

Bonding Under a Pandemic: Forming and Maintaining Friendships Through Mostly Online Interaction in U.S. Higher Education

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University life under COVID-19 forced students not only to take classes remotely but also to meet and interact with peers online. Through semi-structured interviews with 17 graduate/professional students at a large midwestern U.S. university, this study investigates how students navigated and maintained new friendships under interactions that occurred primarily online. The findings reveal a seven-level online friendship formation process that extends a model introduced in Levinger and Snoek's pair relatedness theory. Remote learning mode inhibited friendship formation across the board, but especially in two of the seven levels. Friendships took more effort and time to form, leading to some mental distress. Nevertheless, students also demonstrated workarounds, finding ways to accomplish all levels of the friendship formation process even in the absence of frequent in-person interaction. The findings contribute to 1) friendship formation theories, 2) an understanding of online-first friendship, and 3) the impact of remote learning on university student social life.

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1 INTRODUCTION

The COVID pandemic disrupted social life around the world in a wide range of contexts. Universities were no exception, and students experienced the brunt of coerced online interaction in courses and other activities. Some research has explored the academic consequences for students, but very little work to-date has considered students' social lives under the pandemic.

Student social life is inseparable part of learning experience in higher education. While university students' social lives broadly consists of two facets -- participating in social events and engaging in interpersonal relationships [19] -- the latter, particularly friendship with peers is the basis of student social life that provides a sense of belonging, academic and emotional support, and an social outlet through bonding. Past research has demonstrated that friendship is crucial for students' well-being [34, 42] and academic success[44]. Furthermore, friends made at school can last even after graduation and evolve into life-long friends.

However, the COVID pandemic that pushed graduate schools to adopt remote learning mode to prioritize physical health and safety of students disrupted students' social lives. In the 2020-21 academic year during the pandemic, most classes were held online via videoconferencing tools (e.g., Zoom) and accordingly students were forced to interact with peers online with minimal or no opportunities to meet in person. This unanticipated transition posed a unique challenge where students had to make new friends through mostly online interactions.

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53 Extensive research over recent years has shown negative impact of COVID remote learning mode on university
54 students with respect to academics [12, 22, 23, 30, 52, 55, 56, 59]. In addition, there has been mounting concerns on
55 students' mental health [8, 12, 23, 26, 35, 52, 56, 59] with emotional turmoil such as anxiety [6, 18, 23, 36, 56] and
56 loneliness during the pandemic [26, 31, 56]. Some studies point out that lack of social interaction is a major cause of
57 these negative consequences under remote learning mode [35, 52, 55]. Despite these concerns, however, little research
58 has explored the impact of remote learning mode on students' social lives. Additionally, current theories of friendship
59 formation process, which identify physical proximity and homophily as key principles, assume in-person interaction
60 [40].
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63 With recent increasing and ongoing adoption of remote learning mode due to the pandemic[41], it is necessary to
64 understand how students navigate social life and friendship with peers online to support students' well-being and
65 learning experience. To this end, I conducted semi-structured interviews with 17 graduate/professional students that
66 include first-years in a midwestern U.S. residential university in 2020-2021 during the pandemic. Specifically, I address
67 the following questions:
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- 69 • RQ1: What challenges did students face in friendship formation under remote learning mode?
 - 70 • RQ2: How did students overcome the challenges to build friendships with peers under remote learning mode?
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74 My findings provide new insights into online friendship development and maintenance in the context of higher
75 education under COVID remote learning. I suggest that COVID remote learning mode severely disrupted students'
76 interpersonal social lives in school, causing mental distress among many of them. In this process, I identify a seven-
77 level online friendship formation process that extends Levinger and Snoek's four-level pair relatedness theory (Zero
78 Contact, Unilateral Awareness, Surface Contact, and Mutuality) [40] by surfacing interactions necessary to develop
79 friendship but do not organically happen online: First Meeting, Facial Familiarity, Frequent Meeting, Casual Conversation,
80 Similarities/Common Interests and Repeat Interactions. Simultaneously, while overall online friendship formation
81 was challenging, the findings reveal Facial Familiarity(Level 1b) and Casual Conversation(Level 2b) were severely
82 inhibited, which hampered the rest of the friendship formation process. Participants, however, exerted additional effort
83 to build friendships over the semesters by initiating informal bilateral interactions online; engaging in forced group
84 meetings, initiating casual conversations using chat, securing time for casual conversations and reaching out to those
85 with common interests.
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88 The findings make the following contributions: First, they extend previous friendship formation theories by adding
89 a new context of online interactions. Second, they offer new insight on online friendship studies by revealing initial
90 exploratory interactions to informally connect with unacquainted people amid formal meetings online to develop
91 friendships predominantly via videoconferencing. And third, they shed light on graduate students' interpersonal social
92 lives under COVID remote learning mode and thus provide holistic understanding of higher education students' lives
93 during the pandemic. Based on these findings, specific design recommendations are offered for school administrators
94 and faculty to support students' social lives and friendship development under remote learning mode.
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99 2 LITERATURE REVIEW

100 I review three distinct bodies of literature: (1) friendship formation process, (2) the impact of COVID-19 remote learning
101 mode on students in higher education and (3) online-first friendship.
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2.1 Friendship formation process

Friendship formation is affected by both social and individual characteristics [14]. Fehr [27] identified 4 factors in friendship formation process: environmental, situational, individual and dyadic factors. People interact with those who frequently meet and spend time with in the same environment (environmental), identify similarities/common interests (individual) with some of them and ultimately develop a dyadic friendship (dyadic), while the entire process is also affected by specific circumstances (situational).

2.1.1 Social: environmental and situational. To develop any friendships, people first need to cross paths to start interactions. Social factors hugely influence with whom people meet and initiate interactions in the first place. As for environmental factors, proximity has known as a most salient factor in developing friendships [24, 28, 63]. Physical proximity (e.g., school, workplace, neighbor, residential building) enables people to encounter frequently in the same spaces they spend their daily lives, and social network proximity (e.g., friend's friend, same group membership in the past) increases chances to contact around their social circles. Situational factors also affect chances of developing friendships; people tend to interact more, for example, with those who are expected to see often in the future whose outcome is dependent on one another, and who have availability to make new friends.

2.1.2 Individual: individual and dyadic. People do not enter into deeper interactions with every person they meet. To determine with whom to interact further and become friends, people consider individual characteristics such as physical attractiveness, social skills, responsiveness, shyness and similarity [27]. In particular, similarity, or homophily, plays a central role in friendship formation; people tend to become friends with those who are similar to themselves [47, 63]. Common homophily traits include demographic characteristics such as age, gender, race/ethnicity and hobbies/interests [15, 47]. In a recent publication, Dunbar [1] identified seven cultural dimensions people share with their friends: language, place of origin, educational history, hobbies/interests, sense of humor, and worldview and music tastes. Then, matched individuals are reciprocally attracted to one another and gradually self-disclose about themselves to build a dyadic friendship, as will be explained below.

2.1.3 Pair relatedness theory. As with any interpersonal relationships, friendship formation can be explained as a developmental process where relationships develop through gradual self-disclosure and mutual liking between partners. Levinger and Snoek [40] identifies four levels of pair relatedness: Zero Contact (Level 0), Unilateral Awareness (Level 1), Bilateral Surface Contact (Level 2) and Mutuality (Level 3). Starting from zero contact (Level 0), partners first unilaterally learn some external attributes of potential friends such as physical appearances and estimated potential rewards from the relationships without actual interactions (Level 1). Then they start to exchange superficial information publicly represented such as impressions and behaviors induced from social roles (Level 2). Finally, they gradually disclose more personal information and gain mutual knowledge about each other's lives and develop intimate relationships (Level 3). Their theory is in line with Altman and Taylor's social penetration theory [3] that partners increase self-disclosure of personal information both in depth and breadth as relationships matures.

However, past works on friendship formation process assumes that physical proximity and in-person interactions are viable options. With recent increasing usage of digital communication technology for social and interpersonal interactions in school and workplace with the experience of the pandemic, less explored is friendship formation process in online environment, where some of the assumptions of in-person interaction break down.

157 2.1.4 *Friendship formation process among university students.* The general friendship formation process described
158 above also applies to university student population. It is commonly expected that many environmental and situational
159 factors around school enable students to regularly see and interact on campus, living and studying with peers together
160 during school years. Past research shows that college and graduate students tend to develop friendships with peers they
161 interact in close geographic spaces such as same housing and shared study space. [17, 43, 44, 67]. A body of research
162 also demonstrated that homophily is the major principle of friendship such as demographic characteristics (e.g., age,
163 gender, race, nationalities) and prior collaboration experiences. [32, 43, 61] In a dyadic level, Hays [32] suggests that
164 the level of intimacy and breadth of interaction among same-sex first-year roommate dyads predicted their friendship
165 intensity.
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171 2.2 The impact of COVID remote learning mode on students in higher education

172 Recent research related to COVID remote learning mode in higher education has studied challenges and its negative
173 impact on college and graduate students. Many students showed a negative attitude on their academic learning
174 experience under remote learning mode: increased distractions at home environment [5, 23, 52, 59], difficulty to
175 concentrate on studies [12, 30, 55, 56], reduced motivation [12] and increased workload [5, 23, 56]. In some cases,
176 poor access to high-quality broadband was an additional challenge to participate in remote classes [22]. While some
177 students found that online learning was flexible to manage their studies [30, 55] and felt reduced pressure related to
178 their academic studies [56], the majority of students still preferred traditional face-to-face classes to remote learning
179 mode. [12, 23].
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182 As students attended classes remotely for a prolonged time, they experienced worsening mental health and severe
183 emotional turmoil. [8, 12, 26, 35, 52, 56, 59]. Past studies found that students experienced lower psychological well-being
184 [23] and depressive symptoms and thoughts [21, 29, 56, 65]. Additionally, some students felt high levels of anxiety about
185 their future career prospects caused by concerns over academic performance [56], delayed graduation [18], loss of
186 job/internship opportunities [6, 23] and early termination of practica/clinical training [36] during the pandemic.
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189 One major cause of this negative impact on students under remote learning mode was significantly reduced interaction
190 among peers [35, 52, 55]. Combined with social distancing measures imposed across the nation, lack of social interaction
191 caused an increasing number of students to feel lonely and isolated. [26, 31, 56] However, less is known about how
192 remote learning mode impacted students' social lives at school and how they navigated peer relationships while they
193 continued to pursue their studies. In few exceptions, studies on students' social lives at the beginning of the pandemic
194 found that social distancing measures pushed students to focus their social interactions with a smaller circle of strong
195 ties (i.e., family, friends and someone they lived with) and they maintained nearly the same amount of interactions with
196 them as they did before the pandemic via digital communication or in person at home [5, 26, 29]. But, these networks
197 are centered on close relationships that existed prior to the pandemic from whom they could readily gain social and
198 emotional support during the lockdown.
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201 While remote learning mode implies that students would have had overall limited social lives with peers in school
202 [26], little research has been conducted to understand how students' social lives unfolded and what challenges students,
203 especially newly admitted students with no existing social ties, experienced in making new friends in school under
204 remote learning mode. This study aims to investigate the challenges of friendship formation process among students
205 under remote learning mode.
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2.3 Online-first friendship

Decades of past research demonstrated that friendships can emerge online [20, 37, 45, 46, 49, 51, 60, 62]. Compared to face-to-face communication, computer-mediated communication traditionally that were based on texts lacks non-verbal cues and thus affords limited information exchange at a time. This also offers greater anonymity in online spaces so that people can selectively represent themselves. Another underlying characteristic of online friendship formation is that with elimination of physical space, people initially join an online community based common interests as Baker described, "proximity is replaced by homophily" online [7]. Thus past research has shown that online friendship develops by overcoming and/or utilizing these technical limitations of online environment while meeting based on homophily in the beginning.

Walther (1992) proposed social information processing (SIP) theory that quality of computer-mediated interpersonal relationships online can be comparable to that of face-to-face relationships when partners share sufficient text-based information over extended time. More recent research argues that SIP theory can also be applied to initial interactions with multimodal communication media with richer context such as self-descriptions and visual cues (i.e., social media and videoconferencing) [4, 58]. Toward friendship, Chan and Cheng's study with young adults [20] suggests that online and offline friendships showed minimal differences as time passed, supporting SIP theory. Once friendship emerged online, some migrate to other richer context media such as phone calls, face-to-face meetings to supplement information about their friend partners and further develop their friendship [10, 45, 51]. These past studies show how people try to overcome limitations of computer-mediated communication as online-initiated friendships evolve toward offline.

On the other hand, some scholars argue that limitations of online communication can help building meaningful friendships [46, 60]. They argue that anonymity with lack of visuals in online spaces can foster easier and faster self-disclosure without the need to consider superficial criteria such as physical appearance and social skills, as friend partners can only focus on substantive base such as common interests and conversations for friendship formation. This particularly can be helpful for those who have difficulty making friends in offline settings because of social anxiety, shyness or less confident social skills [46, 60]. Regarding profiles of those who make friends online, however, there exists a counterargument that extroverts or those who can better leverage social skills to online socialization tend to make more friends online [37, 45].

Taken together, past research on online friendship informs that extended time and additional interactions are required to develop friendships in online communities, but individual factors can affect the pace of online friendship development as well as quality and quantity of friendships initiated online. However, while previous research focused on qualities of online friendship and traits of people involved in it compared to offline friendships, little research has explored the entire process of online friendship formation — how people first meet, navigate and select a dyadic friend partner in online spaces. In addition, while much previous work with online friendships focuses on online communities and social media sites where interactions are dominated by text, audio, or an exchange of video clips, there is relatively little research on friendship formation process where videoconferencing is the primary mode of online interaction.

2.3.1 University students' communication channels. University students maintain relationships with peers through multiple communication channels online and off. Past research found that closeness of the relationship determines the frequency of interaction regardless of types of communication medium (i.e., face-to-face, call, e-mail, chat and instant messaging) [11, 33]. For interactions with close friends, face-to-face communication was most common in local areas, while long geographical distance inevitably limited face-to-face interactions. [11]. More recent research revealed that social media platforms exemplified by Facebook are used to maintain peripheral connections such as past classmates

261 and dormitory residents to stay in the loop of various social gatherings in school [9, 25]. These studies are, however,
262 mostly based on relationships first developed offline and transitioned to online communication channels, which play a
263 supplementary role in managing strong- and weak-tie friends in students' social life.
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265 Therefore, this study aims to understand online friendship formation process and subsequent maintenance friendship
266 where unacquainted people meet online without previously knowing similarities/common interests, using a unique
267 situation of COVID remote learning mode where students were situated to socialize predominantly online with wide
268 usage of videoconferencing tools while in-person interactions were significantly reduced or unavailable.
269

271 3 METHOD

272
273 Between October 2021 and January 2022, semi-structured interviews were conducted with 17 full-time students pursuing
274 a Master's graduate/professional degree across 10 different programs in a residential university in the U.S. Midwest. All
275 participants attended school between September 2020 and April 2021, when courses were taught nearly entirely online
276 under COVID remote learning mode. Generally as a new school year starts, first-year students are highly motivated
277 to make new friends to adjust to a new environment, which makes them an ideal population to examine friendship
278 formation process. In this study, 13 participants began their studies under remote learning in Fall 2020, and 4 participants
279 abruptly transitioned to remote learning mode in the middle of the semester.
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283 *3.0.1 Recruitment and participation selection.* The interview recruitment was advertised through my personal connec-
284 tions, flyers advertised across the campus, posts on online communication channels (e.g., Slack and GroupMe) in different
285 graduate school departments as well as snowball sampling technique from participants. Potential participants conducted
286 an online screening survey that included questions about graduate programs, school year, race, domestic/international
287 student status, expected graduation year and intention to pursue a PhD degree directly upon graduation. I asked for
288 interviews only to those who experienced remote learning mode during Fall 2020 and Winter 2021 semesters and were
289 pursuing a Master's degree as a terminal degree. Participants were also selected considering diversity in graduate
290 programs, ethnicity, gender and domestic/international students.
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294 *3.0.2 Demographics of participants.* All participants (Table 1) were graduate/professional students pursuing Master's
295 degrees across 10 different programs. Seven of them enrolled as international students and 10 domestic students. The
296 participants included 9 females, 7 males and 1 non-binary with an average age of 28 (ranged from 24 to 34). Their
297 ethnicity included Asian, Black, Latin, White and multi-ethnicity of these.
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301 *3.0.3 Interview.* The interview protocol included questions about students' social lives under COVID remote learning
302 mode: 1) social interactions with classmates/cohort in orientation sessions, remote classes, social events, extracurricular
303 activities, 2) impact of remote learning mode on their social lives, 3) challenges in terms of social interactions and 4)
304 usage of online communication channels for social interactions. The interviews were conducted either online through
305 videoconferencing or in person. The interviews were video- or audio-recorded upon the participants' consent, lasting 97
306 minutes in average (ranged from 52 to 131 minutes). The interviews were transcribed and analyzed using a qualitative
307 thematic analysis method. First 11 participants received \$20 in cash for their participation. But as the recruitment of
308 participants was getting hard, the compensation was increased in an effort to recruit more diverse populations and thus
309 \$40 were paid to the rest 6 participants. The research received the university IRB approval under exempt status.
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Table 1. Participant Demographics

ID	Program	Gender	Age	Domestic /International status	Nationality	Ethnicity	Started before/after COVID
P1	Public Health	Female	24	Domestic	United States	Asian	After
P2	Information Science	Male	26	Domestic	United States	Black	After
P3	Architecture	Female	24	Domestic	United States	Asian	After
P4	Public Health	Female	25	Domestic	United States	White/Asian	After
P5	Environment and Sustainability /Business Administration	Male	28	Domestic	United States	White/Latin	After
P6	Bio-engineering	Female	26	Domestic	United States	White	After
P7	Public Policy/Business Administration	Male	34	Domestic	United States	Latin	After
P8	Information Science	Non-binary	26	Domestic	United States	Black	After
P9	Social Work	Female	26	Domestic	United States	White	After
P10	Public Policy	Female	28	International	Japan	Asian	After
P11	Nursing	Female	33	International	South Korea	Asian	After
P12	Business Administration	Male	34	International	Japan	Asian	After
P13	Electrical Engineering and Computer Science	Male	25	International	Taiwan /Costa Rica	Asian/Latin	After
P14	Public Policy /Public Health	Male	30	Domestic	United States	Asian	Before
P15	Business Administration	Male	32	International	India	Asian	Before
P16	Electrical Engineering and Computer Science	Female	25	International	India	Asian	Before
P17	Information Science	Female	25	International	China	Asian	Before

4 FINDINGS

Below I describe findings from the analysis of the interviews: 1) online friendship formation process under remote learning mode, 2) challenges in making friends in online world, 3) workarounds to make friends online and 4) maintenance of friendship during the pandemic.

4.1 Online friendship formation process under remote learning mode

The interviews with graduate/professional students about social life under remote learning mode revealed a seven-level online friendship formation process in the context of university. This online friendship formation process extends

365 Levinger and Snoek's four-level pair relatedness theory [40] into a seven-level process to develop friendships online. In
366 addition, this study found that the beginning of the school and orientation weeks as most crucial period to make new
367 friends that would last throughout school years. However, online friendship formation process under remote learning
368 mode was challenging overall and students had little interactions and chances to get to know their cohort through
369 virtual orientation with no participants developing friendships. Thus students missed the crucial timing to make new
370 friends as they started school remotely during the pandemic, causing them to feel lonely and isolated .
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374 *4.1.1 Definition of friends.* The depth of friendship is positioned relatively on the spectrum between a stranger and
375 intimate friend, as one of the participants described, "*Some have been more genuine or organic friendships and others have*
376 *been a little bit more transactional and then everything in between.*" (P5) But when asked, participants were able to identify
377 their friends out of cohort, who are intimate peers with whom they kept in touch as a private and exclusive group and
378 could meet outside of classes to spend time together for the sake of friendship. With friends, they commonly discussed
379 class assignments (academic support), confided in and shared struggles in school and life (emotional support) and hung
380 out outside classes doing various entertaining and mindless activities (entertaining/social outlet). In addition, past
381 research shows that people can only have a small number of intimate friends (approximately 5) due to a cognitive limit
382 with little variance across individuals and cultures [1]. Thus, this study followed the participants' implicit definition of
383 friends they had when describing their experiences about social lives with friends under remote learning mode.
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387 *4.1.2 Online friendship formation process in the context of university.* Using the case of remote learning mode, I
388 examined how a large group of unacquainted students gathered in online spaces interacted with peers, got to know
389 one another and navigated friendships as they took classes remotely. Based on Levinger and Snoek's (L-S) four-level
390 pair relatedness model about interpersonal relationship development (Zero Contact, Unilateral Awareness, Bilateral
391 Surface Contact, Mutuality) [40], I extend their theory into a seven-level online friendship formation process by
392 identifying three additional sub-levels of interactions: Zero Contact, First Meeting, Facial Familiarity, Frequent Meetings,
393 Casual Conversation, Similarities/Common Interests, Repeated Interactions. Each pair of the seven-levels of interactions,
394 excluding Zero Contact, fits within one of the last three L-S levels of interactions. In other words, my analysis consistently
395 suggested that there was additional granularity in the L-S levels that became evident when studying online friendship
396 formation. These series of levels develop friendship as students gradually exchange intimate information with peers
397 online and increase mutuality using both verbal and non-verbal interactions online communication tools can afford.
398 Through this process, students socialize with their cohort members and develop intimate friendships with a few of
399 them. Each level of online friendship formation process is explained on a dyadic level using the case of remote learning
400 mode in the following, except [Level 0: Zero Contact level] where no relatedness exists between a dyad.
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403
404 **[Level 1a: First Meeting]** A student learns about general/basic personal information such as name, concentration,
405 year and sometimes brief personal background of the other student. This type of information is commonly shared in
406 classrooms, social gatherings verbally or online group communication channels in a written format. When students
407 meet with cohort or share profile information on online communication channels, immediate interactions are more
408 difficult to occur. In the context of university, first meeting usually occurs during orientation sessions and welcome
409 weeks before classes officially start. Notably for online interaction, first meeting does *not* necessarily mean that people
410 have made visual contact. Many people "meet" each other on video calls, but with their cameras off. For example, P8
411 remembered one social meeting ("*a pod*") invited by her department and a senior student before the school started, but
412 no one had turned their cameras on. She could not recall who she met in the meeting: "*There are people that I'm friends*
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Table 2. Online Friendship Formation Process

Pair Relatedness Theory (Levinger and Snoek, 1975)		Detail	Online Friendship Formation Process (This study)		Detail
Level 0	Zero Contact	Unaware of each other	Level 0	Zero Contact	Unaware of each other
Level 1	Unilateral Awareness	Aware of and Judge the other without reciprocal interactions	Level 1a	First Meeting	Learn general/basic information
			Level 1b	Facial Familiarity	See and know the face
Level 2	Bilateral Surface Contact	Exchange superficial information between partners	Level 2a	Frequent Meeting	Meet frequently to become familiar and increase interaction opportunities
			Level 2b	Casual Conversation	Have a casual conversation beyond formal agenda and about personal lives
Level 3	Mutuality	Deepen mutuality in the lives of the partners	Level 3a	Similarities /Common interests	Discover and connect through similarities/common interests
			Level 3b	Repeated interactions	Repeat interactions to forge friendship

with now who I would know or not because no one really had their camera on in the meeting including me. I don't even know who my pod leader was."

[Level 1b: Facial Familiarity] A student sees the other student's face.¹ Many participants pointed out that not being able to see the other's face made it difficult to get to know them online. In contrast to P8 above, P13 felt that those who turned on the camera seemed more approachable when he was thinking who to send a message to ask for studymates among attendees in his engineering class: "Some would have the video on. That one seemed friendly." P2 also explained that facial familiarity helped building rapport online: "Virtually, the group might not have their camera on... Those little courtesies [of turning on the camera] helped build rapport quickly... [the others] just got excluded. Sometimes, we'll ask them [to turn on camera] (and) they'll do it. But having the camera on was a big one."

[Level 2a: Frequent Meetings] A student interacts frequently and becomes familiar with the other student by regularly attending classes and participating in social events or extracurricular activities. Particularly taking common classes required for most first-year students in early school years increases chances to meet and interact one another. Chance encounters and subsequent brief conversation opportunities are common in physical school settings, but it rarely occurs in online meetings. Over the semesters, however, some students gradually felt familiar with their cohort by repeatedly seeing them in remote classes even if they "didn't necessarily talk to them a lot" (P4). P5 also mentioned, "just generally adapting to remote learning, I think that more of my relationships formed over time, in part because I would just recognize them in certain classes." Furthermore, interactions among classmates required in remote classes helped them to get to know their classmates. This way, P7 had already "knew most of them [his cohort]" before attending an

¹My participant group did not include anyone with visual disabilities. People with visual disabilities may never experience this step, though, of course, that does not impede their ability to form friendships. This step may still be relevant for them, if they experience something in person that is absent in online interaction.

469 in-person outdoor social event later in the semester and also “got to know a few people a little more [because] we had all
470 been introduced to each other at some point through class interactions, breakouts we would talk and work through.”

471 **[Level 2b: Casual Conversations]** A student has a causal conversation beyond school- or class-related discussion
472 with the other student. Common casual conversation topics include informal opinions on meeting agenda at hand,
473 grumbling and affirmation on common struggles in school and, importantly, life outside classes such as personal
474 background, interests or professional goals, hobbies and living in the newly relocated town and residence. These
475 conversations also involve entertaining and lighthearted interactions such as jokes, laughs and funny photos/memes
476 shared via group chats. Generally the more personal things are shared, the more they feel connected to each other
477 on a personal level. Indeed, the places where participants first met their friends were the environments where they
478 talked with them casually either online or off: orientation social events (P17, P16, P6, P15, P14), informal conversations
479 before/during/after classes (P10, P12, P4, P14, P12, P1, P2, P17, P13), ice-breaking chats during the class (P2), personal
480 conversations digressed from group meetings (P12, P3, P4, P2, P13), professional/ethnicity-based online communities
481 (P8, P14, P11, P12) and same residential building (residents/roommates) (P17, P2, P6, P7, P9, P5). However, online settings
482 were more difficult to carry a casual conversation with classmates as much of unstructured moments where casual
483 conversations usually happen were eliminated. This challenge will be further explained in section 4.2.
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488 **[Level 3a: Similarities/Common interests]** As a student casually interacts with the other student on a personal
489 level, they discover a commonality and connect through it to become close friends. All participants reported sharing a
490 distinct commonality with their friends. The commonalities include the same social circles in the past (e.g., hometown,
491 college, workplace, friend’s friend), same identity (e.g., ethnicity, LGBTQ), similar hobbies/interests (e.g., sports, music,
492 movies, going to brewery) and common professional/research interests (e.g., entrepreneurship, international relations,
493 women’s health). Of all levels, this level is key to becoming friends that nearly cannot be skipped in the process of
494 friendship formation, a well-known rule of homophily in friendship formation as repeatedly demonstrated in previous
495 literature [1, 27, 47]. Without being connected through similarities/common interests on a personal level, they tend to
496 remain as an acquaintance or a professional connection (i.e., cohort members with whom collaborated on team projects,
497 shared helpful resources or discussed internship/job opportunities). Admittedly professional networking is part of
498 social life in graduate school, which most students considered it one of the major reasons to pursue an advanced degree.
499 This relationship, however, is not necessarily considered as intimate friendships with whom they can confide in or
500 meet outside formal classes personally for bonding .
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504 **[Level 3b: Repeated Interaction]** Newly formed friends repeatedly interact to forge and nurture their friendships.
505 Regular in/formal meetings and activities through classes, extracurricular activities and social events can easily facilitate
506 repeating their interactions and function as a point of connection. As they develop intimacy, they keep in touch
507 constantly, commonly using exclusive mobile group chats, and meet outside classes to hang out and spend time together
508 online and/or offline. Through repeated interactions occurring both in the classroom and otherwise, they establish
509 their own patterns of interactions and build trust and strengthening friendships. P8, who stayed in her out-of state
510 hometown and took classes entirely remotely throughout her first year of school, described her friendship formation
511 process through repeated interactions online with her intentional efforts:
512
513

514
515
516 *“I think this is like any friendship, right? I think it was the repetition of interaction, right? Because they say*
517 *that friendship is repetition. Plus non-planned repetition makes a friendship. I would disagree with that.*
518 *Because it was repetition. But we could just walk past each other in the hallway. We really had to say ‘Let’s*
519

521 *video chat at this time on this day'. And I think that it was talking over and over with people about things*
522 *that really interested me and were also interesting to them."*
523

524 The interactions in each level of the friendship formation process often happen in sequence, but not always.
525 Frequently, lower levels facilitate successive ones. But, some of the lower levels can occur simultaneously or be
526 skipped when students are situated or motivated to interact directly in upper levels – particularly similarities/common
527 interests (Level 3a). One example is that unacquainted cohort members shared their own profiles through online group
528 communication channels early in the semester and some students directly contacted those who have similar interests,
529 started conversations and developed friendships, as will be described in section 4.3.4. This implies that an intervention
530 based on friendship formation process can potentially support students' friendship formation under remote learning
531 mode.
532
533

534 *4.1.3 Timing.* Timing is a crucial factor in friendship formation in the context of graduate school. As most newly
535 admitted students relocate to the university town, it is common that they do not have existing social ties in the area. In
536 the beginning of the school year, they are highly motivated to settle in the new environment and make new friends
537 with whom they will spend time together throughout their school years. P5 explained, "*We were taking a lot of classes*
538 *together and we knew for three years we were going to be with each other, so we wanted to invest in those relationships.*" And
539 all second-year participants (P15, P16, P14) who started school before the pandemic mentioned that it was during the
540 orientation and following early weeks of classes when they met their friends with whom they maintained friendships
541 throughout the rest of school years. P16 said, "*All of these [orientation sessions, initial classes, and student gatherings]*
542 *were really instrumental in helping me get to know people, because most of my friends and classmates came through those*
543 *first few weeks and they're still my friends. And we've done our assignments together. So I think those were probably the*
544 *most crucial weeks for me.*"
545
546
547

548 As this time passes and students successfully make new friends, their motivation to make new friends wanes. While
549 they continue to interact with other students they encounter in and out of classes, they tend to focus on maintaining a
550 small group of close friends to spend time with in their social lives. This is demonstrated by the participants whose
551 timeline of programs diverged from their original cohort. At the beginning of his second-year study, P14, a dual degree
552 student who added his second degree after the first year of his original degree, was more motivated to attend social
553 events held for first-year students in both programs to make new connections unlike his second-year peers in his
554 original program. P14 said, "*The [second set of] first-years, at that time, would be the ones that I would graduate with, so*
555 *I was kind of heavily invested into spending my last year with my original cohort and then starting in my dual degree,*
556 *getting to know and spending time with the people that I would graduate with.*"
557
558
559

560 Conversely, P17, who with the outbreak of the pandemic took a gap year between her first and second year, felt
561 lonely when she returned to school because her friends from her cohort had already graduated; she did not have close
562 friends left to hang out with on campus. It was hard for her to make new friends in the classes consisting of second-year
563 classmates from a different cohort. She described that they already seemed to have their own friends without any
564 interest in making new friends, reflecting "*To just make friends I think the best time is when you just get to a new place.*
565 *Everybody doesn't know each other at the time.*" Thus, timing, especially the beginning of the school when students first
566 meet their cohort, is closely associated with students' motivation and capacity to make new friends in graduate school.
567

568 In light of the friendship formation process and timing factor in school, it is clear that orientation programs are not
569 only about learning about the graduate programs and school resources, but also about getting to know their cohort
570 members and making new friends. As described by second-year participants (P15, P16, P14), in-person orientation
571

Table 3. Selected participant quotes about online friendship formation

ID	P6	P14	P10	P2
Online/Offline	Offline and Online	Online	Online	Online
Level /Meeting Place	Interest-based ('going to a brewery') orientation social event	Interest-based (an anime called 'Avatar the Last Airbender') orientation social event	International relations class for first-year students	Coding class for first-year students
[Level 1a] First Meeting	<i>"We introduced ourselves: where we went to college, where we grew up, whether we were a Masters or PhD student, where we were living, what concentration we are interested in, what we wanted to go into."</i>	<i>"As people came in, we would be like 'Hey, introduce yourself! Welcome, What's your name? What's your year?"</i>	(Attended the class regularly)	(Attended the class regularly)
[Level 1b] Facial Familiarity	(Saw the faces one another in-person)	(Saw the faces each other virtually)	(Saw the faces one another virtually)	(Saw the faces of the partner virtually)
[Level 2a] Frequent Meeting	(after the event) <i>"All classes were remote, so a couple of us were in the same classes on Zoom"</i>	(after the event) <i>"We ended up being in this larger class... and sometimes the entire class would watch a seminar and he was just there"</i>	<i>"Those [smaller] classes had discussion time... using a breakout room regularly. That helped more to know classmates..."</i>	<i>"During one of the courses..."</i>
[Level 2b] Casual Conversation	<i>"Just talked about each other and our past and [the university town]"</i>	<i>"I remember having an hour long discussion with random people that I'd never met and having a really great conversation with that (anime)"</i>	<i>"The other time we did more personal conversations during the [group] meeting"</i>	<i>"We're doing icebreakers and he talked about jazz... We met in a private chat and it built from there."</i>
[Level 3a] Similarities /Common interests	<i>"Found that we had some similar interests... I'm a big sports fan, which is why we all bonded, so we talked a lot about sports."</i>	<i>"He really loves the show that I really love, I think I will get along with them."</i>	<i>"Classmates were interested in international stuff. Many people had already experienced living outside the US, so that's more interesting."</i>	<i>"He had an interest in classical jazz music... We debated it. Who was the best musician? I was telling him Davis was better than Duke Ellington."</i>
[Level 3b] Repeat Interactions	<i>"I think two weeks later, we decided to go back to that same outdoor brewery."</i>	<i>"It was 'Oh, that guy that I connected with over 'Avatar the Last Airbender' and once the in-person stuff [outdoor social event] happened, I immediately knew who to talk to first."</i>	<i>"We had to do group projects, so we had to meet outside the class on Zoom. So that's great ..."</i>	<i>"Once we became close, that class was a point of connection, so we do homework assignments etc. and then we met (in person)."</i>

625 sessions they experienced before the pandemic were embedded with social components such as self-introduction, a
626 group campus tour, pre-lectures and discussions, and mini group projects, so that newly met students could interact
627 with one another while obtaining necessary information about their graduate programs through programming sessions.
628 After these sessions, social events were followed to help new students to mingle in an informal and casual atmosphere.
629 P14 remembered the orientation social event at a bar nearby the school where he could “chillax” and were able to “really
630 get to know” his cohort. And there, he met three cohort members who later became close friends with whom he would
631 study and hang out together throughout his school years.
632

633 However, the virtual orientation under remote learning mode could hardly replicate these social components. All
634 participants who had attended virtual orientation sessions remembered that they had little interaction with other
635 students. Many of them described virtual orientation as one-directional information sharing from school. P13 recounted
636 the virtual programming session he attended “they [department] wanted to keep it like short. So they introduced everything
637 they wanted to say and then there wasn’t any interaction” P1, who left in the middle the virtual orientation session, also
638 explained:
639

640
641 *“I didn’t attend the whole thing actually. Oh, it was really long and we weren’t doing... so I kind of just*
642 *left midway because ... it wasn’t very engaging and I didn’t feel like there was any really important*
643 *information that I needed to retain from that. And we didn’t really get to meet for other students. I mean,*
644 *you could see them on the screen, but that was pretty much it”*
645

646 Following the programming sessions, social events were also hosted virtually in an attempt to connect new students,
647 but many students had difficulty getting to know their cohort about even general/basic information (Level 1a) and
648 seeing the faces (Level 1b) as some did not turn on cameras. P13 remembered, “I met some classmates, but barely knew
649 their names because it wasn’t very interactive.” And P10 also described:
650

651
652 *“It’s super awkward. Nobody had talked with each other in person. And they’d never met before, so they*
653 *just followed the direction provided by the instructor or host, ‘you can say your name or places you’re born,*
654 *from, or what is your policy interest...’ When everyone’s done with the introduction, there was a silence ...*
655 *It’s like more official stuff... Some didn’t put their camera on. So, sometimes, some were just voice.”*
656

657 As a result, participants who started their graduate school in the pandemic year missed a crucial opportunity to
658 connect with their cohort and potentially make friends through orientation. Unlike those who attended usual orientation
659 before the pandemic, none of the first-year participants reported making friends out of the virtual orientations. Combined
660 with remote classes that also lacked interactions among classmates, this caused feelings of isolation and loneliness for
661 many first-year students early in the semester. P10 remembered the beginning of the school as the most challenging
662 period during her graduate school years: “Definitely first few weeks ... I felt like I was super isolated... outside of class I
663 didn’t have any personal conversation. I felt super isolated, so it was so hard.” P6, who had met a few cohort members
664 through an in-person orientation social event, also had a hard time going through these early first a few weeks of
665 school as remote learning mode and social distancing hindered the repetition of interactions to forge friendships with
666 them (Level 3b): “I had only met with these people once or twice, so I didn’t know if they were actually going to be my
667 friends.” And she continued to say:
668

669
670
671 *“I would say that end of that first month (of the school) was definitely the loneliest cuz I was really just in*
672 *Zoom class... not being able to reach out to people in my program if I was stressed about something, not*
673 *being sure how the rest of the year would work out as far as socially meeting new people, a lot of uncertainty*
674 *about what the rest of the year would look like.”*
675

4.2 Challenges in making friends in an online world

To meet peers and make friends under remote learning mode, students had to rely on online communication channels including videoconferencing (e.g., Zoom). Online meetings, however, have limited capabilities for socialization: it was difficult to have side conversations, lacked non-verbal language and felt too formal by default, which all challenged friendship formation process. More specifically when interactions are predominantly online, they inhibited Facial Familiarity (Level 1b) and Casual Conversation (Level 2b) in the process of online friendship formation.

4.2.1 Online meetings inhibit side conversations. In online meetings students had difficulty meeting classmates and having a side conversation for socialization with them. Initially, remote learning mode significantly reduced opportunities to meet any classmates (Level 2a) in the first place. In the absence of physical spaces, chance encounters were eliminated around classrooms, which were common ways to start conversations and get to know peers before the pandemic. Some students reported that it was hard to find a moment to start a conversation with classmates in online classes because most students tended to enter meeting rooms on time and leave as soon as classes end by clicking login and exit buttons on their computers. P13 and P14 described it by comparing their experiences of socialization with classmates in online and offline classes: *“When the class finished they will ask like, ‘Did you understand certain part? We didn’t quite get it’ and we will discuss, but sometimes on Zoom when the class ends, people just leave. Okay. And then you don’t get the chance. And you don’t know who to approach. But in person, the one sitting beside or behind you, you can just ask them.”* (P13)

“Being in class with someone, especially during that Zoom setting, there wasn’t a social aspect as much because of the format. You’re not physically sitting next to other people and to me the social aspects of a classroom, it was like you have time to chit chat before classes start, just like ‘Hey’, catching up and then after classes, a lot of the classes end 10 minutes before class, then everyone tends to kind of wait outside auditorium and chat.” (P14)

When students met in online meetings, it was also hard to initiate side conversations (Level 2b) with a small number of students because only one person can speak to carry the conversation flow smoothly in the meeting room; to initiate any conversation in online meetings, students had to speak publicly in front of all the attendees. But casual conversations for the socialization purpose tends not to be formal to be shared with all the meeting attendees and usually starts small locally with a few people nearby independent of the flow of the entire meeting. Online meetings, however, hardly afforded this small casual communications, as P13 described:

“... where you just talk about, maybe comment about something that’s happening... just [you need to] unmute yourself and talk about something in the Zoom. But that’s not very usual. On Zoom if one is talking, other people cannot talk. So that’s kind of challenging. So if you want to share some of your thoughts with just people beside you, that’s hard to do on a Zoom event”

Notably, many students remembered feeling “awkward” (P17, P10, P4, P6, P11, P14, P12) when they attended online social events (e.g., orientation social events, online coffee hour, game night, movie night or happy hours). Not having individual side conversations with others made students difficult to get to know others on a personal level and feel uncomfortable socializing with others online with reduced sense of connection. P16, who would attend online meditation sessions regularly, kept feeling “awkward,” as she did not get to know others doing the same activity as her in the sessions: *“It’s just awkward being on a call, just like one other person and you don’t even know them. In-person would be nice because you can at least chat with them. But every week you’re just seeing these people and you don’t even know who they are. This is really weird for me”*

Without feeling connected on an individual level, many participants who had attended online social events described them as “not fun” (P12) and some ended up not going again to a similar type of online social events. P1, who once went to a virtual game night, said, “It was very awkward. People didn’t really know each other and it’s hard to be engaged over Zoom. So yeah, I didn’t really go after that.” Thus little chances to have side conversations for socialization (Level 2b) online significantly reduced personal interactions to get to know peers and challenged further friendship development.

4.2.2 *Online meetings inhibit non-verbal communication.* A substantial portion of human interactions are communicated using non-verbal language such as facial expression, body language, posture, tonality, eye contact and touch. While videoconferencing tools are considered richer communication media than other text-based media, students still felt that much of non-verbal language could not be fully employed in online meetings. Many participants highlighted that limited non-verbal language from using only texts, voices and/or videos made it fundamentally challenging to interact with others over the computer or mobile screen. P5 described the difficulty approaching others with limited non-verbal language in online meetings: “I might pick up really fast that someone doesn’t want to talk... their camera might be off or not, but there’s still just so much less even if their cameras on and there’s so much less that I can perceive...” P17 noticed that many of her classmates did not necessarily present themselves visually (Level 1b) in online classes as turning on camera was optional, which made her feel disconnected with her classmates: “In many of our classes you didn’t need to open your camera, so you don’t open your camera, so people cannot see your expressions or your gestures or face. I think that decreases the connection between each other.”

Some participants experienced difficulty building trust to deepen friendships online without non-verbal cues. P8 remembered feeling uncertain when texting with a new friend she met online: “When I’m messaging people on Discord, we’re making the connection. It’s cool, right? But I have no clue how this person is actually responding to a lot of what I’m saying. And I also have no clue how this person is like, what’s their tone of voice? How are they reacting to this?” P11 also described that it was hard to share emotion with her friend over online communication channels. One time when was replying to her friend’s message about their common struggles with schoolwork, she found herself typing a rather formulaic text ‘I know it’s tough. I feel that’ without sincere empathy behind the mobile screen. She believed that it was not until she finally met her friend in person that she was able to share emotional support to their common struggles. Only after this face-to-face meeting did she feel trust in their friendships (Level 3b) despite having been messaging and talking online nearly every day for one year.

In addition, international students who were not confident with their English proficiency felt that remote learning mode added another challenge to making friends. They felt more “nervous” (P10) as they had to heavily rely on verbal language with little capacity to leverage non-verbal language when carrying a conversation with classmates in online meetings. P10 and P11 described these experiences: “It was first time to attend those kind of Zoom meeting and I am an international student... I was not sure I could talk in English well. So I was super nervous and I couldn’t remember the names [of the classmates].” (P10)

“In my case, a language barrier needs to be considered because last year my English was not that proficient and I was really nervous. I was afraid of making new friends. And the COVID hit... it was a bad synergy. So it was really hard to make friends. If it were in-person, to be honest, I could have made many friends because now I am making a lot [of friends] in person.” (P11)

Overall limited non-verbal communication over online meetings slowed friendship formation process as it hampered reciprocal interactions and emotion sharing required to build trust to develop friendship and deepen the intimacy of friendships.

781 4.2.3 *Online class meetings are formal by default.* Some students felt that online class meetings are formal by default
 782 and afforded little room for casual interactions (Level 2b) to build friendships. P12 mentioned that Zoom meetings where
 783 people see each other's face directly were "too formal" to feel connected personally with other students, saying that he
 784 would choose a 5-minute in-person meeting over an 1-hour Zoom meeting if he needs to build a new relationship as
 785 in-person meeting affords additional casual moments to interact with: *"If you're on Zoom, emotionally this communication*
 786 *is not good because facing the face is usually too formal. . . . in-person [5 minutes] is not exactly five minutes because going*
 787 *in and going out and walking is kind of easy to distract each other. It's easy to be casual."*
 788
 789

790 Feeling "too formal" in online meetings was also described by P17. She explained that while online meetings tended
 791 to only focus on getting work done efficiently, in-person meetings were easier to talk informally with teammates about
 792 various topics outside work: *"On Zoom I think you set a time for work, so we work during that time. We don't have a lot of*
 793 *topics talking about lots of other topics. . . . It's more efficient because you only focus on the things you need to do for your*
 794 *homework or this work. But if we met in person, we have more interesting things."*
 795

796 As shown in the friendship formation process, informal moments where students can feel comfortable talking about
 797 personal lives are essential for friendship formation. But these casual moments disappeared under remote learning, as
 798 P9 explained: *"For me something that's really important is in between moments of class - walking the class, leaving class,*
 799 *during breaks talking, which you don't get on a Zoom. It's the little interactions that kind of build up my friendship versus*
 800 *see each other on Zoom and not being able to interact more on personal level"*
 801

802 In addition, many participants missed entertaining components that foster lively atmosphere for socialization.
 803 Common entertaining components include food (e.g., group lunch/dinner, potluck party, free donuts), drinks (e.g., coffee
 804 hours, beer after completion of a team project), music and games. These entertaining components are also commonly
 805 found in social events, contributing to a vibrant and entertaining atmosphere. While they may be "not a center piece"
 806 (P5) for friendship development, they can function as a conversation starter and fun activities to facilitate bonding with
 807 peers and classmates. They also create a jovial mood where students can be more open to starting a casual conversation
 808 with unfamiliar students. For example, P12 emphasized how casual atmosphere with food and walking eased "emotional
 809 barriers" of looking smart that many MBA students build in the beginning of the school, helping them to feel connected
 810 on a personal level: *"Food is really important to distract. That means no need to focus on only conversation. That makes*
 811 *easier to connect with people. . . . especially the very beginning of the MBA, [students] try to be smart. . . . [It's] some kind of*
 812 *a hurdle, wall. Something related to food or walking in that angles [side by side], it's easy to [go] beyond these emotional*
 813 *hurdles."*
 814
 815
 816

817 As another illustration, P17 had a fond memory of collaborating and feeling connected with her teammates in a
 818 casual environment with food and a dog before the pandemic:
 819

820 *"I went to my one of my teammates' house and she ordered a pizza and we played with her dog. Even*
 821 *though the work lasted from the morning to the night and it was very heavy workload, we still felt like 'It'll*
 822 *be interesting.' [We] were happy because in that environment we were closer with each other and we had*
 823 *food together around, playing together. . . . I think that would be better if you only doing that in MIRO (an*
 824 *online visual collaboration platform) or some digital platform."*
 825
 826

827 P11 also mentioned that drinking her own coffee with some cohort members over the computer screen "didn't feel
 828 socializing" and was "totally different" from in-person dinner she had after the intensive training in her department
 829 with her classmates. Many of these instinctive joy shared at a physical spot disappeared in virtual settings because they
 830 were just hard to be replicated online.
 831
 832

While online classes may have been able to deliver class materials more efficiently, they lacked informality that afford casual conversations (Level 2b) opportunities through which students build friendships with classmates.

4.3 Workarounds to make friends in online world

Despite the challenges of online socialization, all first-year participants except one - who lived with existing friends - were able to make friends under remote learning mode. While online friendship formation process was generally took longer than in usual in-person school life, students built friendships when the context of online meetings afforded frequent and informal interactions one another in addition with their conscious efforts to overcome inhibited levels of interactions in the friendship formation process by 1) engaging in forced group meetings 2) initiating casual conversations using chat, 3) securing time for casual conversations and 4) reaching out to those with common interests.

4.3.1 Engaging in forced group meetings. Group activities that forced students to meet group members frequently (Level 23a) increased chances to have casual conversations (Level 2b) among group members. Unlike lectures, group activities such as team projects, practical training meetings and study groups by nature require students to regularly meet and discuss as a small group over an extended time in and outside classes. Thus they provided opportunities to talk and build relationships for first-year students who had few opportunities, or even none, to talk with their cohort by merely attending classes under remote learning mode like P4:

“In my practical projects, wellness coaching class, they were the first other people [other than her friend who she already knew from undergrad] that I started to do things with. We would do a dinner at someone’s house or hang out at someone’s house. . . . We did spend a lot of time together online. It was a lot of training, we had a full day before classes started and then for maybe a month or two, we had all day training on Fridays, so it was quite of time together.”

Also for P13, a study group mate matching system facilitated by his department helped him to not only form a study group to discuss tough class assignments but also make a new friend. He developed a friendship with one study group mate with whom he discussed most frequently (Level 2a) and gradually talked more about personal backgrounds (Level 2b). He appreciated the initial connection made by the system as *“it’s really hard to meet people remotely. And then since for me and for many other students, it was the first year here and then they wouldn’t know many people here. So that group gives you more opportunity to reach out to certain people.”*

Notably, group activities that had good teamwork and/or that group members had much interest in the common activities increased chances to build friendships. Apparently good teamwork is prone to create a friendly atmosphere that better fostered casual conversations (Level 2b), thus being more conducive to developing bonding relationships among group members. For instance, P2 highlighted that his team promoted *“a more open atmosphere that builds rapport in the long run”* and *“really spending that time engaging in contextual inquiry.”* In one of the team sessions, he happened to connect with one teammate through Indian band music which he played as background (Level 3a) and kept in touch with her even after the project as friends. In one of her architecture classes, P3 also became friends with her project partner she enjoyed collaborating with: *“We just did a lot of text messaging and we just had very similar style of like work ethic and communication, so that just made it really easy for us to be project partners and also be able to converse about other things . . . she always did her part and she’d always keep me updated which I really enjoyed on.”*

Similarly, P10 developed friendships with her teammates with whom she had small group discussions regularly (Level 2a) in her international relations class. They were all interested in the discussion topics (Level 3a), which led them to digress from the meeting agenda (Level 2b) and be personally close to become friends:

885 *“I’m still hanging out with those classmates... especially that class was international relations, like the*
886 *international policy. The classmates were interested in international stuff or many people had already*
887 *experienced living outside the US So if there was some small group, like a discussion, breakout room*
888 *regularly, that helps more to know classmates I guess... the other time we would do some more like personal*
889 *conversation during the meeting.”*

891 In this way regular group meetings that required students to collaborate and help out one another for schoolwork
892 provided opportunities to have a casual conversation (Level 2b) with other students and learn about them on a personal
893 level. As a result, some participants were able to make friends out of group activities in remote classes.
894

895
896 **4.3.2 Initiating casual conversations using chat.** While side conversations during online classes was inhibited, one
897 common alternative was using a private chat feature in online meetings. For example, when the instructor was having
898 a brief casual conversation with the class, or “ice breaking time” (P2), at the beginning of his coding class, P2 started
899 a private chat (Level 2b) about a common interest (Level 3a) with one classmate with whom ended up developing
900 friendship. He described: “We debated it. Who was the best musician or something? I was telling him, I was, Davis was
901 better than Duke Ellington. Anyway, I think we met in a private chat and it built from there.” Once they became close, this
902 class became a point of connection (Level 3b) and they later met in person to discuss class assignments and hang out. In
903 another case, P13 sent out private chat messages to a number of random classmates who seemed “friendly” among those
904 who have their cameras on Zoom to find a study group mate to discuss homework problems in his engineering class.
905 Some did not reply to his message, but some did. That way he was able to form a study group with three classmates
906 and stayed in touch with some of them. Furthermore, P5, whose department has tight-knit cohort, remembered that
907 his classmates used multiple communication platforms in and outside class meetings simultaneously to share small
908 comments about discussion happening in the class (Level 2b). This strategy was how he built some of relationships
909 with his cohort:
910

911 *“DMing people over Zoom or being able to like multitask, so to speak, when someone’s lecturing and then*
912 *I could like shoot someone a text. I think people were craving connection in that way, so the group like*
913 *the chat feature here on Zoom will always be popping up. There’d be a lot of messages taking place and*
914 *that helped to form relationships. It might just start with like ‘Oh, that’s a great comment.’ and they’re*
915 *like ‘Oh, thanks I like your comment.’ and then you start talking with each other, so I know I formed some*
916 *relationships that way.”*

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921
922 **4.3.3 Securing time for casual conversations.** Some participants intentionally secured time for casual conversations
923 (Level 2b) to bond and talk with other students beyond meeting agenda and course materials. P7 described that he
924 interacted with the student government members during and after the meetings to socialize and share personal updates
925 about life:
926

927
928 *“We would have weekly meetings with the student government, and that was a time for us to kind of connect*
929 *and talk. And we might connect after [or] we might not online, but for the most part that’s how we socialized*
930 *within the meetings...to discuss agenda - proof expenditures, and all that fun stuff and talk about updates,*
931 *occasionally you get to do little breakouts and talk about life, how we deal with the pandemic.”*

932
933 P15 also described that he explicitly asked extending the meeting time so that he could socialize and talk about life
934 with some of the team members after the meetings ended:
935

937 *“After the group meeting, if I had to hang out with one of the person, then I would just ask them to stay*
938 *back and we were just talking about life. Yeah, for example, if the group meeting was from, say 10 to 10:30.*
939 *Then we were hanging out 5 more minutes offered and 30 are talking about team meetings. Extend the team*
940 *meetings or just connected team meeting and then come back on call and talk to them.”*

942 P2, who knew the importance of the casual atmosphere for teamwork, emphasized that he made sure to have *“little*
943 *moments”* to talk before getting into work with his teammates during team meetings online so that the team could feel
944 connected personally:

946 *“Just like with conversation, the icebreakers and how you conversate and how you talk about somebody’s*
947 *day before you get into the rest of everything, or you just keep a sort of casual atmosphere that’s like a*
948 *little chat. It’s still business, but it’s casual. So you feel you can hang back a little bit. You know, you’re not*
949 *speaking to your professor. . . It just creates like a different atmosphere, communication and working with*
950 *each other. And getting to know each other and having little moments, connecting beyond just the course*
951 *material.”*

954 Additionally, P8 recalled an informal videoconferencing that grew out of an online group chat in her department.
955 They set a specific date and time to meet and around 9 people showed up in that meeting. They talked about their
956 school life such as classes they were taking together and personal life. She was able to see their faces, talk casually and
957 feel connected with them:

959 *“Someone was like ‘We should meet up, we should do a big video chat,’ and a lot of people were also*
960 *interested. Someone made the happy hour channel. I remember someone said a time and a date and they*
961 *were like, ‘Hey, let’s meet up Tuesday at 6pm’ and just chat, talk about life, things like that. It was very*
962 *informal. It was just drinking wine, talking about classes, professors, talking about people showing their*
963 *pets, people talking about their pandemic, hobbies, things like that. . . I only went to one or two of the happy*
964 *hours, but even that was really helpful with just putting name to face and like connecting with people.”*

968 4.3.4 *Reaching out to those with common interests.* In friendship formation process, Similarities/Common interests
969 (Level 3a) ultimately connect students to become friends. Thus identifying personal commonalities was one of the most
970 effective ways to make friends under remote learning mode. Explicitly displayed interests and/or personal background
971 information enabled some participants to reach out to or be reached out by those who had common interests or
972 backgrounds. For example, P1’s department requested all incoming students to submit a profile that included name,
973 education background, hometown, interests, hobbies and photos and disseminated to the entire cohort via email. After
974 seeing these profiles, P1 found one cohort member whose research interest was the same as her and reached out to her:
975 *“We all got to see a slideshow of everybody. . . And so one of the girls that I’m friends with now, I saw that she was interested*
976 *in the same thing as me. . . we’re interested in women’s health research. So I reached out to her and I asked her like ‘Are you*
977 *doing anything related to this on campus?’”*

981 In the same vein, P5 shared his bio in one of the cohort group chats early in the semester (*“There were multiple*
982 *platforms, through which we could talk about ourselves, and because I said ‘Oh, I was evacuated from Peace Corps in*
983 *Uganda now I’m here to study X, Y or Z”*) and was approached by two cohort members, one who had worked in the
984 same profession and the other in the same region. That way he formed a friend group who became close friends in his
985 department. In another case, P14 met one of his friends through an anime-interest group meeting on Zoom (*“animated*
986 *TV show called ‘Avatar the Last Airbender’*) that he volunteered to organize during the new student welcome weeks.

989 Unlike the virtual orientation social event he did not attend because he thought that the event seemed “unstructured”
990 with no “mutual interest” to connect with others, his interest-based online meeting motivated him to connect with one
991 attendee he met for the first time: “So I just remember having like an hour long discussion with random people, the first
992 years in a program that I’d never met. . . . he [his friend] came to the anime event. And that’s when I kind of like ‘Oh, okay
993 he really loves the show that I really love, I think I will get along with them’” He additionally mentioned that even though
994 they did not keep in touch regularly afterwards during his busy semester, this initial connection based on their favorite
995 anime connected them again immediately when they finally met in an in-person social gathering in his department
996 later.
997

999 For students from minority population groups, it was common to actively connect with those who share the same
1000 identities in and outside of the department through online communities. For example, P11, an international Korean
1001 first-year nursing major, met her best friend who happened to be in the same cohort through online Korean nursing
1002 professional community based on the state she lived. After being connected, they relied on each other to catch up on
1003 classes and do homework together throughout the remote school years during which she had difficulty making new
1004 friends under remote learning mode. P8 also met one of her best friends who she described was “a life line” to get
1005 through tough times in graduate school through an online LGBTQ community in university. Despite studying different
1006 majors, they stayed connected online, constantly texting and regularly videoconferencing to do their own homework
1007 together or just chat about their lives occasionally all night long. These cases are in line with the benefits of online
1008 communities that provides social support for students from minority groups [48].
1009

1011 While some students proactively initiated casual conversation and reached out to others to overcome challenges of
1012 friendship formation through online interactions, not everyone felt comfortable doing so presumably depending on
1013 students’ individual characteristics. Those who proactively reached out to random unfamiliar classmates as described
1014 above tend to be extroverted or strongly motivated for networking. Other participants including those who are shy
1015 or introverted were not comfortable connecting with stranger classmates online. P17, who identified herself as a shy
1016 person, mentioned that she tended to stay muted and not to participate in conversation unless required by classes
1017 especially with more than 5 attendees. P9 did not even attend virtual orientation social events where she could have
1018 met and greeted her cohort because she thought “meeting people trying to interact in an icebreaker way, it’s always been
1019 challenging and so the thought of that on a computer was intimidating and daunting to me.”
1020

1023 Overall, the majority of participants had to put additional and conscious efforts to informally and casually connect
1024 with peers under remote learning mode, as P5 described, “I had to be super intentional with who I was talking to,” and
1025 endure extra time to build friendships in an online world.
1026

1028 4.4 Hanging out with friends during the pandemic

1029 Despite the prevalence of the COVID virus on campus, participants dominantly preferred to meet and hang out with
1030 their newly formed friends by choosing to take “low risks” of infecting the virus: they met outdoors, gathered in a
1031 small/medium-sized group, got tested and vaccinated and/or wore masks. Most participants explained that they had to
1032 prioritize their mental health over physical health to meet the desire for social connection and human bonding. All
1033 participants who first developed friendships online also met their friends in person when as soon as situations allowed.
1034 Online hang-outs using videoconferencing emerged as well but were only alternatives, with varying satisfaction levels,
1035 during the time they could not meet in person for reasons of long distance or absence of palaces to meet in the winter
1036 time.
1037
1038
1039

1041 4.4.1 *In-person hang-outs.* Most students who lived nearby the campus chose to meet and hang out in person with their
 1042 newly formed friends even before the first dose of vaccines was available, even if overall the frequency of meeting may
 1043 have reduced than normal school days. They met their close circle of friends mostly in one of their houses and outdoors,
 1044 as most indoor commercial places were restricted due to social distancing measures in the town. They reported that
 1045 they felt comfortable meeting their friends in person with “low risks” (P6, P14, P5, P10) by meeting friends in a small
 1046 group outdoors. P6 chose to attend in-person orientation social event, which were rarely offered in other departments,
 1047 and continued to meet her friends outdoors: “Obviously the in-person option in the groups of four or five people, so it’s
 1048 still small enough that it still felt pretty low risk and ours was also outdoors so that made me feel better about it definitely.”
 1049 P7 and P14 also “tried to maximize the low risk” (P14) by attending a social event held by the department in the park,
 1050 saying “As people were getting vaccinated through them throughout the month of March and April. I think people felt more
 1051 I mean safer and we would all still be pretty good about spacing out and all that was outdoors”. P5 also felt “safe” hanging
 1052 out in person with a small bubble of friends he knew well, saying he could “trust” them as he perceived that they were
 1053 being cautious with COVID by testing before and after meeting (later the school required all student to get tested every
 1054 week): “... three to five weeks after school and you start having your friends the people that you’re connecting with and it
 1055 was like ‘Hey, have you been tested recently? I’d like to hang out’, and you take, like the 12 or 14 days of in between, before
 1056 and after and then. We only knew each other so well, but I was trusting and I think they were also trusting in retrospect.”
 1057 Even though the university discouraged students from gathering and even officially not allowed to invite people in his
 1058 residential building, he occasionally invited his friends to his place during the pandemic: “I don’t know if that was the
 1059 best thing, but at least for my mental I had maybe a group of five or six people outside of my roommate’s that I would see in
 1060 person.” Like P5, many participants said that they just had to meet friends in person because they were “much more
 1061 concerned about my mental health” (P12) than physical health, and needed a minimum social interaction as “a break
 1062 from being alone or being in class” (P1) under remote learning mode as the pandemic prolonged. Furthermore, P4, a
 1063 public health first-year, remembered that despite feeling guilty for meeting her friends in person she had to meet them
 1064 because it was their “only social interaction”:

1071
 1072 *“Public health students were supposed to be following all the rules when it came to protecting people from*
 1073 *getting sick... There was a sense of ‘public health guilt’ that we weren’t supposed to be seeing each other*
 1074 *indoors without masks on ... whenever you would go and do something it’s ‘Okay, we definitely shouldn’t*
 1075 *be doing this, but ... it’s our only social interaction.”*
 1076
 1077

1078 Even if participants could not meet in person when they were developing friendship online due to geographical
 1079 distance (e.g., taking classes remotely in a different city or outside the U.S.) or health concerns (e.g., concerns about
 1080 catching COVID, living with family members whose jobs are essential healthcare workers), they met in person when the
 1081 situation allowed however late it was: when they started to feel safer about COVID after the vaccines were distributed
 1082 (P3, P7); when the border between Canada and the U.S. reopened (P11); when his international friend finally got a US
 1083 visa and arrived on the campus (P2). P2 described the excitement when he finally met his friend in person for the first
 1084 time at the end of the semester, “I don’t have any pen pals. I gotta see your face at some point... Yeh, we both texted, it was
 1085 digital relationship, it was fine. Then meeting in person was great. Crazy, it is real? Is this your face?” P8, who stayed in
 1086 her out-of-state hometown throughout her first year, finally met her friend whose friendships were developed online
 1087 on the first day she came to the campus: “September 2020 and ever since then, we just started talking and connecting and
 1088 yeah, they just picked me up from the airport a couple of days ago, so we’re still friends!”
 1089
 1090
 1091

1093 Overall, however, it was inevitable that there were less variety in ways to hang out with friends. Indoor places and
1094 facilities where students used to visit such as bars, restaurants, and stadium were restricted or closed at least before
1095 the vaccines were rolled out. They met and hung out, for example, by taking out food/coffee and walking in the park
1096 nearby. Some continued to play outdoor sports such as volleyball, basketball and snowboarding. But most participants
1097 met their close circle of friends at one of their houses doing usual mindless things they would do with friends such as
1098 cooking, eating, drinking, watching shows or playing games. As human beings, in-person human bonding seemed to be
1099 essential to fully enjoy friendship and irreplaceable completely by online communication.
1100
1101

1102 **4.4.2 Online hang-outs.** Some participants hung out with friends using videoconferencing. While it was already
1103 common to make video calls with existing relationships like family and old friends living in different geographical
1104 locations, online hang-outs with newly formed friends in school was adopted by the participants only when there
1105 was no other option to meet friends in person. Only one participant living on campus transitioned to weekly Zoom
1106 hangouts with her friends she used to meet in person because they did not have a place to meet during the lockdown in
1107 the winter - it was too cold to meet outside, the restaurants/bars downtown were closed and they could not visit one of
1108 their houses as they all had roommates. Based on their friendship they had been strengthening by regular hang-outs in
1109 person before the winter, they continued hang out online to maintain their "social outlet". *"I think there wasn't much*
1110 *social interaction for all of us outside of classes being on Zoom. So I think it was a social outlet, and I would say we are*
1111 *extroverted, so we're definitely looking for more social interaction than what we were going from remote school."* (P6) She
1112 described that when they met they mostly chatted about "random stuff", occasionally trying to do some entertaining
1113 activities like making cocktails or watching movies together at the same time.
1114
1115

1116 Six participants who took classes remotely in different geographic locations had to stay in touch and hang out
1117 with friends from school only using online communication channels. However, only three of them reported using
1118 videoconferencing to talk with their friends and the level of satisfaction about online hang-outs varied depending on
1119 their familiarity with online socialization and individual characteristics. One participant who described joining online
1120 communities as her "second nature", enjoyed new friendships she made online; she met approximately 8 friends regularly
1121 on videoconferencing to do homework together and chat about their lives. Another participant mentioned that despite
1122 being somewhat limited to share emotion, she still kept in touch with her friend nearly every day, occasionally sharing
1123 their life through videoconferencing. Yet another introverted participant who had relocated to her home country after
1124 the outbreak of the pandemic said that she had to stop meeting her friend as they transitioned online because there was
1125 little to talk about without common classes and activities at hand:
1126
1127

1128 *"If we meet here in person, we tried to do an event where either like bowling or ice skating or just having*
1129 *fun and then also talking. On Zoom, it's like you're only talking. You're not doing an activity. So it's a little*
1130 *boring even when I connected with my friends from school. And I'm an introvert. It did not bother me that*
1131 *much not having those many friends. But online there wasn't a lot to talk about. So yeah, we would just*
1132 *space out... At one point I had to tell my friend that let's not talk as much. I don't have anything to talk*
1133 *about. I'm sorry, but that's the truth."* (P16)
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1139 And the rest of the 3 participants did not report using videoconferencing, in part due to time zone differences, and
1140 mostly communicated with their friends through text messaging. As with the preference for in-person hang-outs with
1141 friends, the varying satisfaction of online hang-outs reflect the limitations of online socialization that cannot be replaced
1142 by in-person bonding.
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5 DISCUSSION

An examination of online friendship formation among U.S. graduate students revealed a novel seven-level online friendship formation process (Zero Contact, First Meeting, Facial Familiarity, Frequent Meetings, Casual Conversation, Similarities/Common interests, Repeated Interactions) that extends Levinger and Snoek's pair relatedness theory of interpersonal relationship development [40]. Among the seven levels, Facial Familiarity and Casual Conversations were severely inhibited by online-primary interactions, causing overall friendship formation process to be challenging and prolonged. Despite these challenges, however, students demonstrated workarounds to initiate informal bilateral interactions online and made new friends over semesters. This new context of online friendship formation process contributes to literature in 1) friendship formation theories, 2) online-first friendship and 3) the impact of remote learning on university student social life in higher education.

This study identified seven-level friendship formation process in online world by further breaking down Levinger and Snoek's four-level pair relatedness theory [40]. Their theory is originally based on in-person interactions with assumptions that when a person first makes contact with a person, they can automatically see each other's face (Facial familiarity), and the meeting subsumes interactions and conversations that enable reciprocal self-disclosure (Frequent Meetings and Casual Conversation) for interpersonal relationship development. However, I found that because online meetings do not necessarily involve visual representation or informal personal interactions, participants had difficulty getting to know peers and felt others to be difficult to approach. They also had little chances to have an individual conversation on a personal level to get to know other students and develop friendships when a large group of people gathered in online meetings. These activities naturally happen in in-person settings, but were severely inhibited in online meetings where majority of human interactions have to be prescribed and structured online. These difficulties made implicit assumptions of the Levinger-Snoek model visible. Thus, I added three more granular levels to Levinger and Snoek's levels – Facial Familiarity, Frequent Meetings and Casual Conversation.

Previous HCI studies have also noticed the challenges of informal interactions for successful online collaboration and networking [13, 38, 39, 54, 57], and some have created technology tools that facilitate informal interactions online in professional settings such as conferences and workplaces by explicitly exhibiting texts and interests to others [54, 57]. Though some of my individual findings – about the importance of information interactions and common interests – are similar to those for professional collaboration, friendship is at once more open-ended, more demanding, and more essential to student life than professional interaction. Professional teamwork, for example, is often mandated, and so work can be accomplished even in the absence of mutual trust (even if at lower quality). Friendships, in contrast, are voluntary and organic; they do not form if a minimum of trust is absent. Thus, we find, for example, that the timing of university friendship formation is crucially tied to the academic year.

Furthermore, my study offers insights into online-first friendship formation process. Previous studies are primarily based on text-based online communities such as newsgroup and social media sites where possibly anonymous people voluntarily joined based on common interests in the first place [20, 46, 60]. However, in online meetings where a large group of unacquainted peers gathered to regularly attend formal classes, students do not necessarily know personal common interests one another when seeking friendship. While homophily identically functions as the basis for mutual friendship online with absence of physical proximity [7], I identified prior interaction behaviors (i.e. Facial Familiarity, Frequent Meetings, Casual Conversation) that facilitate identification of homophily to make friends virtually. Thus, this study shows the process of how people first met without knowing personal commonalities explore friendships online.

1197 I also found that it generally took longer to make new friends through online meetings than it would have been in
1198 usual in-person settings. This provides additional evidence that Walther’s SIP theory [64] holds in computer-mediated
1199 communication with predominant usage of videoconferencing. In addition, while there exist mixed results regarding
1200 tendency to make online friends between extroverts and introverts with some scholars claiming that anonymity in online
1201 spaces can be more favorable to make friends for those who are shy or with stigmatized identities [46, 60], my finding
1202 adds weight to the claim that extroverts tend to leverage their social skills more easily than shy or socially anxious
1203 people in online meetings. This implies that as online communication technology approximates offline settings more
1204 elaborately to self-represent oneself such as little anonymity with higher visual representation, individual characteristics
1205 and social skills may be more closely reflected in online socialization and thus can replicate difficulties of socialization
1206 one may experience offline in online spaces in addition to inherent challenges of friendship formation I identified in the
1207 findings.
1208
1209

1210 Recent research repeatedly finds that students suffered a lack of belonging and fewer social interactions since the
1211 pandemic [8, 12, 23, 26, 31, 35, 50, 52, 56, 59]. My study provides insight into the cause of this finding. Overall, I found
1212 that the difficulty of making friendships caused students to feel lonely and mentally distressed. Notably, no participant
1213 reported making friends out of virtual orientation sessions and many participants felt isolated not being able to connect
1214 with peers early in the school year. This is a stark contrast with the orientation experiences of participants who started
1215 their school in “normal” times before the pandemic, who reported making most of their close friends in the first few
1216 weeks of school.
1217
1218

1219 Though my study was specifically about graduate students at a U.S. university, the proposed online friendship
1220 formation process might be applicable to a range of other organizational contexts where videoconferencing is the
1221 dominant means by which people interact. For example, friendship in workplace is also beneficial for employee wellbeing
1222 and productivity [2, 53], and the recent increase in work-from-home poses a similar challenge of forming new informal
1223 relationships and workplace friendships among new hires as they have significantly reduced opportunities to connect
1224 and have a social talk[13, 66?]. The findings of this study may provide insights in facilitating friendship development
1225 among employees in an online or hybrid organizational settings where long-term and regular interactions are expected.
1226 Future research can examine friendship formation process in different types of remote organizations such as workplace.
1227
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1230 6 DESIGN RECOMMENDATIONS

1231 Based on the findings, I provide three key elements and related examples for student life administrators and faculty to
1232 consider when designing (in)formal programs to support students’ friendship formation and social lives in a remote
1233 learning environment in higher education. The recommendations include best practices through which some participants
1234 reported making friends online under remote learning mode.
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1236

1237 First, school should focus on creating opportunities that students can frequently meet and casually interact with
1238 peers on a personal level, as they were most inhibited in online meetings but crucial to develop friendships. Once
1239 students became friends, they tend to naturally find their own ways to meet and nurture their friendships. Thus
1240 school need to pay more attention to initial levels of interaction in online friendship formation process. For example,
1241 school could intentionally add and arrange short informal meetings (e.g., 10 - 15 minutes) for students before or after
1242 classes by diverting time saved from not commuting classes physically. During small informal meetings, school could
1243 facilitate ice-breaking activities, small talk or informal class-related discussion (e.g., assignments) with a small group of
1244 students (e.g., less than five) through online breakout rooms so that students can have opportunities to learn more
1245 about classmates and casually talk with them regularly.
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1247
1248

1249 Second, school could directly intervene to help students find mutual interests one another as some participants
1250 who found peers with common interests proactively reached out to them and developed friendship relatively fast.
1251 For example, universities could collect and share student profiles with photos, contacts and personal background
1252 information, such as education background, hometown, work experiences, hobbies, and research/career interests via
1253 email or online common online spaces (e.g., department websites, cohort group chat) to provide students with chances
1254 to get to know their cohort and potential friends to initiate conversations with.
1255

1256 Lastly, it is most effective to implement social interaction programs, but not limited to, at the beginning of the school
1257 year, as the findings indicate that this period is when new students are most open to getting to know others and making
1258 new friends than any other time later in school years. For instance, during welcome weeks school could form small
1259 student groups based on their interests surveyed in advance and facilitate them to have casual conversations around
1260 their common interests. And school could encourage these groups to participate in a series of group-based activities
1261 such as online board games and scavenger hunt that contains information that are commonly shared in orientation
1262 programming sessions or students should or would want to know, such as academic policies about programs, useful
1263 information about university, campus and city, and basic subject knowledge of their studies. Furthermore, school could
1264 incentivize groups' participation and collaboration with some entertaining elements, which many student reported
1265 missing in their social lives such as free food voucher that could be used during their group activities or freebies that
1266 would be rewarded after completing them. This way school could foster interactions among small number of students
1267 based on some commonalities students, while meeting one another frequently early weeks in the school year.
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1272 7 LIMITATIONS

1273 This study can be limited to represent the entire student population in higher education as the participants were
1274 full-time graduate/professional Master's students in a residential university based in the U.S. despite my effort to
1275 recruit students from diverse groups of students. Thus the findings may not be generalized to students in different
1276 types of programs and/or institutions in different countries. However, given that university students form a relatively
1277 homogeneous group in demographics such as age range and education levels [14], I believe that this study can provide
1278 some insights to university students and administrators in higher education institutions. Additionally, as with any type
1279 of interpersonal relationships, individual characteristics such as personality dispositions may have affected participants'
1280 friendship formation process. However, this study primarily aimed to examine the effect of structural change of
1281 friendship formation environment caused by unprecedented remote learning mode all students experienced during the
1282 pandemic.
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1288 8 CONCLUSION

1289 Through interviewing 17 graduate/professional students at a large midwestern U.S. university, I reveal a novel online
1290 friendship formation process that extends Levinger and Snoek's pair relatedness theory[40] by surfacing implicit
1291 assumptions in their theory and adding sub-levels necessary in online environment. COVID-19 remote learning
1292 mode inhibited this friendship formation process - especially Facial Familiarity and Casual Conversation, leading to
1293 some mental distress. However, I also reveal that students demonstrated workarounds to overcome these challenges
1294 by intentionally accomplishing all levels of interactions to make friends online. This work can help student life
1295 administrators and faculty in higher education in designing programs to support student social life and friendship
1296 development in an online learning environment.
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 1304

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