



Implementation of a Technology-Enhanced Peer Mentor Referral System for First-Year University Students

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Abstract

COVID-19 forced college administrators to reassess how they provide students with the most effective methods of support. This project examined the first year of a novel digital peer mentoring program with the goal of connecting diverse students to campus resources they needed to navigate the transition to and through their first year of college. MentorHub, a referral and supportive accountability mobile application, was implemented with first-year undergraduates at a large, private university in the northeastern region of the USA. MentorHub tracked students' current challenges and connected them with trained peer mentors who provided students with support and referrals to campus resources (e.g., mental health, financial, academic). Analyses were not hypothesis-driven, but instead were exploratory and intended for improving the platform. In the first year of the program (August 2021 to June 2022), 47% ($N = 3141$) students logged onto the platform at least once. Patterns of self-reported challenges revealed that career concerns were the most challenging at the beginning of the fall semester, and that academic habits were most challenging over the course of the year. Referrals ($N = 756$) were made by mentors, 13% of which were for health and well-being. First-generation and underrepresented minority students showed distinct patterns in referrals. Findings revealed distinct patterns in self-reported challenges across the academic year. Students' use of MentorHub and responses to in-app questions allowed for a real-time understanding of student challenges and patterns of engagement with peer mentors. Implications for a stepped-care approach to addressing student challenges are discussed.

Keywords Peer mentoring · College transition · Supportive accountability · Technology

Although completing a college degree confers a range of financial, social, and health benefits (Ma et al., 2016), 30% of college freshmen drop out before their sophomore year. Dropout is most salient for first-year students (Engle & Tinto, 2008), especially for those of first-generation, non-white, and low-income populations. Student engagement with campus resources often leads to positive academic outcomes and connectedness to the university (Wilson & Gore, 2013), particularly among more marginalized students. Researchers have found that using social and academic support services and college-based mentoring is associated with better grades (see Crisp et al., 2015) and lower stress (Garriott & Nisle, 2018). Unfortunately, the complex university administrative

structure can leave students feeling unsure of how to access services, which may increase stress and delay their access to campus resources. The COVID-19 pandemic has only exacerbated these challenges and highlighted the need for innovative strategies that improve students' support experiences.

The current study describes the first test of a novel technology-enhanced peer mentoring support and referral system for first-year college students during the 2021–2022 academic year at a private, large university in the northeast part of the United States. This program was designed in the wake of the COVID-19 pandemic with the goal of providing first-year students a stepped-care approach to academic, social, and wellbeing support through a digital peer mentoring system. More advanced undergraduate and graduate students at the same institution (i.e., peer mentors) were trained to respond to students' needs by monitoring challenges, providing support and referrals to campus resources, and ensuring sustained engagement in those resources. All first-year students were invited to participate and connect with their peer mentors through a mobile application, MentorHub.

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Institutional Characteristics as Barriers to Student Success

Although a college education can be a bridge to economic empowerment, many students experience barriers to college success (e.g., Long, 2014). For years, scholars have argued that student characteristics predict success in college (see review in Smart et al., 2006). This “student-centered research tradition” (Smart et al., 2006) encouraged researchers to neglect higher-level institutional variables critical to student success. However, more recent theories of student retention and completion have started to focus on institutional-level variables (e.g., Tinto, 2012), a key one being student support, particularly during the vulnerable first year of college (Tinto, 2012). Although satisfaction with student support can predict university connectedness (Wilson & Gore, 2013), students who experience low levels of support are at higher risk for attrition (Olmedo-Cifuentes & Martínez-León, 2022). During the COVID-19 pandemic, students are experiencing reduced sources of social support overall (Madrigal & Blevins, 2022), highlighting a need for innovative support systems.

Although academic advising is an important strategy to support students, many students express low satisfaction and low rates of meeting with their advisor throughout college (Allard & Parashar, 2012). This low satisfaction stems from advisors not meeting students’ expectations and from the variability in advisors’ ability and willingness to support students. Others have noted that approaches to higher education academic advising in universities can be fragmented (Joslin, 2018). Within a given institution, there may be different types of advising and varying requirements based on school or majors, causing confusion and frustration among students trying to navigate their first year of college. In the aftermath of COVID-19, increasing demands on advisors have introduced additional complexities and delays for students wishing to meet with their advisors (Ammigan & Liu, 2022).

Institutionally-supported student mental health services also need to be improved. Pre-pandemic, it was estimated that 36% of college students had a lifetime mental health diagnosis (Lipson et al., 2019). Since COVID-19, there have been clear increases in mental health challenges among college students, such as anxiety (Lee et al., 2021; Wang et al., 2020), depression (Kim et al., 2022; Lee et al., 2021; Wang et al., 2020), and a general lack of motivation (Madrigal & Blevins, 2022). This has created even longer university counseling service waitlists (i.e., Cohen et al., 2022), and has underscored the importance of finding alternative methods of triage for students’ challenges (e.g., a stepped care approach where students can seek peer support for relatively less serious concerns, such as stress or loneliness).

More generally, the specialized nature of university administrative and support structures places the burden on

students to navigate resources when they need them. Time spent struggling to access resources or being shuffled from one office to another diverts students’ focus from pressing academic tasks and from building new social ties (Plass et al., 2010). The frustrations of navigating complex systems represent a cognitive load on students, requiring them to hold many tasks and concepts in mind, which can lead to stress, procrastination, and reduced motivation (Castleman & Page, 2013; Feldon et al., 2019). Navigating complex university resources may be a particular challenge for first-generation, underrepresented, and marginalized populations. Evidence suggests that many first-generation students struggle to navigate bureaucratic structures (Collier & Morgan, 2008; Yee, 2016), and experience stressors that continuing-generation students largely do not face. First-generation students, by definition, do not have parents or guardians with higher education experience, thus they do not have that particular layer of support to help them decipher the complexities of university life (Davis, 2010). First-generation students also tend to rely on themselves to succeed, instead of leaning on others at the institution for academic support (Yee, 2016). Although research tends to focus on the academic challenges faced by first-generation students, these students’ strengths should also be acknowledged. Research suggests that first-generation students are prosocial (they want their learning to benefit their home communities) and interdependent (they want to learn with others) (see Ives & Castillo-Montoya, 2020).

Despite these institutional-level challenges, solutions exist. Evidence suggests that online informational support interventions (i.e., providing easy access to information and resources as guidance) facilitated by a mentor may help bridge gaps for incoming first-generation college students (Ware & Ramos, 2013).

Improving Support Systems with Peer Mentors

Although faculty and staff can help address some of the challenges associated with navigating higher education, meaningful connections between students and faculty/staff are relatively rare and unequally distributed across students (Raposa et al., 2021). Overall, studies of underrepresented college students suggest that faculty and staff comprise a small percentage (i.e., less than 10%) of mentors during their first 2 years (Hagler et al., 2021; Raposa & Hurd, 2021; Rios-Aguilar & Deil-Amen, 2012), suggesting that underrepresented students have unequal access to such supports when compared to their peers. Moreover, students who need institutional and faculty support the most may be the least likely to access it (Alexitch, 2002). Research suggests that young adults’ ability to connect with informal mentors may depend on

their past social experiences (Gowdy et al., 2020), which means that students with limited existing social experiences may be particularly at-risk of not forming strong connections with faculty and staff at college. Furthermore, more marginalized students may be less willing to seek out help than their continuing-generation counterparts (Lareau & Cox, 2011). These results highlight the need for innovative strategies for underrepresented and first-generation students to be more directly connected with faculty, staff, and other academic services.

The literature clearly highlights the importance of providing support to students from diverse backgrounds to increase their sense of connection and their exposure to academic and other resources. Peer mentors can normalize the challenges associated with transitioning to and through college (see Hagler et al., 2021) by drawing on their recent experience to help students identify and reach out to campus resources, services, staff, and faculty (Hynes, 2015). Wilson and Gore (2013) found peer support to be a positive predictor of university connectedness and suggested leveraging more experienced peers at a university to support first-year students via a university peer mentoring program. To increase efficacy, Ware and Ramos (2013) propose mentor-facilitated informational support interventions to deliver additional support that may be unique to first-generation populations.

Although peer support may help bridge gaps in access to student support services, many young college students still struggle to find or recruit a peer mentor within their social networks (Gowdy et al., 2020), hence increasing the popularity of formal mentoring programs at university settings. There is an abundance of research supporting the potential formal cross-age mentoring programs hold, including for college adjustment (Etzel et al., 2018), student motivation (Dennehy & Dasgupta, 2017), and psychosocial outcomes (i.e. connectedness; Yomtov et al., 2017). Despite this potential, the effects of formal mentoring programs more broadly are generally small and tend to fall short. A recent meta-analysis demonstrated that mentoring programs that use targeted approaches (i.e., having specific goals and focus areas for the mentoring relationship) are about twice as effective as general support models (Christensen et al., 2020), suggesting a need for innovative targeted peer mentoring approaches at the university level.

The Role of Technology

Supportive accountability (Mohr et al., 2011) is one model for implementing a targeted approach to mentoring relationships. The model includes providing mentees with supportive encouragement and accountability for

engaging with resources, which can include campus-specific resources or digital mental health technologies. Recent literature on technology-delivered interventions suggests that providing human support for intervention use can lead to positive associated outcomes (e.g., Andersson & Cuijpers, 2009; Linardon et al., 2019), supporting the use of supportive accountability models in college-level mentoring programs to ensure students' use of targeted resources.

Given the level of accessibility that they offer, these technology-delivered interventions are being looked at as one potential solution to increasing gaps in supportive care. The COVID-19 pandemic has only exacerbated this need, as students are reporting adverse experiences with changing (often limited) social support networks (Madrigal & Blevins, 2022). For wellbeing, in particular, an abundance of recent research supports the potential of technology-delivered interventions in improving the depression (i.e. Domhardt et al., 2019; Grist et al., 2019; Heber et al., 2017; Sztejn et al., 2018), anxiety (i.e. Grist et al., 2019; Heber et al., 2017; Sherifali et al., 2018), and stress (i.e. Heber et al., 2017; Sherifali et al., 2018) of users. Despite this potential, uptake to such resources remains low (Baumel et al., 2019; Stiles-Shields et al., 2017) or inconsistent across platforms (Lattie et al., 2016), limiting the overall impact. As alluded to, researchers are finding higher engagement and effect sizes when a form of human support is provided for the individual's use of the intervention (i.e. Andersson & Cuijpers, 2009; Domhardt et al., 2019; Heber et al., 2017; Linardon et al., 2019), hence explaining the increased attention human support and supportive accountability has received.

Current Study

In the current exploratory and descriptive study, students (second years through graduate students) were paid to serve as peer mentors to all incoming first years in the same institution. This was the first peer mentoring program at this institution and was designed to be a targeted mentoring initiative (i.e., peer mentors facilitate students' access to university resources) administered via technology platforms. They were tasked with responding to questions, providing support, and making referrals to connect first-year students with appropriate resources on campus through a digital mentoring platform.

This study examines the proximal outcomes of the program's first year. First, we focus on the acceptability and feasibility of the program by examining student engagement and their feelings of connection to the university. Second, we explore whether there were differences in engagement based on student characteristics, including generational and

Table 1 First-year students' demographics

	Full first-year class	Students in peer mentoring program	Difference statistic
Number of students (<i>N</i>)	6709	3141	
Age (<i>m</i> [<i>sd</i>])	18.60 (0.70)	19.36 (0.65)	$t(3140) = 65.53, p < 0.001$
Gender* (<i>n</i> [%])			$\chi^2(2) = 13.08, p = 0.001$
Female	3979 (59.33)	1961 (62.43)	
Male	2724 (40.60)	1177 (37.47)	
Not reported	6 (0.09)	3 (0.10)	
International students (<i>n</i> [%])	605 (9.02)	334 (10.63)	$\chi^2(1) = 10.10, p = 0.002$
Race and ethnicity ^a (<i>n</i> [%])			$\chi^2(6) = 21.71, p = 0.001$
Asian	1318 (19.65)	543 (17.29)	
Black or African American	449 (6.69)	203 (6.46)	
Hispanic or Latino	849 (12.65)	377 (12.00)	
Other	6 (0.09)	6 (1.63)	
White	2883 (42.97)	1391 (44.29)	
Two or more races	468 (6.98)	240 (7.64)	
Race and ethnicity unknown	131 (1.95)	47 (1.50)	
Generational status (<i>n</i> [%])			$\chi^2(2) = 79.68, p < 0.001$
First generation	751 (11.19)	331 (10.54)	
Continuing-generation	3631 (54.12)	1484 (47.25)	
Not reported	2327 (34.68)	1326 (42.22)	

*The university only reports female and male gender at this time

^aThe university only collects race and ethnicity from domestic students

minority status. Third, we describe time-based trends in attitudes about the university and self-reported challenges of first years across six domains: academic habits, academic planning, career, connectedness, finances, and health and wellbeing.

Method

Participants

The first-year class was eligible to participate in the peer mentoring program ($N = 6709$). Of the first-year class, 46.83% ($n = 3141$) opted into the program, defined by downloading, installing, and logging into MentorHub.¹ Demographic statistics of the full class and those who opted-in are listed in Table 1. There were 315 peer mentors during the first year; 79% of those mentors were international students, 58% were women and, of those who were US citizens (21%), 16% were from an underrepresented racial group. This study was deemed exempt from the university's Institutional

Review Board, given it was a programmatic evaluation of an initiative for all incoming first years.

Program Description

The program and associated mobile app were introduced to incoming students as a way to engage the support and guidance they need to thrive at the university by being paired with a trained peer mentor. Throughout both semesters there were multiple outreach interventions, including emails to students and parents, social media posts, in-person tabling events, and one-on-one outreach to students in on-campus housing. The peer mentors provided support to first-year students through a version of MentorHub (Donofrio et al., 2021) that was created for this specific university. Students were encouraged to participate by downloading MentorHub and by logging in using their university's single sign-on feature. MentorHub includes a secure chat feature through which mentors and mentees can message one another, which is monitored by university staff coordinators assigned to supervise peer mentors. Within MentorHub, students regularly rate how they are doing across multiple domains (e.g., wellbeing, academic habits, connectedness), in which peer mentors can see responses and provide appropriate, time-sensitive referrals. This technology-enhanced peer mentor referral system builds on models of peer mentoring, digital health, supportive accountability, and stepped-care

¹ These data were analyzed after new students were allowed into the platform for the next academic year, which meant that we had to filter the data for the current (first year) sample. Data were filtered based on number of credits earned, which is a proxy for year in school.

approaches to provide first-year students with an innovative approach to accessing the resources they need to thrive in college.

Students were also incentivized to participate in the program through a points and prizes program in the fall 2021 semester. Students received points by interacting with MentorHub by completing an interactive app feature (i.e., Check-In) that prompted students to rate their challenges (see below); students could then use those points to gain access to university merchandise or monetary prizes (e.g., coffee gift cards, picnic blanket, or a shopping spree at the bookstore). Students who did not download and log in to MentorHub were sent reminder emails from their assigned peer mentors at the beginning of the semester; however, there were no consequences for not participating. Students who did not continue to engage in MentorHub (message their peer mentor or use Check-In) were sent regular messages from their peer mentor to remind the student to engage.

Peer Mentors' Training and Supervision

Any students who were in their second year of undergraduate studies or higher (including graduate students) from this university were eligible to apply to be a peer mentor as a part-time job at the university. Applicants were interviewed for the hourly paid position and those who were offered and accepted the role received 3 days of web-based synchronous training prior to working with students. The first day welcomed mentors to the program and explained the basic goals and guiding principles. There were multiple presenters, including the first author (AW) who discussed providing support to students, helping students set realistic goals, and using empathy. Day two training focused on the day-to-day requirements of working with students. Day three training focused on recognizing and responding to students in distress. Presenters representing various offices were invited to ensure that mentors received well-rounded training. Mentors were also asked to complete asynchronous training and quizzes at the beginning of the semester and throughout the year. During the first year, training focused on operational issues and did not include training on working with students from different backgrounds.

Drawing from the digital mental health literature, the peer mentors were also trained in supportive accountability (Mohr et al., 2011), which involves monitoring students' engagement in referred resources with nudges, encouragement, and alternative referrals as needed to ensure students' access and use. If students had trouble gaining access to resources (ranging from procrastination to long wait times), the peer mentors were able to help troubleshoot the next steps.

Mentors were supervised by coordinators, each of whom had approximately 30 mentors to manage. Coordinators met

with their mentors every other week for group supervision. During these group meetings, mentors would bring in challenges or questions, and coordinators and other mentors would help problem-solve. Mentors' conversations with students in MentorHub were monitored by coordinators for the students' protection. Coordinators also had supervisors who would help them with challenging student and mentor cases, as needed.

A key feature of the program was providing students with referrals to university services. Peer mentors were instructed to reach out within 24 h to students who indicated elevated challenges on the Check-In. Mentors provided resources for students' challenges to determine the best course of action. MentorHub enables mentors to provide students with a referral to a university resource (e.g., an appointment with an academic advisor, meeting with financial aid, or getting in touch with career services).

Each peer mentor was assigned approximately 30 first-year students. Students were grouped based on their college (e.g., engineering, arts, sciences), and every attempt was made to pair students with a peer mentor from their college; however, this was not possible in all cases. College was the only characteristic that students were matched on; the goal was to encourage peer mentors to share any institutional knowledge from their own experiences, in addition to the information they learned during formal training. Peer mentors were not given information about their students' background or identity (e.g., first-generation status or under-represented minority status); however, this information may have come up during conversations between peer mentors and students.

Student Demographics

Student demographics and grade-point average (GPA) were obtained from university records at the end of the academic year.

MentorHub

MentorHub is a mobile and browser application for students and a mobile application for mentors. MentorHub allows mentors and students to securely communicate via text message and video chat. The application also collects survey data from students. Mentors can monitor students' responses in order to provide tailored solutions for students' current challenges. Information from the survey data and discussions in MentorHub allowed mentors to refer students to relevant information and links, which guided them on how to navigate the complex university administration and resources. To allow university staff to monitor student well-being throughout the year, Tableau dashboards were created to visualize real-time program metrics collected through MentorHub.

MentorHub Measures

Student Adjustment

A questionnaire was created for MentorHub² for this university; selected items were included in this analysis and were chosen a priori. Each item was presented with a 5-point Likert scale from *strongly disagree* (1) to *strongly agree* (5). “I feel part of the [university] community” was adapted from Goodenow (1993). “I am confident that I will be a successful student at [the university]” was adapted from Bedewy and Gabriel (2015). “When I have questions about [the university], I reach out to my peer mentor” was created for this measure to assess students’ perceptions of support by their mentor. This questionnaire was presented the first time students used MentorHub, then was presented again every 3 months. Given that students opted into the program at various points throughout the year, students could respond to the questionnaire items up to four times.

Weekly Challenges

This assessment was broadly informed by Weisz et al.’s (2011) Youth Top Problems idiographic assessment. Six domains were presented to students: *Academic Habits*, *Academic Planning*, *Career*, *Connectedness*, *Finances*, and *Health & Wellbeing*. Students were instructed to “rate your top challenges by dragging the sliders to the right. The further you drag it, the more you are concerned about that challenge.” See Fig. 1a for a screenshot of the Check-In assessment. Until April 25, 2022, the default response on the sliders was *Not a challenge* (0); after April 26, 2022, the default changed to the center of the scale (5). After moving the sliders, students selected to save their responses. After completing Check-In, students could view their scores over time in MentorHub, see Fig. 1b. Check-In could be completed every 24-h; however, students were prompted to complete it once per week.

Engagement

Engagement in MentorHub was indexed by number of messages sent, number of referrals received, and number of times the student used the Check-In from August 2021 to June 2022. Using Check-In is not hypothesized to vary by students’ wellbeing (i.e., we hypothesize that students will use Check-In regardless of how they are doing); however, number of referrals and number of messages sent may

be confounded by a student’s wellbeing (i.e., a student in greater distress may send more messages than a student doing well). Despite these limitations, we examine messages, referrals, and Check-Ins as indicators of engagement.

Analytic Plan

Given that students opted into the program at various points throughout the year and could respond to the questionnaire items up to four times, each student has a different pattern of engagement. Raw data are presented here without transformation or adjusting for missing data.

Differences between the samples of students who opted into the peer mentoring program were compared to the full first-year class. One-sample *t*-tests were conducted to compare the mean ages; Chi-squared tests of observed versus expected frequencies were conducted to compare sample and population proportions for other demographic variables. One-way analyses of variance (ANOVAs) were conducted to examine whether there were differences in average responses to the student adjustment questionnaire and Check-In items by month (this analysis was chosen given there were different students responding at each time point). Tukey-HSD was used for calculating post-hoc differences. One-way ANOVAs were also conducted to examine whether Check-In domain averages differ significantly within each month; Tukey-HSD was used for post hoc analyses. Differences between first- and continuing-generation students, as well as differences between majority and underrepresented minority students, on (1) number of messages sent, (2) number of referrals received, and (3) number of Check-Ins completed were examined using Welch’s two-sample *t*-tests. A Pearson’s Chi-squared test will be used to assess whether there are differences in referrals made by students’ first-generation status and underrepresented minority status. Correlations were used to examine whether a relationship exists between engagement and GPA.

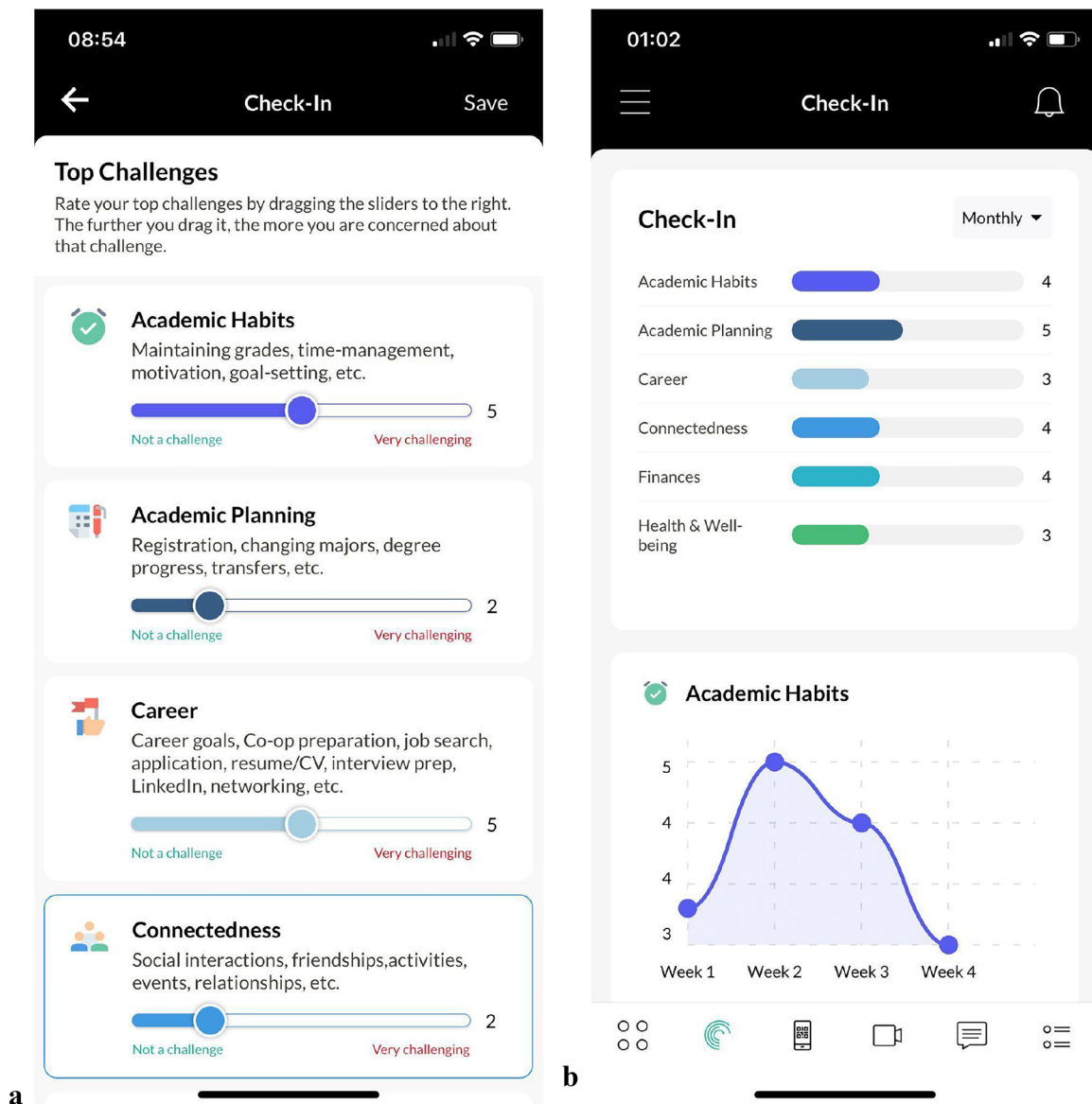
Results

Differences between the full first-year class and those who opted into the program are shown in Table 1. When comparing the full first-year class to the students who opted into the peer mentoring program, small but significant differences emerged in demographic characteristics: age, gender, international status, race, and generational status.

Engagement

Of the 3141 students who downloaded MentorHub, 191 (6.08%) did not use any features (i.e., did not use Check-In, send messages, or receive referrals).

² Additional data are collected via MentorHub. Please contact the first author for a full list of measures.



Note. Screenshots of MentorHub's Check-In feature (a) and display of a student's scores over time in the student version (b).

Fig. 1 Check-In features in MentorHub

Check-In

There were 17,032 Check-Ins from August 2021 to June 2022. Of the students who used Check-In ($n = 2947$), the average number of times a student checked in during the year was 5.74 ($sd = 9.57$, range was from 1 to 163 times). Among all of the students who downloaded and logged into MentorHub, a Pearson's Chi-squared test was conducted to examine whether there was a relationship between first-generation status and whether a student used Check-In; there

was no significant difference in proportions between first- ($n = 316$, 95.47%) and continuing- ($n = 1378$, 92.86%) generation students in whether they used Check-In ($\chi^2(1) = 2.56$, $p = 0.110$). Among the students who did use Check-In, there was no significant difference in the number of Check-Ins completed between students who identified as continuing-generation college students ($m = 5.53$, $sd = 9.09$) and those who identified as first-generation college students ($m = 5.93$, $sd = 11.75$); $t(404.27) = -0.55$, $p = 0.577$. Among all of the students who downloaded and logged into MentorHub,

a Pearson's Chi-squared test was conducted to examine whether there was a relationship between underrepresented minority status and whether a student used Check-In; there was no significant difference in proportions between students from an underrepresented background ($n=648$, 94.19%) versus not ($n=2302$, 93.84%) in whether they used Check-In ($\chi^2(1)=0.06$, $p=0.809$). Number of Check-Ins did not differ between students who are not from an underrepresented background ($m=5.70$, $sd=9.27$) and those who were from an underrepresented background ($m=5.88$, $sd=11.56$); $t(941.89)=-0.39$, $p=0.690$.

Messages to Peer Mentor

There were 13,456 messages sent to peer mentors. Of students who messaged their peer mentors ($n=1798$), students sent an average of 7.48 messages over the year ($sd=14.88$, range was from 1 to 263 messages). Among those students who downloaded the MentorHub app, a Pearson's Chi-squared test was used to assess whether there was a relationship between first-generation status and whether students sent at least one message to their peer mentor. There was no evidence of an association, ($\chi^2(1)=0.54$, $p=0.464$); first-generation students ($n=193$, 61.08%) were not significantly different from continuing-generation students ($n=808$, 58.64%) in their likelihood of messaging their peer mentors. Among the students who did send messages to their peer mentor, there was no significant difference in the number of messages between students who identified as continuing-generation students ($m=7.82$, $sd=18.41$) and those who identified as first-generation students ($m=8.47$, $sd=12.80$); $t(404.99)=-0.57$, $p=0.564$. A Pearson's Chi-squared test was also used to assess whether there was a relationship between underrepresented student status and whether students sent at least one message to their peer mentor. There was no evidence of an association, ($\chi^2(1)=1.31$, $p=0.253$), again suggesting that students from an underrepresented background ($n=408$, 62.96%) did not differ from their non-underrepresented peers ($n=1390$, 60.38%) in the likelihood of messaging their peer mentor. Number of messages between majority ($m=7.26$, $sd=14.19$) and underrepresented minority ($m=8.26$, $sd=16.90$) students did not differ among those who did send at least one message; $t(585.52)=-1.09$, $p=0.274$.

Referrals

There were 756 referrals made. Of those students who received referrals from their peer mentor ($n=458$), students received an average of 2.28 referrals during the year ($sd=1.74$, range from 1 to 12 referrals). Among those students who downloaded MentorHub, a Pearson's Chi-squared test was used to assess whether there was a

relationship between first-generation status and whether students received at least one referral. There was significant evidence of an association, ($\chi^2(1)=14.66$, $p<0.001$). First-generation students were more likely to receive a referral ($n=74$, 23.42%) compared to their continuing-generation peers ($n=199$, 14.44%).

Among students who did receive referrals, there was no significant difference in the number of referrals between students who identified as continuing-generation college students ($m=2.19$, $sd=1.60$) and those who identified as first-generation college students ($m=2.17$, $sd=1.63$); $t(133.88)=0.113$, $p=0.910$. A Pearson's Chi-squared test was used to assess whether there was a relationship between underrepresented status and whether students received at least one referral. There was significant evidence of an association, ($\chi^2(1)=8.31$, $p=0.004$); students from an underrepresented background were more likely to receive a referral ($n=120$, 18.52%) compared to their non-underrepresented peers ($n=319$, 13.86%). Among students who did receive at least one referral, the number of referrals did not differ by underrepresented background; students not from an underrepresented background ($m=2.28$, $sd=1.73$) did not differ from students from an underrepresented background ($m=2.27$, $sd=1.75$); $t(218.88)=0.06$, $p=0.956$ students.

A Pearson's Chi-squared test was used to assess whether there was a relationship between first-generation status and referral category. There were significant differences in the relative frequency of referrals made by category, $\chi^2(5)=25.68$, $p<0.001$. A Pearson's Chi-squared test was also used to assess whether there was a relationship between underrepresented minority status and referral category. Again, there were significant differences by referral category, $\chi^2(5)=11.087$, $p=0.050$. Note that the Chi-squared tests are omnibus tests and indicate that there are significant differences between the two groups' proportions. See Table 2 for referral frequencies by referral categories and student status.

Student Adjustment Questionnaire Responses

A total of 3101 students completed the six items at least once during the year, with their first survey date ranging from late August to late June. Nineteen students completed the questionnaire four times.

See Fig. 2 for questionnaire responses over time. For the item, "I feel part of the [university] community," a one-way ANOVA revealed significant differences in responses over time, $F(10, 4390)=2.38$, $p=0.008$; however, the effect was small, $\eta^2=0.01$. Throughout the year, the only months that significantly differed in the mean responses were December and January, with students agreeing more strongly with the statement that they are part of the community in December compared to

Table 2 Referrals by student status

	All first years, <i>n</i> (%)	First-generation students, <i>n</i> (%)	Continuing-generation students, <i>n</i> (%)	Underrepresented minority students, <i>n</i> (%)	Non-underrepresented minority students, <i>n</i> (%)
Academic habits	138 (18.25)	42 (25.15)	67 (14.76)	50 (17.73)	135 (17.69)
Academic planning	213 (28.17)	44 (26.35)	127 (27.97)	72 (25.53)	236 (30.93)
Career	124 (16.40)	22 (13.17)	92 (20.26)	45 (15.96)	144 (18.87)
Connectedness	91 (12.04)	6 (3.59)	62 (13.66)	37 (13.12)	87 (11.4)
Finances	93 (12.30)	30 (17.96)	58 (12.78)	49 (17.38)	81 (10.62)
Health & wellbeing	97 (12.83)	23 (13.77)	48 (10.57)	29 (10.28)	80 (10.48)

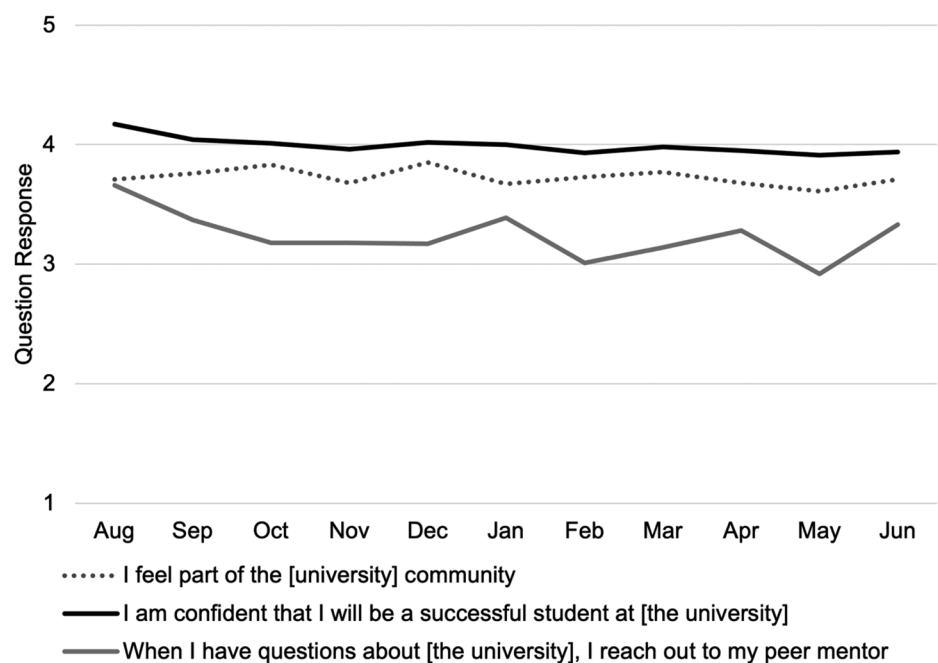
Significant differences emerged in omnibus Chi-squared tests between first- and continuing-generation students' proportions of referrals, and between underrepresented minority students and non-underrepresented minority students' referrals

January, $p = 0.012$. For the question, “I am confident that I will be a successful student at [the university]” a one-way ANOVA also revealed significant differences over time, $F(10, 4378) = 5.23$, $p < 0.001$; however, the effect was small, $\eta^2 = 0.01$. Scores in August were significantly higher than in January, February, March, April, May, September, and December, $ps < 0.05$. “When I have questions about [the university], I reach out to my peer mentor” also significantly differed over time, $F(10, 4371) = 18.46$, $p < 0.001$, and the effect was small to medium in size, $\eta^2 = 0.04$. Students reported that they were most likely to reach out to their peer mentor in August, which was significantly higher compared to all of the months except June. Students were also more likely to endorse reaching out to their peer mentors in January compared to February, March, May, and December; September also was

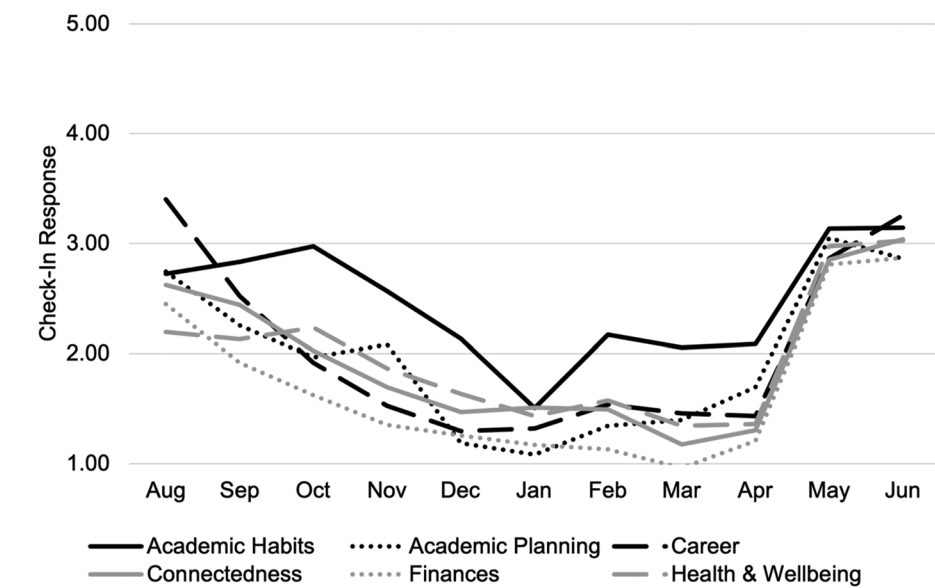
significantly higher than February and May, all $ps < 0.05$. Means and standard deviations for each month are available in Online Supplement 1.

Check-In Responses

See Fig. 3 for Check-In ratings over time and see Online Supplement 2 for means and standard deviations of monthly Check-In responses. One-way ANOVAs revealed significant differences within each month by domain for all of the months with the exception of May and June, $\eta^2s = 0.01–0.03$, $ps < 0.001$. At the beginning of the semester in August, the most challenging domain for students was Career; however, across September, October, November, December, February, March, and April, Academic

Fig. 2 Successful student questionnaire mean responses

Note. Mean responses by month of the questionnaire items.

Fig. 3 Check-In mean responses

Note. Mean responses to Check-In by month. Note that the default value of the Check-In changed from 0 to 5 (out of 10) at the end of April.

Habits were the most challenging domain for students. At the end of the first year in May and June, domains did not significantly differ from each other. ANOVA statistics and post hoc comparisons for each month are available in Online Supplement 3.

Within each domain, scores significantly differed across months, η^2 s = 0.02–0.07, $ps < 0.001$. Across the domains, responses were highest (suggesting more challenges) in August, May, and June. ANOVA statistics and post hoc comparisons for each domain are available in Online Supplement 4.

Engagement and First-year GPA

Among all students, there was a significant correlation between number of Check-Ins completed and GPA such that greater number of completed Check-Ins was related to a stronger GPA at the end of the first year, $r(2945) = 0.04$, $p = 0.043$. Number of messages sent ($r[2945] = 0.01$, $p = 0.739$) and number of referrals made ($r[2945] = 0.00$, $p = 0.918$) did not significantly correlate with students' GPA at the end of their first year.

Discussion

At the end of the first year of a new, technology-enhanced peer mentoring program at a private university, results suggest that the program was both feasible (47% of the first-year class opted into the program) and acceptable (students used the MentorHub application to report their wellbeing

across six domains and communicate with their peer mentor). There were no significant differences in Check-In use or number of messages to peer mentors based on students' generational or underrepresented minority status. However, results suggested that first-generation students were more likely to receive a referral than their continuing-generation peers, and students from an underrepresented background were more likely than their peers to receive a referral. Over the year, clear patterns of students' challenges emerged: career was the primary stressor at the beginning of the academic year, but this shifted to academic habits as the semester progressed.

Relevant Findings

Overall, the first year of this technology-enhanced peer mentoring program was successful. First-year undergraduates had the opportunity to use a novel mobile app, MentorHub, to connect with paid older peer mentors at their university. Peer mentors were trained to provide specialized support based on presenting challenges of their students. A large proportion of students reported their current challenges via MentorHub and their peer mentors responded typically within 24 h to follow up with support and referrals. Although the original goal of the program was for peer mentors to provide formal referrals through MentorHub, we found that many students did not use the referral function, suggesting that students were engaging with their peer mentors for more than just connections to campus resources. Although technology not only facilitated communication between students and their peer mentors, it also allowed the

university to monitor current challenges for students across the year. Students reported their current challenges (at varying frequencies by student) over time; in future iterations of the program, the university can make just-in-time decisions about relevant supports for students based on live data.

Engagement

Students from different backgrounds participated in this optional program at different rates. Students who opted in were slightly older and more likely to be female, an International student, White, or multiracial when compared to the full first-year class. However, Asian students were less likely to opt-in compared to the full first-year class. Although speculative, students from different backgrounds may have had differing interests and motivations to use this service. It is possible that the program was promoted in ways that were differentially attractive to individuals from different backgrounds, as well. Future research needs to understand why this program may not have been as appealing to Asian students and how it can be promoted as an appealing and useful service to more diverse individuals. Interestingly, the paid peer mentor position was especially appealing to international students. Although recruitment efforts did not intentionally aim to recruit international applicants, we nonetheless saw a high proportion of applications from this group for the position. Future work on the motivations to become university peer mentors will likely shed light on why this position is appealing to certain cohorts of students.

There were no significant differences between first- and continuing-generation college students or students who were versus were not from an underrepresented minority in terms of likelihood of messaging their mentor or using Check-In. There were also no differences in number of messages or Check-Ins completed between groups of students. However, students from underrepresented backgrounds or first-generation students were more likely to receive a referral compared to their peers. Moreover, patterns in referral domains varied based on background characteristics. Among students who engaged in MentorHub, first-generation and students from an underrepresented background were more likely to receive referrals than their peers. First-generation students received a higher proportion of financial, academic habits, and health and wellbeing referrals and a lower proportion of career and connectedness referrals when compared to their continuing-generation peers. Given that referrals were made based on identified challenges of students, we can infer that first-generation students at this university needed additional support in accessing financial resources, building strong academic habits (e.g., study skills), and connecting to wellbeing resources. These resources may be seen as relatively more foundational needs; in other words, these students need to be able to pay bills and know how to study before being able to focus on more distal goals of career

planning. Importantly, these patterns were different between students based on underrepresented minority status, as underrepresented minority students sought additional support around connectedness and finances when compared to their peers. This suggests that this program helped these students not only access financial resources but also helped them connect with their peers at the university. However, it is important to note that the relative use of referrals was low; only 9% of students who participated received referrals. This suggests that this feature of the program was not popular overall and that other features (e.g., chatting and problem-solving) may be more salient for this population. It also could be possible that peer mentors were making recommendations during their conversations with their students, and may not have taken the next step to create a formal referral in the system. It is possible that students used this program to connect with other students and did not use it for other types of support. COVID-19 social distancing procedures caused increased feelings of loneliness among young people (Weissbourd et al., 2021), so during this time immediately following the return to college campuses, students may have needed social connection most. This could have resulted in relatively low use of referrals. Of course, it is also possible that formal referrals were not useful for students.

There were a number of features of the program that likely served to increase engagement in the program. The development team enabled the university's single sign on feature shortly after the program started. At the very beginning of the program, anecdotal evidence suggested that students reported frustration that they had to sign in with a password each time they wanted to use MentorHub. However, the development team was able to update the app to include single sign on to allow students to stay logged in over time. This made using the app much easier. Possible barriers to higher sustained student engagement could have been the timing of rolling out the program (i.e., when students were moving into their university housing and starting classes may have been a busy time) and the challenges with getting buy-in from critical university stakeholders, given this was the first year of the program. Critically, the team was trying to enroll students while simultaneously building awareness across other university community members (e.g., advisors, faculty).

Links to Prior Work

Similar to previous university peer mentoring programs, (i.e., Dennehy & Dasgupta, 2017; Etzel et al., 2018; Yomtov et al., 2017), the current model holds promise for cross-age peer mentoring models at the college level. While many peer mentoring programs focus solely on facilitating strong mentoring relationships, the current initiative integrated aspects of supportive accountability, digital interventions, and stepped-care approaches. As the literature clearly

demonstrates, access to effective mentorships are scarce and unequally distributed across diverse groups of students (Gowdy et al., 2020; Raposa et al., 2021), and this program attempts to bridge such gaps by training formal peer mentors to provide stepped-care to all first-year undergraduate students.

Based on previous literature that suggests targeted approaches (i.e., having specific goals and focus areas for the mentoring relationship) are about twice as effective than general support models (Christensen et al., 2020), the current initiative took advantage of supportive accountability models (Mohr et al., 2011) to increase the efficacy of targeted resources and interventions. Leveraging technology platforms, which promise just-in-time support with efficient communication methods, can be used to streamline such mentoring approaches, are a relatively new approach for the mentoring field.

Implications

Leveraging Technology to Understand Patterns of Student Success

The implementation of this program facilitated access to information about students' attitudes and challenges that they were willing to disclose to the university staff and their peer mentors. During the year, dashboards were created that allowed for real-time monitoring of how students were doing across multiple data sources: Check-In responses, messages, and referrals. This integrated system of visualizing data from students allows university staff and administration to have a pulse on students' needs and wellbeing.

Across the year, students' self-reported feelings about belonging to the university community did not change. Students were most likely to think that they would be successful at the university at the beginning of the school year; these feelings decreased throughout the rest of the year; however, the effect was small. Although noteworthy that connection to the university did not seem to waver as a function of time, it is critical to consider that students report feeling less able to succeed as the year progresses. Academic self-efficacy is linked to academic performance and health (Chemers et al., 2001), stressing the importance of providing consistent support to boost self-efficacy. Understanding the predictors—including time of year—of students' anticipated academic performance will be important in future work.

Students reported low agreement with reaching out to their peer mentor when they needed support, and these responses fluctuated over time. Students said that they were most likely to reach out to their peer mentor at the beginning and end of the year. Given the novelty of the program, it is interesting to consider that students endorsed feeling like

they could reach out to their peer mentor at the beginning of the year. This is perhaps a function of the students opting to use the program at that time of the year. Those students who were optimistic that a peer mentor could help them may have been the students who were most likely to engage with MentorHub. It is also possible that at the end of the year, students were experiencing burnout or other challenges, which would prompt them to use their peer mentor for support.

Patterns in results over the year also suggested differences in challenges that students face. At the beginning of the school year, students were reporting challenges with their career, suggesting that students entering into their first year at university are thinking about what they will potentially be doing with their lives. However, as the students become more involved with courses, academic habits (e.g., studying) became most salient. These shifts in priorities and challenges should inform university staff of how to shift messaging about types of support available to students throughout the course of the year. For example, a university may want to highlight opportunities for connecting with alumni (to consider career options) at the beginning of the year; however, workshops for study skills may be most appealing during the semester when students are focusing on their classes.

Notably, patterns of engagement suggested that participation was lower at the end of the year. This is likely a result of numerous factors, including decreased messaging from the university for students to opt into the program. In the fall, students received numerous emails and could see social media posts about downloading and installing MentorHub. Moreover, students were incentivized to download MentorHub, engage with their mentor, and complete Check-Ins. Students could receive university swag for showing staff their downloaded app at tabling events on campus, as well as completing frequent Check-Ins. However, these campaigns slowed throughout the course of the second semester. It is also possible that first years may also have needed MentorHub and the peer mentors less as they became settled into the university and became familiar with the resources available, which could indicate the success of the program. Future work investigating the reasons for the decline in participation will be important to better understand how peer mentoring programs can be successful.

Virtual Support in the Wake of COVID-19

COVID-19 has exacerbated challenges among college and university students. There have been increased demands on academic advising (Ammigan & Liu, 2022) and counseling centers (Cohen et al., 2022). This technology-enabled peer mentoring program appears to shift some of the burden of supporting students onto peer mentors, potentially reducing the pressure on academic advising and other university triage services. The data suggest that referrals were made

by the peer mentors; however, engagement with the referral service within the app was low and may need further refinement. This notwithstanding, the data allow us to understand some of the stressors students faced when returning to in-person classes in the fall of 2021; although we do not have counterfactual evidence, the stress of COVID-19 likely affected students' reported concerns.

Limitations

There are a number of important limitations to consider regarding this research. First, this was an initial test of a program available to all first years within a given incoming class at a private university. Students could opt into the program at any point during their first year and data were not collected from students until they opted in, resulting in no true baseline data for all students. We are also unable to make inferences about how the program helped students navigate campus resources, given there was no control or comparison group (and, in light of COVID-related shifts to off-campus learning, no previous years of data to which we could compare). Moreover, although checking in, messaging, and accepting referrals from peer mentors does suggest actual engagement in the program, these are relatively crude measures. For example, a student could have sent many messages in a row to a peer mentor to convey the same content that someone else could have sent in one message, thus inflating the student's "level" of engagement. Moreover, we do not know the relative influence engagement in Check-In has on student success. Future work will need to examine whether a relationship exists, or if Check-In is merely a useful feature for universities to understand the wellbeing of their students. Finally, significant differences between Check-In responses over time were likely driven in part by a change in Check-In procedure. At the end of April, the default Check-In responses went from 0 to 5 (i.e., until April, the sliders were automatically set to 0 and students had to drag up to 10 to rate their challenges across domains; in April, the slider default was changed to 5 so students could drag left or right to indicate the severity of the challenge).

Conclusions

The novel technology-enhanced peer mentoring program at a university in the wake of the COVID-19 pandemic was both feasible and acceptable by students. The program was successful in engaging students from diverse backgrounds, which we hope allows students from all backgrounds to be equipped with the resources they need to succeed. Although the program was created to allow peer mentors to provide just-in-time referrals based on current challenges, this feature of the program was used infrequently. In response,

the program is shifting to include self-service access to resources within MentorHub to supplement mentor referrals. Moreover, as COVID-19 distancing restrictions are decreasing, peer mentors are being encouraged to engage with students both in person and through MentorHub, with the goal of fostering strong mentor-student relationships. This program also brought university staff greater awareness of their first-year students' challenges in real time to inform targeted time-bounded interventions. Future work on developing just-in-time programming for diverse students' needs will allow students to reach their full potential on their academic journey.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s41347-023-00303-8>.

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Declarations

Conflict of Interest The authors have no relevant or non-financial interests to disclose.

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