Designing the Virtual SPIKEY-20 Epidemic

Engaging Youth in Seeking Information and Using Personal Protection

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ABSTRACT

In this paper, we share the design of a virtual epidemic with recognizable similarities to the real-life COVID-19 pandemic in order to engage children and youth in seeking information about the outbreak and practicing usage of personal protection equipment. In our research we sought to create a safe space in the virtual world, Whyville, for youth to "play" with serious topics of infection, asymptomatic disease transmission, prevention measures, and research and reporting of public health information. We examined the logfiles of 1,022 youth aged 10-18 years (mean = 13.7 years) who participated in an outbreak of a virtual virus, SPIKEY-20, in October and November 2020. Analyzing log files, we found that player engagement in productive infectious disease practices increased, including information seeking as well as purchases and usage of personal protective equipment during the virtual epidemic. In the discussion, we address the potential for virtual epidemics to provide a safe, playful space to practice and learn how to productively confront infectious disease and build promising connections between virtual and real-life epidemics.

CCS CONCEPTS

• **Human-centered computing** → Interaction design; Empirical studies in interaction design; • **Applied computing** → Education; Interactive learning environments.

KEYWORDS

Virtual worlds, Public health practices, Virtual epidemics

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1 INTRODUCTION

Little attention has been paid to how the design and research of interactive technologies could contribute to children's engagement and understanding of epidemics to support their health and well-being—a topic of growing relevance following the global COVID-19 pandemic [1, 5, 8, 14]. In virtual communities, the creation of virtual epidemics can leverage player's social interaction for spreading the design and immerse youths in the visual, interactional, and economic impacts of widespread infections [11, 12]. We propose that designing virtual epidemics can immerse youths' own personalized avatars—not just as dots in a simulation [15]—in a widespread infection with visual, interactional, and economic impacts, leveraging a situated learning experience to knit public health knowledge to preventive practices [2]. Through virtual epidemics, youth can become emotionally invested, examine their lived experience in more systematic ways, and develop better insights into the relationships between infection parameters and social dynamics—the very same questions that engage real-world epidemiologists [13].

In previous designs and studies of virtual epidemics in Whyville, an online community for tweens with millions of players researchers identified increased levels of engagement ranging from simple information seeking, to more in-depth discussion of cases, and even running repeated simulations with improved predictions about infection spread Kafai, Quintero, and Feldon [6]. Kafai and Fields [7] further showed that participation in various online activities changed before, during and after an outbreak of WhyPox, revealing the impact of an epidemic on player behaviors. Research on a later virtual epidemic, Dragon Swooping Cough, found that emotional engagement increased Whyville players' information seeking (e.g. visiting virtual CDC, discussion forums) and preventive behaviors (e.g., use of virtual personal protective equipment) [3], as well as exploration of infection statistics—a critical component of public health literacy [4, 9, 10].

In this paper, we share the design and implementation of a virtual epidemic with recognizable similarities to the real-life COVID-19 pandemic, to engage children and youth in seeking information about a virtual outbreak and practicing preventive actions. The aim of this initiative was to create a safe virtual space for youth to "play" with serious topics of infection: asymptomatic disease transmission, prevention measures, and research and reporting of public health information. We examined the logfiles of 1,022 youth aged 10-18 years who participated in Whyville during an outbreak of SPIKEY-20, a virtual epidemic launched on October 13, 2020

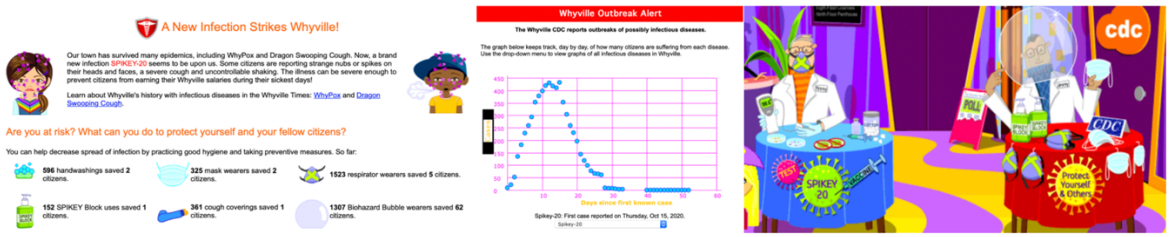

Figure 1: Unfurled public homepage announcement about SPIKEY-20 symptoms and PPE shown at login (left), SPIKEY-20 Community infection graph in virtual CDC (center), and testing and PPE tables for SPIKEY-20 at City Hall, outside the virtual CDC (right)

and lasting until November 30, 2020. In this study, we examine whether a design of a virtual epidemic 1) promotes engagement in information seeking and preventive practices, and 2) functions as platform for learning about real epidemics among youth.

2 VIRTUAL WORLD OF WHYVILLE

Our study took place Fall 2020 in collaboration with Numedeon, Inc., the company that hosts Whyville.net and provided the logfile data for this study. Whyville has drawn over 8 million+ users since 1999, when it was first launched as a virtual world to let players explore science, citizenship, and economics. Whyville was designed for youth ages 8-18 play casual science games in order to earn a virtual salary (in "clams"), which they can then spend on buying and designing parts for their avatars (virtual characters), projectiles to throw at other players, and other goods such as cars and plots of land [7]. The general consensus among Whyvillians (the citizens of Whyville) is that earning a good salary to spend on face parts or other goods is essential for full social participation in Whyville. Avatar appearance also demonstrates a player's tenure on Whyville and experience level; new players have fewer clams, and their looks show this because cheaper face parts are perceived as less attractive.

2.1 Design of SPIKEY-20

In contrast to the previous WhyPox outbreak [6] and the Dragon Swooping Cough epidemic [3] which used fantastical symptoms (e.g. flying), the authors designed SPIKEY-20 to mimic the infectious spread and symptoms of COVID-19 (with one critical exception: players' avatars could not die from contracting SPIKEY-20). Visual symptoms (cough clouds, spikes; see Figure 1) simulate respiratory disease and the iconic spike protein image of COVID-19; we offered PPE with a variety of efficacy leves and price points (e.g. free and cheap single-use face covers all the way to exorbitant reusable hazmat-style bubbles; and SPIKEY-20 uses the same naming convention of including the year of discovery. Critically, SPIKEY-20 was released during an active global pandemic, unlike any previous virtual diseases in Whyville. The virus was deliberately launched during the height of the COVID-19 pandemic to leverage players lived experiences and draw parallels to a real-life public health crisis.

Whyville hosts a virtual Center for Disease Control (CDC) where players can follow real-time tracking of SPIKEY-20 infection rates, purchase personal protective equipment (PPE), get tested for the virus, and explore epidemiology concepts through games and simulations. The SPIKEY-20 virus was released into the entire Whyville community on Oct. 13, 2020 by randomly infecting a set number of individuals based on algorithms taking into account preventive actions by users who logged in each day. The infection (including incubation and infectious periods) lasted 8 days in total, with a latent period from days 1-3, an infectious period from days 1-5, and a symptomatic period from days 4-8, with days 5-7 showing more severe symptoms.

Infectious symptoms of SPIKEY-20 included visual changes to a player's avatar (such as spikes protruding from avatar bodies, shown in Figure 1, left), interruptions to social features (such as coughs randomly replacing chat text and visible shaking back and forth), and interruptions to the player's in-world salary. These symptoms were chosen based on prior findings (Fields, et al., 2017) that emotional impact is important in engaging Whyvillian player participation in disease preventive behaviors, and also because they mimic real-life hardships facing sick individuals. Since SPIKEY-20 was intended to engage players in public health behaviors as well as in learning about the mechanisms of disease spread, we also provided different information sources within Whyville for players to learn more about the spread of SPIKEY-20: a clickable homepage banner that unfurled with a SPIKEY announcement (see Figure 1, left) and live infection statistics at the Whyville CDC (see Figure 1, center).

2.1.1 Design of Personal Protective Equipment and Actions. We made a number of preventive actions and personal protective equipment (PPE; see Figure 1, left) available to Whyvillians ranging from free measures (e.g., handwashing, covering mouth to cough) to expensive measures that would wipe out the middle 50% of Whyvillians' savings (e.g., biohazard bubbles with ~95% chance of protection). PPE offered varying levels of protection for disease transmission and reception, inspired by effectiveness of real-life protective factors (see Table 1). Whyvillians would also visit City Hall to purchase four forms of personal protective equipment (PPE): face masks, respirators, sanitizer lotion, and a biohazard bubble (see Figure 1, left). Furthermore, Jimmy and Timmy, two familiar characters in Whyville, provided both preventive measures (for sale) and tests for infection (unlimited for free) from booths at City Hall (see Figure 1, right). Test-takers were informed that these tests gave false positives (21%) and false negatives (30%), in line with medical testing in the real world.

Table 1: Cost, permanency, and effectiveness levels of virtual PPE for preventing SPIKEY-20 spread in Whyville.

Mitigation	Cost	Permanency of Protection	Transmission Effectiveness(Prevents Spread)	Reception Effectiveness (Prevents Infection)
Handwash	free	Only Temporary	10%	15%
Cover	free	Only Temporary	10%	0%
Mask	50 for 50 clams	Disposable, reapply upon entering chat room	20%	0%
Lotion	3 for 30 clams	Disposable, reapply daily	10%	15%
Respirator	200 clams	Reusable, permanent wear	30%	20%

2.2 Data Collection and Analysis

For this study, we first selected all active Whyville players during epidemic dates (Oct. 1 – Nov. 30, 2020) who self-identified between 10-18 years old (initial N=1,022). Using logfile data on epidemic behaviors, we further focused on in-world information-seeking behaviors (provided by logfile data) such as visiting the CDC, viewing the community graph about player infection rates, and the purchase and use of PPE. All analyses were reflective of the 275 youth in our sample who took at least one epidemic-related action during the epidemic. Descriptive analyses were conducted to examine behaviors across time, in order to identify any trends related to the spread of SPIKEY-20 in the Whyville community.

3 FINDINGS

The design and launch of the virtual epidemic SPIKEY-20 was successful in promoting infections, information seeking, and preventive actions. After releasing the virus on October 13, the first observed cases started on October 14 and ramped up between October 15 and 19 (with 17 new cases). The largest number of player infections (41) in our sample peaked between October 20-29. The virus remained active with only 3 additional infections before November 3. In all of Whyville, 61 out of 1,022 total players were infected; the 10-18 year old subset, 20 total players were infected. Because such a low proportion of the sample were infected (5% of all players 10-18 years), we do not present statistical comparisons of infected vs non-infected players. Instead we focus on general trends of players overall, and descriptive trends across the wider sample.

Players began seeking information about SPIKEY-20 before the initial cases began(see Figure 2, left), when the clickable homepage banner with information about SPIKEY-20 was released (see Figure 1, left). Unfurling this banner, which was prominently displayed on the homepage at login, remained the predominant information source throughout the epidemic. The second most popular information source was free preventive measures literature at City Hall during the peak of the epidemic, which later shifted to getting tested for infection, followed by visiting Jimmy and Timmy in City Hall, where players could learn about and purchase PPE. Testing for infection spiked, along with repeated testing, at the same time that actual infections dropped, perhaps as infected players checked their infection status. Information seeking behaviors remained high (e.g. ~450 homepage banner clicks at height of epidemic) compared to the number of actual infections among 10-18 year old players (20 total players).

With PPE, single-use mask purchases began a week before the virus was released, and all PPE purchases steadily climbed after the start of the epidemic, spiking during and after the height of the outbreak (see Figure 2, left). Masks, reusable respirators, and single-use lotion (the three cheapest forms of PPE) were most popular. A smaller number of very expensive and reusable bubbles (similar to a biohazard suit) were purchased during the peak of infection.

When it came to using PPE, including free and paid options, reusable respirators were by far the most popular choice, followed distantly by free handwashing (see Figure 2, right). All PPE use began almost immediately during the first case of infection. Reusable respirators were used more commonly than single-use masks and lotion. This is perhaps because the cheaper masks and lotion required frequent re-application (e.g., every time players entered a new room or location on Whyville), while more expensive respirators (similar to a real-life N95 mask) became part of a player's static outfit. In comparison, bubbles were priced far out of reach for newer players.

4 DISCUSSION

The design of the virtual epidemic was intentional in facilitating kids' inquiry and preventive practices across the virtual and real worlds. Engaging kids in a close mirror of the COVID-19 pandemic and providing them agency and control allowed them to engage the epidemic in a safe environment. Our analysis demonstrated that players did actively participate in a range of information seeking about the virus at multiple sites in Whyville, and purchased and used PPE throughout the epidemic and after the virus infection curve had not only flattened but ceased to exist.

Player actions largely matched the prevalence of the SPIKEY-20 virus. All cheaper forms of PPE were used at about equal levels, though eventually reusable and more effective respirator use emerged as the most popular choice for use during and even after the epidemic. We interpret this to mean that players opted for the best protection they could afford on slim earnings from salaries and games. The frequency of information seeking behaviors suggests that our design allowed players to make choices about how much attention to pay to info sources about SPIKEY-20, opting to either ignore, skim, or dive into available information. The design decisions around SPIKEY-20 information sharing encouraged players to evaluate the source and accuracy of information, engaging them to sifting through information to make educated decisions about personal and public health protection.

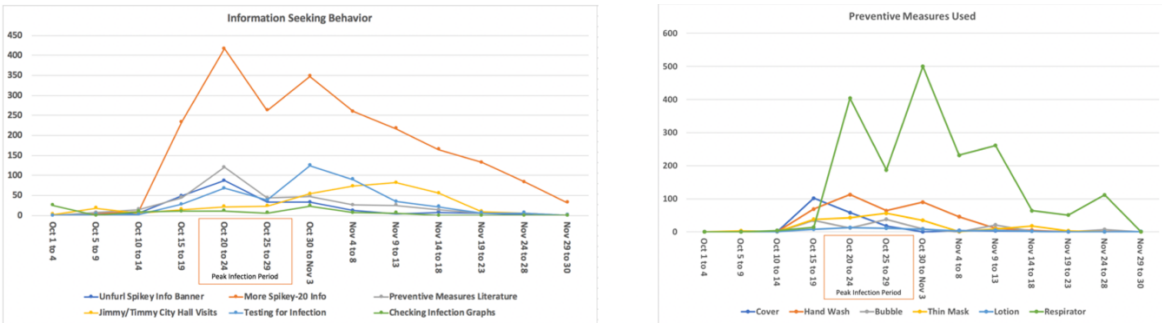

Figure 2: Number of players seeking information from different sources before, during, and after the outbreak (left), and PPE use (right). Highlighted dates are peak infection periods.

4.1 Designing for Connections to Real Epidemics

While our design of SPIKEY-20 emulated as many aspects of COVID-19 as possible (e.g., respiratory transmission, asymptomatic infectious period, and similar PPE) there were also clear distinctions from the real pandemic in terms of health and economic impact. Players took advantage of some epidemic design features that did not mirror real life, such as free and unlimited access to testing, unlimited PPE (i.e., no shortages), and accurate and complete information about infection rates in Whyville. While getting COVID-19 tests in real life has been fraught with challenges and delayed results, many players took SPIKEY tests multiple times, even in a single day. In contrast, some behaviors mimicked real life. For example, spikes in information seeking preceded spikes in more sophisticated PPE, i.e., with better quality respirators, mimicking a trend observed in real life (e.g., during Zika and COVID outbreaks) of information seeking being correlated with preventive behaviors [9, 10]. Designing immersive, experiential epidemic simulations can support learners to cultivate preventive public health behaviors in real life, thus avoiding public health crises in the future.

4.2 Looking Toward the Future

Present day infectious disease education is minimal at best in the United States, and what does exist tends toward didactic instruction. Virtual epidemics provide a means for children to engage in active inquiry and practice productive behaviors that mirror real-life practices of prevention and protection while maintaining a safe physical and emotional distance. Our design research demonstrates that youth took advantage of opportunities in the virtual world for information seeking and preventive practice, with observed changes in activity before, during, and after the virtual epidemic. Yet virtual epidemics and research on them can go further.

In an upcoming iteration of the SPIKEY-20 epidemic, we plan to offer a virtual donation campaign for two-stage vaccine development, again mirroring design with real life parallels. In addition, have developed and implemented an accompanying school curriculum that connects school science about viruses and biology with epidemiological concepts, such as stages of individual viral infection and population-level influences. Work is ongoing to explore the how students translated virtual epidemic experiences to real-life behaviors and attitudes. Similarly, we implemented a survey before and after the SPIKEY-20 epidemic, about player attitudes and behaviors in real-life. We aim to use these data to point to concrete connections between in-game and real-life public health behaviors.

The SPIKEY-20 epidemic uniquely took place during the throes of the worldwide COVID-19 pandemic, but the opportunity for education will need to become a part of the standard curriculum as the threat of epidemic outbreaks will continue to exist. Virtual epidemics supported by classroom activity and reflection could support students in advance of an epidemic, especially since students could practice and evaluate the results of preventive behaviors before rather than during an epidemic.

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