

Understanding Student Perceptions Around Mandatory Use of Smartphone Apps for COVID-19

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In this short paper, we present our findings from a survey (n=178) conducted on a college campus to understand student perceptions of the deployment of CoVerified app to regulate COVID-19 spread on campus by limiting access to on-campus locations and events to only those with a “cleared” status. We expect our recommendations could help with future deployments of smartphone apps for managing spread of COVID-19, should there be new variants. Additionally, we also highlight our innovative pedagogy of bringing research into the classroom by incorporating the study data into a class project.

CCS Concepts: • **Human-centered computing** → **Empirical studies in collaborative and social computing**;

Additional Key Words and Phrases: covid; deployment; survey; smartphones; mandated app

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1 INTRODUCTION

After a year of remote instruction due to social distancing restrictions mandated by the COVID-19 pandemic, several colleges switched back to in-person classes by implementing strategies to help mitigate and contain the spread of COVID-19. In addition to requiring vaccination for all students and staff, many colleges (including ours) continued to monitor the spread using weekly testing and apps specifically designed to monitor a student’s COVID-19 status. The CoVerified app has been used by over 350,000 users across businesses and college and school campuses across the country to enable students to report daily symptoms, share vaccination status, manage testing appointments and access and share test results [1]. Most colleges used CoVerified to enforce daily symptom monitoring and weekly testing, by requiring students to obtain a “cleared” status to gain entry to locations on campus [2]; a “cleared” status implies that the student is unlikely to be infected with COVID-19 and a “restricted” status implies otherwise.

We conducted a survey to understand the factors that affect student perceptions about the mandated use of the CoVerified app on one such college campus. The primary goal of this study was to better understand user concerns surrounding deployments of mandatory apps on college campuses, so as to improve user experiences with similar

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deployments in the future. Prior research has mostly focused on deployments of contact tracing and exposure notification apps; we are not aware of any other studies that have tested mandated apps for symptom and testing management used on college campuses. Contact tracing and exposure notification apps are used to alert a user if they came in close proximity of another user, as soon as the latter tests positive for a COVID-19 infection. Symptom and testing management apps are more intrusive than contact tracing apps because 1) they expect the user to interact with and provide data to the app regularly and 2) data shared to and from the app immediately affects the user’s daily routine. Even though they do not automatically collect location or proximity information of the user, symptom and testing management apps collect and can access sensitive medical information such as vaccination status, test results and daily symptoms and require the user to share test results with others.

Our survey addresses the following research questions: **R1:** Do concerns about COVID affect people’s perception about using app? **R2:** Do attitudes towards COVID protocols affect people’s perception about using app? **R3:** Do people’s attitudes towards sharing Co-Verified status with peers, friends, professors and to gain entry at events affect people’s perception about using app? **R4:** Do negative experiences such as being turned away at locations and events affect people’s perceptions about the CoVerified app? Our secondary goal was to explore ways to use the survey data to provide feedback to users to improve their user experience and build community as we faced the pandemic together.

We hope this paper will encourage college administrations to 1) revisit the design of their COVID-19 protocols to minimize negative experiences among students when using mandatory apps, 2) conduct surveys to collect student feedback and 3) use survey results to highlight the positive aspects of the use of such applications to foster a sense of community among the app users.

2 RELATED WORK

Digital technologies have been used around the world to combat the spread of COVID-19 and in this section, we present prior research that highlight the successes and challenges of such app deployments. A study conducted of Singapore residents who used the TraceTogether app from July 2020 to February 2021 highlighted concerns about privacy, smartphone battery efficiency, and app effectiveness [5]. A study of users from US, Germany and China showed that the strongest predictors of public acceptance of contact-tracing apps were perceived effectiveness of these apps, previous experience using similar apps, and perceived benefits and risks [6]. Degeling et al. discovered that users were not convinced that contact tracing apps were effective, especially when direct benefit to them was not immediately apparent [4]. Our paper focuses on user perspectives surrounding the deployment of CoVerified which, unlike most of the papers cited in this section, is not used for contact tracing or exposure notification but for managing spread of COVID-19 by enforcing daily symptom tracking, and weekly testing to obtain entry to spaces on campus. Even though the apps were different in what information they collected and when, and how the information was used, we expected users to have similar concerns surrounding app effectiveness.

One prior work similar to ours is that of Scherr et al. which describes user perspectives from a pilot deployment of an app called COVIDKey that used contact tracing to determine whether a user was “cleared” to access spaces [7]; our work differs in two ways: one, this app generated “cleared” status based on contact tracing, since it was created in 2020, before vaccines and weekly surveillance testing were mandated on college campuses, and two, the researchers recruited 45 users specifically for testing the app, whereas we recruited participants from a pool of students who were mandated to use the app every day.

3 METHODS

To understand the factors that affect student perceptions about the mandated use of CoVerified app, we conducted a survey at our institution which at the time of the study, mandated the use of the CoVerified smartphone app [1]. All students on campus had to install the app on their phones and use it to schedule weekly testing and obtain a “cleared” status to gain access to the dining hall and to attend events. The study was approved by our Institute Review Board and was administered using Qualtrics [3]. All participants were compensated \$5 on completion of the survey, which we computed should not take more than 15 minutes through a pilot study.

3.1 Study Design

Our survey obtained participants’ opinions about COVID-19, the protocols and safety measures taken to reduce spread of COVID-19 and their experiences using the CoVerified app on campus, using a 7-point Likert-scale ranging from Strongly disagree (1) to Strongly agree (7). There was also one open-ended question where we asked participants to share at least one instance where the app made it difficult to attend events or get food in-person at the dining hall. We also asked questions about their technology usage. See survey questionnaire in Appendix A.

3.2 Participants

We recruited 178 participants through email at our institution. Among our participants who reported their gender, 116 identified as female, 49 as male, and 11 as non-binary/third gender. 28 were Asian, 12 were Black or African-American, 106 were white, 11 were Hispanic, 19 were biracial, 1 multi-racial and 1 chose other. 150 participants were born in the US, while 28 were immigrants. 5 participants lived alone, 29 lived with one other person, 121 lived with 2 or 3 people, while 23 lived with more than 4 other people. All participants reported being able to use the CoVerified app on their phones. Among the participants, 10 participants reported that they had, on some occasion, used their laptop to share their CoVerified status, instead of their phones, while 4 participants reported they had used tablets.

3.3 Analysis

To analyse the study data, we used Wilcoxon rank-sum tests to test for dependency between two groups of categorical data. Before conducting the tests, the 7-point Likert scale were converted into binary data, separating “Slightly Agree”(5) to “Strongly Agree”(7) versus everything else and the Yes/No questions were separated into Yes(1) and No(2). The responses to the question about number of adults in their home (residents) was separated into 1 or 2 adults vs >2 adults. In all tests, we excluded missing data, which was marked as 0. To eliminate bias due to the number of tests performed, we used a Bonferroni correction for each research question. Finally, we used thematic analysis on participants’ open-ended responses.

4 RESULTS

Next, we present the results from the Wilcoxon tests we ran for the four research questions.

4.1 Do concerns about COVID-19 affect people’s perception about using app?

Table 1 shows the means of both groups, effect sizes and p-values for the tests to understand whether concerns about getting infected with COVID-19 (risk_self), concerns about family and friends getting infected with COVID-19 (risk_family_friends), concerns about spreading COVID-19 to others (risk_others) and the number of people residing

	cv_convenient	cv_comfortable
risk_self	4.89 vs 4.98 (-0.02)	3.74 vs 4.83 (-0.25)**
risk_family_friends	5.0 vs 4.97 (0.0)	3.67 vs 4.71 (-0.16)
risk_others	4.87 vs 4.98 (0.02)	3.6 vs 4.76 (-0.2)*
residents	4.74 vs 4.7 (0.01)	4.35 vs 4.4 (-0.01)

Table 1. Do concerns about COVID-19 affect people’s perceptions about CoVerified? Values shown are the means with effect size in parentheses. * denotes $p < 0.05$, ** denotes $p < 0.01$, *** denotes $p < 0.001$

	cv_convenient	cv_comfortable
college_protocol	2.48 vs 4.99 (-0.41)***	2.14 vs 4.7 (-0.42)***
coverified_access	3.18 vs 5.17 (-0.41)***	2.45 vs 5.1 (-0.6)***
masking_protects	1.33 vs 4.9 (-0.49)***	1.46 vs 4.52 (-0.4)***
staying_home_protects	2.59 vs 4.84 (-0.35)***	2.35 vs 4.52 (-0.35)***
vaccinated_protects	1.38 vs 4.88 (-0.46)***	1.25 vs 4.55 (-0.45)***
get_vaccinated	1.76 vs 4.88 (-0.38)***	1.44 vs 4.57 (-0.42)***
testing_protects	2.29 vs 4.92 (-0.4)***	2.06 vs 4.6 (-0.4)***
other_contact_tracing	5.34 vs 4.86 (0.1)	4.97 vs 4.55 (0.09)

Table 2. Do attitudes towards protocols affect people’s perception about using app? Values shown are the means with effect size in parentheses. * denotes $p < 0.05$, ** denotes $p < 0.01$, *** denotes $p < 0.001$

in their home (residents) affect their perceptions about using the app, specifically, whether the app is a convenient way to share vaccination status and test results (cv_convenient) and if the participants felt more comfortable being at events and in the dining hall (cv_comfortable). The results show that students who were more concerned about getting COVID-19 themselves ($p < 0.01$) and spreading COVID-19 to others ($p < 0.05$) were more likely to be comfortable being in spaces on campus because of the CoVerified app.

4.2 Do attitudes towards protocols and measures affect people’s perception about using app?

Table 2 shows the means, effect sizes and p-values for the tests to understand whether attitudes towards COVID-19 protocols, such as the overall protocol enforced by our institution (college_protocol), use of CoVerified to gain access to places (coverified_access), wearing masks (masking_protects), staying home (staying_home_protects), getting vaccinated (vaccinated_protects), mandating vaccines (get_vaccinated), regular testing (testing_protects) and use of other apps for COVID-19 (other_contact_tracing) affect their perceptions about using the app, specifically, whether the app is a convenient way to share vaccination status and test results (cv_convenient) and if the participants felt more comfortable being at events and in the dining hall (cv_comfortable). The results show that students who believed in the effectiveness of measures such as regular testing, masking, staying home, and vaccines and in the effectiveness of the college’s protocols and the Coverified app itself in reducing the spread of Covid-19 ($p < 0.0001$) were more likely to find the CoVerified app to be convenient and feel more comfortable being in spaces on campus because of the CoVerified

	cv_convenient	cv_comfortable
share_peers	4.0 vs 5.03 (-0.14)	3.93 vs 4.66 (-0.11)
share_close_friends	3.44 vs 5.02 (-0.16)*	3.67 vs 4.65 (-0.09)
share_professors	3.73 vs 5.02 (-0.16)*	3.73 vs 4.66 (-0.11)
share_events	3.38 vs 5.03 (-0.16)*	3.12 vs 4.68 (-0.16)*

Table 3. Do people’s attitudes towards sharing Co-Verified status affect people’s perception about using app? Values shown are the means with effect size in parentheses. * denotes $p < 0.05$, ** denotes $p < 0.01$, *** denotes $p < 0.001$

	cv_convenient	cv_comfortable
turn_away_restricted	4.53 vs 3.5 (0.15)	4.16 vs 4.25 (-0.04)
turn_away_no_access	4.11 vs 4.11 (-0.0)	4.11 vs 4.32 (-0.03)
difficulty	4.06 vs 5.19 (-0.3)***	4.2 vs 4.75 (-0.15)

Table 4. Do negative experiences such as being turned away at locations and events affect affect people’s perceptions about CoVerified? Values shown are the means with effect size in parentheses. * denotes $p < 0.05$, ** denotes $p < 0.01$, *** denotes $p < 0.001$

app. However, use of other contact tracing apps did not seem to affect their perceptions of the CoVerified, though the group which used contact tracing apps were slightly more likely to agree that CoVerified was convenient and that they felt more comfortable being in spaces on campus because of the app.

4.3 Do people’s attitudes towards sharing Co-Verified status affect people’s perception about using app?

Table 3 shows the means, effect sizes and p-values for the tests to understand whether people’s attitudes towards sharing Co-Verified status with peers (share_peers), close friends (share_close_friends), professors (share_professors) and at events (share_events) affect their perceptions about using the app, specifically, whether the app is a convenient way to share vaccination status and test results (cv_convenient) and if the participants felt more comfortable being at events and in the dining hall (cv_comfortable). The tests revealed that students who felt more comfortable sharing their CoVerified status with friends, professors and at events ($p < 0.01$) were more likely to also find CoVerified convenient to use. Additionally, students who felt more comfortable sharing their CoVerified status at events also felt more comfortable attending events and getting food in-person.

4.4 Do negative experiences such as being turned away at locations and events affect people’s perceptions about CoVerified?

Table 4 shows the means, effect sizes and p-values for the Wilcoxon rank-sum tests we conducted to understand whether negative experiences such as being turned away due to having a restricted status (turn_away_restricted) and due to not having access to the CoVerified app (turn_away_no_access) and difficulty to attend events (difficulty) affect their perceptions about using the app, specifically, whether the app is a convenient way to share vaccination status and test results (cv_convenient) and if the participants felt more comfortable being at events and in the dining hall (cv_comfortable). Our results show that students who were more likely to feel that CoVerified made it difficult to attend events were more likely to find it less convenient to use ($p < 0.0001$).

Next, we present the three themes we identified from a qualitative analysis of the open-ended responses.

Inconvenience caused by students not complying with college’s protocols. Students who did not test on time were unable to get test results quickly enough, which prevented them from getting food at the dining hall. For example, one student described, “If you miss testing you have to wait for results which can be delayed and cause you to miss out on entry to dining hall or events.”

Inconvenience caused by testing protocols. The additional check caused longer lines and delays in getting food, which affected students’ schedules. Inconclusive tests also resulted in a “restricted” status preventing students from getting access to locations.

Negative consequences of using smartphone apps. The college’s protocols expected students to carry their phones with them at all times, but many students disliked being dependent on their phones. Additionally, the phones also needed to have charge in them for the student to use the app. One student said, “if my phone dies during a long block of classes, then I have to wait for it to charge before I can eat.”

Students also described how the app would log them out frequently and the sign-in process sometimes would not work or take a long time. For example, one student mentioned “Sometime the connection is bad and I can not access the app so I have to wait for quite a long time to get through the signing in process.”

5 RECOMMENDATIONS

Based on our findings, we provide the following recommendations to college administrations when they plan future deployments of symptom and test monitoring apps for Covid-19.

5.1 Focus on the positive impact

Overall, it is encouraging that students felt safer on campus because of the use of this app and by mandating the use of the app, students were required to comply with the testing rules. Could sharing this information (that students feel safe when using the app) have changed the perspectives of the students who were unhappy about being turned away at locations? The students were turned away in most cases for legitimate reasons, because they were, in fact, not supposed to be in those spaces due to “restricted” status. Since the impact of the app was not immediately evident, any negative experience led users to blame the CoVerified app and the college’s COVID-19 protocols and in some cases, become hostile towards the people working at the entryways to the various locations, based on anecdotal evidence.

Some students were turned away for not getting tested for COVID-19 on time, which could be resolved if the app sent them reminders to get tested. Additionally, to create a feeling of inclusion and responsible togetherness, the app could also prompt users about how they feel about COVID-19 through ecological momentary assessments (EMA) and share aggregate and anonymized results frequently with the broader community or integrate social aspects such as allowing a user to text a friend to pick up food.

5.2 Reduce dependence on smartphones

Even with a “cleared” status, students were sometimes prevented from gaining access to locations, for example if they did not have their phone on them. To prevent this, CoVerified status could be connected to the student records so swiping an ID card, which is required to gain entry to dining halls, could also reveal the student’s CoVerified status - the CoVerified website mentions this feature was adopted by some colleges. However, this might not be easy to implement as it will involve changing college infrastructure by installing ID card readers at entrances to all locations where a “cleared” status was required to gain access. Any mechanism used by a student to share CoVerified status, other than the

student's own phone or ID card, will require implementation of additional authentication techniques to verify that the information shared was indeed accurate. For example, anecdotal evidence showed that some students attempted to game the system by changing the date on printouts containing their CoVerified status, hence our college did not consider printouts to be a legitimate way of presenting CoVerified status. Instead, perhaps the app could permit the student to choose a friend they trust, so that the app on the friend's phone could also be used to access this student's CoVerified status, using a secret code known only to the student. Alternately, the app could generate a QR code containing the student's CoVerified status, which can be subsequently printed and produced as proof to gain access.

Adding additional authentication should not come at the cost of usability, since requiring students to login frequently negatively affected their user experience. For example, some students were unable to quickly share their CoVerified status because of network connectivity issues, which prevented them from logging in to the app to obtain their CoVerified status and could also have contributed to long wait lines at the dining hall.

6 INCORPORATING RESEARCH INTO THE CLASSROOM

Since we wanted to determine how students reacted to data collected from our survey, we incorporated the study results into an assignment in a digital arts class where they were expected to create a one minute animation to visualize quantitative data. The data from the survey was shared with the students as a .csv file. The students created animations using Adobe Illustrator and AfterEffects. The students were expected to use animation to tell a story about the data through time-based media using the formal elements of pattern/texture, movement, and scale. Students were given two weeks to complete the project. From their submissions, it was evident that they were able to interpret the survey data, relate to the data as participants who used Co-Verified and synthesize the data into their submission to show the impact that the app had on the community.

7 FUTURE WORK

We plan to conduct a follow-up study with the staff members – many of whom were students and users themselves – who were responsible for checking students' CoVerified status at various events and locations, to understand their experiences. Finally, we plan to implement a COVID-19 symptom and testing management system that one, will not require a student to show their phone to prove their status, and two, allows students to become aware of how the system helps others in the community feel safe and motivate them to comply with the protocols.

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Appendices

A SURVEY QUESTIONNAIRE

- (1) Please choose what gender you identify with: Male, Female, Non-binary/third gender, Prefer not to say
- (2) Select the racial category or categories with which you most closely identify: Asian, Black or African American, Native Hawaiian or Other Pacific Islander, White, Hispanic, Other
- (3) What is the yearly household income of your family? Less than \$25,000/\$25,000- \$50,000/\$50,000-\$75,000/\$75,000-\$100,000/\$100,000-\$150,000/ \$150,000 or more/I don't know
- (4) Were you born in the U.S.? Yes/No.
- (5) How long have you been resident in the United States?
- (6) How many adults (18+) reside in your home, including yourself? 1/2/3-4/5 and over
- (7) Respond to the following 2 statements below by indicating how much you disagree or agree with it on a scale of 1 to 7 where 1 equals disagree strongly and 7 equals agree strongly: I am concerned about getting infected by COVID-19/I am concerned about my family and friends getting infected by COVID-19/I am concerned about spreading COVID-19 to others
- (8) Respond to the following 2 statements below by indicating how much you disagree or agree with it on a scale of 1 to 7 where 1 equals disagree strongly and 7 equals agree strongly: Wearing masks reduces the spreading of COVID-19/Staying home reduces the spreading of COVID-19/Getting vaccinated will reduce the spreading of COVID-19/Everyone with access to the COVID-19 vaccine should choose to get it (if it does not pose a medical risk)/Testing regularly will reduce the spreading of COVID-19
- (9) Respond to the following 2 statements below by indicating how much you disagree or agree with it on a scale of 1 to 7 where 1 equals disagree strongly and 7 equals agree strongly: Skidmore's protocol for masking and social distancing will reduce the spread of COVID-19/The use of Co-verified app to grant entry on various places on campus will reduce the spread of COVID-19.
- (10) Respond to the following 5 statements below by indicating how much you disagree or agree with it on a scale of 1 to 7 where 1 equals disagree strongly and 7 equals agree strongly: The Co-verified app is a convenient way to prove my vaccination status and show my test results/The Co-verified app makes me feel more comfortable attending on-campus events and getting food in-person at the dining hall
- (11) Respond to the following 5 statements below by indicating how much you disagree or agree with it on a scale of 1 to 7 where 1 equals disagree strongly and 7 equals agree strongly: I feel comfortable sharing my Co-verified status with my peers/my close friends/my professors/at events on campus
- (12) Co-verified makes it difficult to attend on-campus events and get food in-person at the dining hall: Yes/No
- (13) If yes to 12, explain at least one instance where the app made it difficult to attend on-campus events or get food in-person at the dining hall.
- (14) If yes to 12, have you ever been turned away because of not having a cleared status on the app: Yes/No
- (15) If yes to 12, have you ever been turned away because of not having access to the Coverified app: Yes/No
- (16) Does your phone allow you to use the Co-verified app? Yes/No
- (17) Other than your phone, what other device have you used to show your cleared status on Co-verified? Laptop/Tablet/Other: N/A, I always use my phone
- (18) Did you install any other smartphone app to help curb the spread of COVID-19? Yes/ No