 3,000 faculty/staff in a U.S. college town with a mathematical and compartmental model. They simulated several combinations of policies and evaluated the impact of COVID-19; more proactive and quick testing, high mask use adoption, better risk communication with students, and remote work for high-risk individuals. Bilinski [12] developed an agent-based network model to simulate transmission in elementary and middle school communities. They built three screening strategies; weekly or twice-weekly screening of all students and teachers, and a 24-hour test turnaround time. They then compared these screening scenarios to three scenarios; five-day in-person attendance, a hybrid model in which half of the students attended class on Monday and Tuesday and the other half on Thursday and Friday, and fully remote learning. McPeck [13] built an Agent-Based Model in which students moved and interacted on a university dormitory floor. They simulated multiple scenarios as combinations of vaccination and masking rates.

C. Summary

Our simulation model was classified into the Inside School Model. Previous studies on it assume that all students' behavior is the same or target one type of school system. Despite this, we focus on the difference in the effect of school schedules on COVID-19 between school types. We then modeled the self-contained and departmentalized classrooms. Students of self-contained classrooms took the same lesson in the same classroom; this could be regarded as a kind of cohorting. However, students in departmentalized classrooms took individual lessons in different classrooms. These differences would react differently to school schedule interventions.

III. School Virus Infection Simulator

SVIS is a tool used to simulate the spread of virus infection at a school. It simulates students' behavior. Based on their lesson schedule, classroom volume, classroom air change rate, and infectability of the virus. SVIS is based on an extended version of the Susceptible-Exposed-Infectious-Removed Model and Agent-Based Model [14]–[19].

A. School Scheduling Model

UNESCO proposes four types of school schedules [4](Figure 1); Option 1 as the hours based model, Option 2A

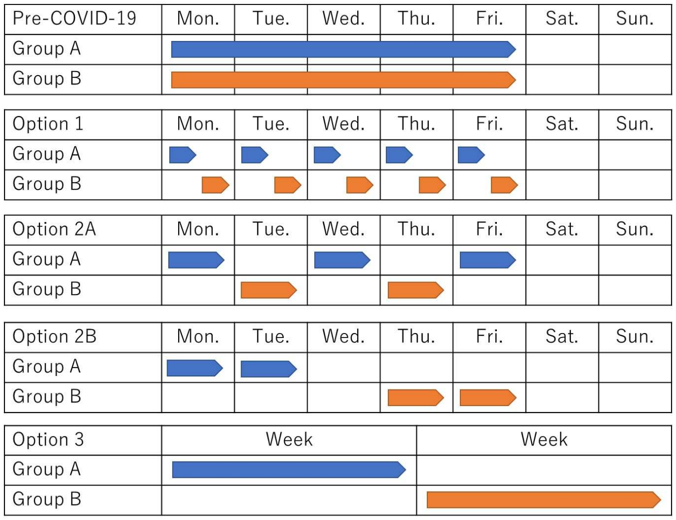

Fig. 1. UNESCO school schedule [4]

and 2B as the days based models, and Option 3 as the weeks based model. UNESCO states that infection risk decreases in this order [4]. These models have different advantages and disadvantages. For example, one of Option 1's pros is "students constantly interact with peers improving their emotional connection" and one of Option 1's cons is "logistically demanding for parents face to face instruction time is short."

Along with these school schedules, there are many types of school schedules. For instance, all students come to school for two or three weeks, after which they stay at home for a week. The WHO states that "the average time from exposure to COVID-19 to the onset of symptoms is 5-6 days" [20], Hence, when. students are infected, their symptoms would appear while at a home week and take the day off school. Accordingly, the infection risk decreases. For another instance, students are divided into four groups, and then two or three of the groups come to school for a week alternately so that they can interact with more peers.

Teachers and education policymakers have to choose a school schedule from many schedule options without the knowledge about the infection risk of the schedule. SVIS is based on Agent-Based Model, and every student (agent) takes lessons based on their schedules.

B. Infection Model

Students' status consists of susceptible, exposed, infectious-exposed, infectious, asymptomatic, and recovered (Figure 2). Susceptible students become exposed according to the infection probability. Exposed students become infectious-exposed after a certain period. Infectious-exposed students become infectious or asymptomatic, probabilistically, after a certain period. Infectious and asymptomatic students recover after a specific period. Infectious-exposed and asymptomatic students infect susceptible students according to infection probability. Infectious components are the students who develop symptoms

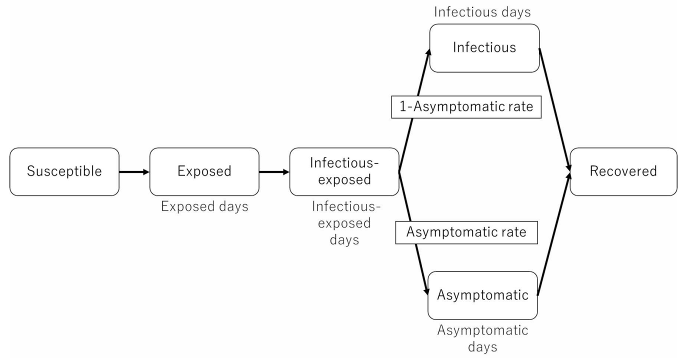

Fig. 2. Infection model

and take the day off. Asymptomatic students are do not develop symptoms and continue school.

Infection probability is calculated based on the Wells-Riley Equation [21]–[23].

$$P = 1 - e^{-Iqpt(1-n_I)(1-n_S)/Q} \quad (1)$$

P is the probability of infection, I is the number of infectors (infectious-exposed and asymptomatic students), p is the pulmonary ventilation rate of a student, q is the quanta generation rate, t is the lesson time interval, Q is the classroom ventilation rate with clean air, n_I is the exhalation filtration efficiency, n_S is the respiration filtration efficiency.

A student takes lessons based on their schedule and gets infected according to Equation (1). The Wells-Riley Equation is generally used to calculate the basic reproduction number of the infection, and the number of new infection cases divided by the number of susceptible people. Therefore, we should calculate the new infection cases as the number of susceptible students multiplied by Equation (1). However, the number of students in the classroom is often less than 100, and the probability of infection is generally less than 0.01; then, the new infection cases become under one student. Therefore, we used Equation (1) as the probability of infection for each susceptible students. The expectation value of the new infection cases fits the basic reproduction number using multiple simulations.

SVIS enables teachers and education policymakers to simulate the effects of their school policies in specific situations. Their positions were different. The lesson schedule and classroom volume vary according to school, country, and state. Moreover, the budget is different; even if teachers and education policymakers in developing countries know a high ventilation rate with clean air is effective, they would not have enough funding to change the air conditioner. SVIS can consider these problems and help them plan lesson schedules to reduce infection probability without exchanging air conditioners.

TABLE I
BASIC PARAMETERS

Item	*Value*
p: the pulmonary ventilation rate of a person	0.54(m3/h)
q: the quanta generation rate	48
n_I: is the exhalation filtration efficiency	0.5
n_S: is the respiration filtration efficiency	0.5
Asymptomatic rate	0.3
Exposed days	Three days
Infectious-exposed days	Two days
Infectious days	14 days
Asymptomatic days	Eight days

IV. EXPERIMENT DESIGN

First, we show the effects of changing classroom volumes and classroom air change rates during COVID-19. Then, we demonstrate the impact of several school schedules in self-contained and departmentalized classrooms and evaluate those schedules from the maximum number of students infected simultaneously and the percentage of face-to-face lessons. The former is an essential indicator for controlling COVID-19 because hospitals must accommodate isolated beds for infected people and medical equipment (e.g., extracorporeal membrane oxygenation) [24]. Moreover, the percentage of face-to-face lessons is also essential for educational effect, students' motivation, and classroom community [1].

A. Basic Parameters

Table I lists the basic parameters in all experiments. Buonanno estimated the pulmonary ventilation rate of sedentary activity as 0.54(m3/h) [25], [26]. Dai calculated the quanta generation rate of COVID-19 as 14-48 in 2020 [21]. We adopt 48 as q because the Delta variant is spreading worldwide, and the infectability is estimated to be stronger than the original [27]. Dai estimates the exhalation filtration efficiency and the respiration filtration efficiency as 0.5 when all students wear a mask [21]. CDC says "isolation, and precautions can be discontinued 10 days after symptom onset and after resolution of fever for at least 24 hours and improvement of other symptoms" [28]. Then, we roughly estimated 14 as infected days. Dai estimates that infectability is a peek at two days before to one day after symptom onset and WHO states "the time from exposure to COVID-19 to the moment when symptoms begin is, on average, 5 to 6 days." Hence, we adopted three days and two days as exposed days and infectious-exposed days [20], [29]. Bullard estimates that SARS-CoV-2 infected Vero cell infectivity is only observed eight days after symptom onset [30]; hence, we adopted eight days as asymptomatic days. Also, we consider the CDC estimate of the percentage of infections that are asymptomatic as 30% as the current best [31].

B. School Schedules

We designed several school schedules (Tables VI, VII, and VIII). A school divides students into several groups, conducts face-to-face lessons for some, gives homework to the others, or teaches online classes. The school schedules P50_HD_2G-1, P50_D_2G-1, P50_Ds_2G-1, and P50_W_2G-1 correspond to UNESCO's options 1, 2A, 2B, and 3 [4].

An example of generating a school schedule P50_W_4G-2 and simulating it in departmentalized classrooms is shown below.

Step (1): We accumulate students from 1 to 480.

Step (2): We divide the students into four groups: group A included students 1 to 120, group B included 121 to 240, group C included students 241 to 360, and group D includes 361 to 480.

Step (3): We allocate the students in each group to 20 classrooms evenly and randomly at every lesson time, creating classroom patterns.

Step (4): We assign the groups to face-to-face lesson schedules. We generated their patterns in all combinations under two limiting conditions: group A was permanently set face-to-face lessons in the first week, and no group took face-to-face lessons for three weeks straight. In this case, two groups are assigned to the face-to-face class every week, and all combinations of the two groups are six; all permutations of six are 46,656. After considering two limiting conditions, the total number of combinations of face-to-face lesson schedule patterns was 48.

Step (5): We simulate each case, 20 (classroom patterns) multiplied by 48 (face-to-face lesson schedule patterns), 10 times. The total number of simulations was 9,600.

The school schedule P50_W_4G-2 includes all combinations of two groups, and students can meet all members in face-to-face lessons; the percentage of class members the students meet in face-to-face lessons is 100%.

Tables IX, X, XI, and XII show the school schedules of self-contained classrooms and departmentalized classrooms. We adjusted the number of simulations in each case by considering the total number of simulations. In the shortened schedule, six days are lesson days, one day is day off every week, and six lessons every day from the first day to the fifth day, and five on the sixth day.

Every school schedule makes student one as infectious or asymptomatic probabilistically on day 0 (Monday) and simulates virus infection spread for 12 weeks.

V. EXPERIMENT 1

To evaluate the effects of classroom volumes and classroom air change rates, we used a School Schedule Basic and changed the classroom ventilation rate with clean air (Q in Equation 1) to 540 m3/h, 1,080 m3/h, 1,620 m3/h, and 2,160 m3/h. This experimental design corresponds to a change in the volume or air rate as a basic parameter, doubled, tripled, and quadrupled.

Figures 3 and 4 present the results. The maximum number of students infected simultaneously decreases, and their variance increases as the classroom ventilation rate increases. Although it is known, these results show that increasing the classroom ventilation rate is effective for COVID-19.

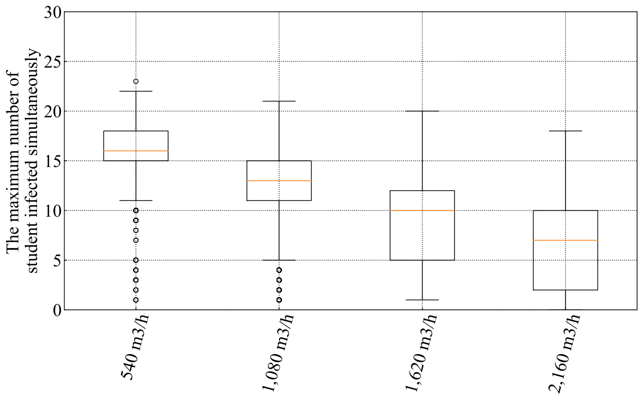

Fig. 3. Experiment 1: The maximum number of students infected simultaneously in self-contained classrooms

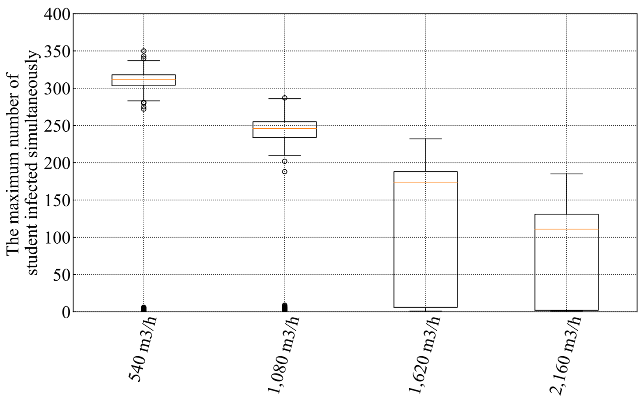

Fig. 4. Experiment 1: The maximum number of students infected simultaneously in departmentalized classrooms

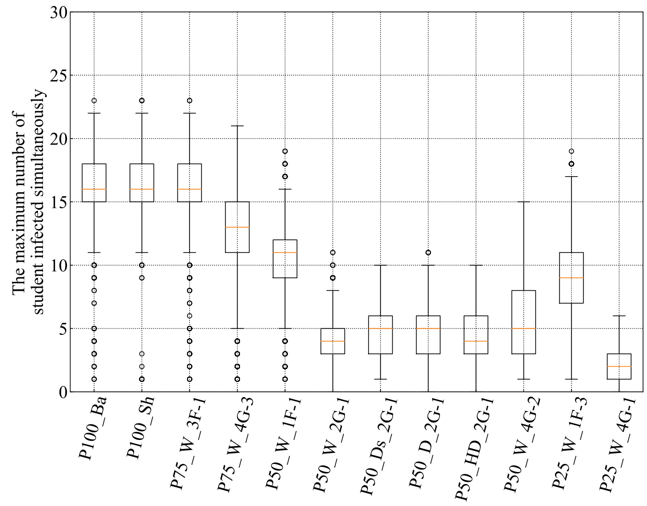

Fig. 5. Experiment 2: The maximum number of students infected simultaneously in self-contained classrooms

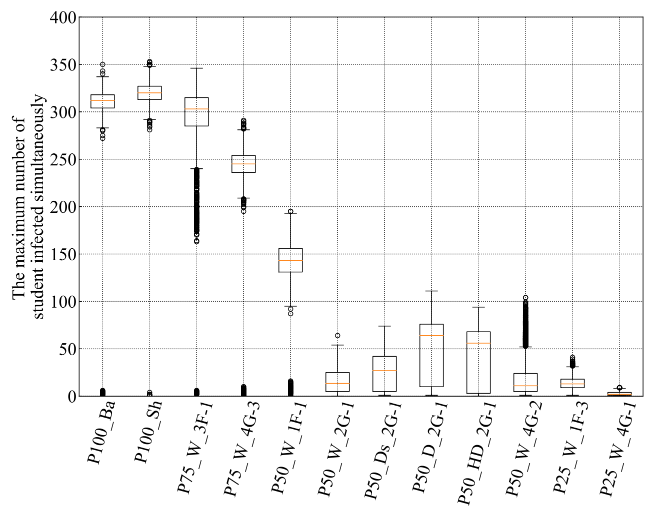

Fig. 6. Experiment 2: The maximum number of students infected simultaneously in departmentalized classrooms

VI. Experiment 2

We simulated school schedules to evaluate the impact of school schedules of several school schedules in self-contained and departmentalized classrooms. Figures 5 and 6 present the results. As a general tendency, the maximum number of students infected simultaneously decreases as the percentage of face-to-face lessons increases.

A. Effect of Shortened School Schedule

The maximum number of School Schedule Shortened is slightly higher than the basic school schedule in self-contained and departmentalized classrooms. The total lesson time per day is shorter, and the infection risk per day would decrease. However, the continuous period of face-to-face lessons was one day longer. An additional day would increase the maximum number of infected cells.

B. Effect of 75% Face-to-face School Schedule

The 75% Face-to-face School Schedules (P75_W_3F-1 and P75_W_4G- 3) do not match effectively in self-contained and departmentalized classrooms. All students went to a school for three weeks, after which they took off school for one week in P75_W_3F-1. The SARS-CoV-2 would spread equally like the Basic School Schedule during the face-to-face lesson week.

The maximum number of P75_W_4G-3 was slightly lower than that of the Basic and P75_W_3F-1 School Schedules. Three of the four groups went to a school alternately, and each group took face-to-face lessons for three weeks in P75_W_4G-3. The period of these is the same as that of P75_W_3F-1, and the number of students who take face-to-face simultaneously is lower than that of Basic and P75_W_3F-1. Then, the reduction in class size would decrease the maximum number.

C. Effect of 50% Face-to-face School Schedule

The 50% Face-to-face School Schedules (P50_W_1F-1, P50_W_2G-1, P50_Ds_2G-1, P50_D_2G-1, P50_HD_2G-1,

TABLE II
INFECTION PROBABILITY OF P50_W_4G-2 IN EACH CLASSROOM IN SELF-CONTAINED CLASSROOMS

Infection probability	*day* 0	*1*	*2*	*3*	*4*	*5*	*6*
0	0%	0%	72%	72%	15%	100%	100%
0-5%	100%	100%	28%	28%	61%	0%	0%
5-10%	0%	0%	0%	0%	24%	0%	0%
10-15%	0%	0%	0%	0%	0%	0%	0%
10-20%	0%	0%	0%	0%	0%	0%	0%

TABLE III
INFECTION PROBABILITY OF P50_W_4G-2 IN EACH CLASSROOM IN DEPARTMENTALIZED CLASSROOMS

Infection probability	*day* 0	*1*	*2*	*3*	*4*	*5*	*6*
0	95%	95%	98%	98%	91%	100%	100%
0-5%	5%	5%	2%	2%	9%	0%	0%
5-10%	0%	0%	0%	0%	0%	0%	0%
10-15%	0%	0%	0%	0%	0%	0%	0%
10-20%	0%	0%	0%	0%	0%	0%	0%

and P50_W_4G-2) are effectively in self-contained and departmentalized classrooms. The decrease in P50_W_1F-1 was smaller than that of P50_W_2G-1, P50_Ds_2G-1, P50_D_2G-1, and P50_HD_2G-1. All students go to school for one week, after which they took off school for one week in P50_W_1F-1. In contrast, half of the students attended school simultaneously in P50_W_2G-1, P50_Ds_2G-1, P50_D_2G-1, and P50_HD_2G-1. Then, the reduction in class size would decrease the maximum number.

The maximum number of P50_W_4G-2 is different between self-contained and departmentalized classrooms. Two of the four groups went to a school alternately, and each group took face-to-face lessons for some weeks in P50_W_4G-2. The decrease in P50_W_4G-2 is smaller than that of P50_W_2G-1, P50_Ds_2G- 1, P50_D_2G-1, and P50_HD_2G-1 in self-contained classrooms; however, the results are opposite in departmentalized classrooms.

Tables II and III show the infection probability of P50_W_4G-2 in each classroom in self-contained and departmentalized classrooms. The infection probability increased on day 4, and that of self-contained classrooms was higher than that of departmentalized classrooms. The student one comes to school from day 0 (Monday) to day 1 (Tuesday) and infects other students; when the student is asymptomatic, the student continues school. The newly infected students become exposed; two days later, become infectious or asymptomatic and start to infect other students. The number then becomes the highest on day 4 (Friday). After that, all students took the day off school from Saturday for three weeks. All new infectious and asymptomatic students come to the same classroom in self-contained classrooms; meanwhile, the new infectious and asymptomatic students are scattered to several classrooms in departmentalized classrooms. Then, the infection probability of classrooms in self-contained classrooms is higher than that in departmentalized classrooms.

The percentage of class members that the students meet in face-to-face lessons of P50_W_4G-2 is 100%. That of the others with out P50_W_1F-1 is 50%. This means that P50_W_4G-2 of departmentalized classrooms has two advantages; a lower maximum number of students infected simultaneously and constant interaction with a wide variety peers.

TABLE IV
INFECTION PROBABILITY OF P25_W_1F-3 IN EACH CLASSROOM IN SELF-CONTAINED CLASSROOMS

Infection probability	*day* 0	*1*	*2*	*3*	*4*	*5*	*6*
0	0%	0%	70%	70%	3%	100%	100%
0-5%	100%	100%	30%	30%	31%	0%	0%
5-10%	0%	0%	0%	0%	56%	0%	0%
10-15%	0%	0%	0%	0%	9%	0%	0%
10-20%	0%	0%	0%	0%	0%	0%	0%

D. Effect of 25% Face-to-face School Schedule

The P25_W_4G-1 School Schedules are effective in self-contained and departmentalized classrooms. One of the four groups went to a school for one week and took leave for three weeks in P25_W_4G-1. When students are infected during the face-to-face lesson week, symptoms appear while staying at home, and they skip the next face-to-face lesson week. This reduces the maximum number of infected individuals.

The effects of P25_W_1F-3 were opposite between self-contained and departmentalized classrooms. All students go to a school for one week, after which they take leave for three weeks in P25_W_1F-3. The P25_W_1F-3 School Schedules is effective in decentralized classrooms; however, it is not as effective in self-contained classrooms. The maximum number of P25_W_1F-3 in self-contained classrooms is nearly that of P50_W_1F-1 and higher than that of the other 50% Face-to-face School Schedule.

Tables IV and V show the infection probability of P25_W_1F-3 in each classroom in self-contained and departmentalized classrooms. The movements are the same as those in Tables II and III. All students of P50_W_4G-2 and P25_W_4G-1 go to a school for the first week; then, the causes should be the same.

VII. CONCLUSION

We developed the SVIS for teachers and education policymakers. It simulates the spread of instruction at a school considering the students' lesson schedules, classroom volume, air circulation rates in classrooms, and infectability. We then show the effects of changing classroom volumes and classroom air change rates during and demonstrate the impact of

TABLE V
INFECTION PROBABILITY OF P25_W_1F-3 IN EACH CLASSROOM IN DEPARTMENTALIZED CLASSROOMS

Infection probability	*day*						
	0	*1*	*2*	*3*	*4*	*5*	*6*
0	95%	95%	98%	98%	84%	100%	100%
0-5%	5%	5%	2%	2%	16%	0%	0%
5-10%	0%	0%	0%	0%	0%	0%	0%
10-15%	0%	0%	0%	0%	0%	0%	0%
10-20%	0%	0%	0%	0%	0%	0%	0%

several school schedules in self-contained and departmentalized classrooms

The results show that increasing classroom ventilation rate is effective, however, the impact is not stable compared to customizing school schedules, in addition, school schedules can differently impact the maximum number of students infected simultaneously depending on whether classrooms are self-contained or departmentalized. It was found that one of school schedules had a higher maximum number of students infected simultaneously, compared to schedules with a higher percentage of face-to-face lessons. This result implies that teachers and education policymakers have to consider the combination of school schedules and their classroom types; this is a complex phenomenon and a difficult task.

SVIS and the simulation results can help teachers and education policymakers plan school schedules appropriately and reduce the number maximum of simultaneously infected students, while also conducting face-to-face lessons.

However, this study has certain limitations. COVID-19 can spread through contact, droplet, and airborne transmission [32], especially in school cafeterias. SVIS simulates only airborne infection in classrooms. In addition, frequently conducting antigen and PCR tests, contact tracing, cleaning, and disinfecting are effective in reducing the transmission of COVID-19; SVIS does not consider these measures [11], [33]. In the future, SVIS should consider accounting for these factors.

TABLE VI
SELF-CONTAINED CLASSROOMS AND DEPARTMENTALIZED CLASSROOMS PARAMETERS

Item	Self-contained	Departmentalized
Classroom volume	180 m3	
Classroom air change rate	Three time/h	
Classroom ventilation rate with clean air (Classroom volume multiplied by classroom air change rate)	540 m3/h	
Lesson time	45 min	
Total number of students	24 students	480 students
Number of classrooms per lesson	One classroom	20 classrooms
Lesson weeks (Five days are lesson days and two days are days off in a week)	12 weeks	
Number of lessons per day	7 lessons	

TABLE VII
SCHOOL SCHEDULES

	School schedule name					
	P100_Ba	*P100_Sh*	*P75_W_3F-1*	*P75_W_4G-3*	*P50_W_1F-1*	*P50_W_2G-1*
Schedule type	Basic	Shortened	Weeks	Weeks	Weeks	Weeks
Number of groups	1	1	2	4	1	2
Number of face-to-face lesson groups at one time	1	1	1	3	1	1
A continuous period of face-to-face lesson for each group	Always	Always	Three weeks	Three weeks	One week	One week
A continuous period of not going to a school for each group	No	No	One week	One week	One week	One week
Percentage of face-to-face lessons	100%	100%	75%	75%	50%	50%
Percentage of class members that the students meet in face-to-face lessons	100%	100%	100%	100%	100%	50%

TABLE VIII
SCHOOL SCHEDULES

	School schedule name					
	P50_Ds_2G-1	*P50_D_2G-1*	*P50_HD_2G-1*	*P50_W_4G-2*	*P25_W_1F-3*	*P25_W_4G-1*
Schedule type	Days	Days	Days	Weeks	Weeks	Weeks
Number of groups	2	2	2	4	1	4
Number of face-to-face lesson groups at one time	1	1	1	2	1	1
A continuous period of face-to-face lesson for each group	Two and a half days	One day	A half-day	Depends on groups	One week	One week
A continuous period of not going to a school for each group	Two and a half days	One day	A half-day	Depends on groups	Three weeks	Three weeks
Percentage of face-to-face lessons	50%	50%	50%	50%	25%	25%
Percentage of class members that the students meet in face-to-face lessons	50%	50%	50%	100%	100%	25%

TABLE IX
NUMBER OF SIMULATIONS OF SELF-CONTAINED CLASSROOM

	School schedule name					
	P100_Ba	*P100_Sh*	*P75_W_3F-1*	*P75_W_4G-3*	*P50_W_1F-1*	*P50_W_2G-1*
Classrooms patterns	1	1	1	1	1	1
Face-to-face lesson schedule patterns	1	1	1	18	1	1
Number of simulations in each case	3,600	3,600	3,600	200	3,600	3,600
Total number of simulations	3,600	3,600	3,600	3,600	3,600	3,600

TABLE X
NUMBER OF SIMULATIONS OF SELF-CONTAINED CLASSROOM

	School schedule name					
	P50_Ds_2G-1	*P50_D_2G-1*	*P50_HD_2G-1*	*P50_W_4G-2*	*P25_W_1F-3*	*P25_W_4G-1*
Classrooms patterns	1	1	1	1	1	1
Face-to-face lesson schedule patterns	1	1	1	48	1	6
Number of simulations in each case	3,600	3,600	3,600	75	3,600	600
Total number of simulations	3,600	3,600	3,600	3,600	3,600	3,600

TABLE XI
NUMBER OF SIMULATIONS OF DEPARTMENTALIZED CLASSROOM

	School schedule name					
	P100_Ba	*P100_Sh*	*P75_W_3F-1*	*P75_W_4G-3*	*P50_W_1F-1*	*P50_W_2G-1*
Classrooms patterns	1	1	1	18	1	1
Face-to-face lesson schedule patterns	100	100	100	20	100	100
Number of simulations in each case	20	20	20	20	20	20
Total number of simulations	2,000	2,000	2,000	7,200	2,000	2,000

TABLE XII
NUMBER OF SIMULATIONS OF DEPARTMENTALIZED CLASSROOM

	School schedule name					
	P50_Ds_2G-1	*P50_D_2G-1*	*P50_HD_2G-1*	*P50_W_4G-2*	*P25_W_1F-3*	*P25_W_4G-1*
Classrooms patterns	1	1	1	48	1	6
Face-to-face lesson schedule patterns	100	100	100	10	100	25
Number of simulations in each case	20	20	20	20	20	20
Total number of simulations	2,000	2,000	2,000	9,600	2,000	2,000

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