

Crowd-Based Design Activities: Helping Students Connect with Users Online

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ABSTRACT

By definition, human-centered design relies on interaction with users. While interacting with users within industry can be challenging, fostering these interactions in a classroom setting can be even more difficult. This qualitative study explores the use of *crowd-based design activities* as a way to support student-user interactions online. We motivate these online methods through a survey of 27 design instructors, who identified common challenges of conducting student-user interactions in physical settings, including coordination constraints and geographical barriers to meeting in person. We then describe our research through design approach to create and test 10 activities in a classroom setting, including using Twitter for needfinding and using Reddit to brainstorm ideas with experts. Finally, we present an emergent framework outlining the design space for *crowd-based design activities* where students learn to use input from online crowds to inform their design work. We discuss plans to refine and expand the current set of activities for open access to instructors.

Author Keywords

Online crowds, crowdsourcing, design methods, classroom activities, innovation

ACM Classification Keywords

H.5.3 [Group and Organization Interfaces]. Crowdsourcing

INTRODUCTION

There is a growing demand for human-centered design instruction as industry and government look for new ways to prepare students for careers in innovation [11,19]. Instructors teach students the importance of authentic user interactions as users can provide a better understanding of real-world needs [4,35], help generate useful and creative solutions [24,41], and provide useful feedback [2].

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Figure 1: A student design team collects Twitter data to understand user needs.

Typically, designers interact with and study users through in-person research methods, such as contextual inquiry [2], interviews [5], and user enactments [36]. However, orchestration challenges, such as locating users and setting up meetings, can limit the opportunities for such interactions. While these methods offer a rich understanding of users, performing these tasks could take weeks or months [34].

The Internet offers a supplementary approach to reaching potential users [9]. Designers in industry [45,46,47] and academia [14,23,26] have already begun exploring the value of soliciting design feedback and ideas online, such as testing first impressions of web-pages through an online usability tool [48] and using crowdfunding platforms, like Kickstarter, to publicize student projects [9]. Our research seeks to understand how students in design classes can leverage the Internet to collect user data, brainstorm ideas, and test prototypes for student design work.

We stress that these online design methods are supplemental to current in-person design practices and literature studies, and not replacements. Students should learn both face-to-face and new online techniques because online methods provide a way to connect with a wider range of geographically distant users quickly.

HCI research has only begun to study how online crowds can inform human-centered design work. In this paper, we:

- Survey design instructors to identify the challenges of conducting student-user interactions (Study 1)

- Design and test 10 *crowd-based design activities* that teach students how to collect and synthesize online data to inform their design projects (Study 2)
- Present an emergent framework outlining the design space for future activities

From the survey in Study 1, instructors identified several challenges to gathering user input, including anxiety around contacting strangers, geographical barriers, motivating outsider participation, lack of etiquette, and time and coordination constraints. In study 2, we follow a research through design approach [44] to create and test 10 *crowd-based design activities* in classroom settings, discussing three activity examples in depth. Taking into consideration the findings from Study 1 and Study 2 as well as related work in HCI, we present an emergent framework outlining the design space for *crowd-based design activities*. We conclude with a discussion of how to improve upon and create new activities and provide open access to instructors.

STUDY 1: SURVEY

While researchers have studied the pros and cons of design practices [15,17], including benefits of having design students interact with real users [30], little research examines what the barriers to fostering student-user interactions in the classroom. In order to gain a better understanding, we surveyed 27 instructors from twelve design institutions across the US, including public and private, and small and large.

Participants and Procedure

We identified participants by searching for design instructors at the top 60 design institutions [49]. We contacted 43 in total via email, and 33 responded (76%). Six respondents were excluded from the dataset because they either did not complete the survey or did not involve users in their design process. The remaining 27 participants have a range of design teaching experience from one year to over 20 years, and teach a variety of design courses, including interaction (12 people), product (6), service (4), engineering (3), communication (3), web (2), and graphic (2). We asked instructors to fill out an 18-item survey, which consisted of 10 multiple-choice and two open-ended questions about their teaching experience, current practices for connecting students and users, and the challenges they face.

Analysis

We tallied the multiple-choice data to identify how students interact with users (Figure 2), with how many users, and how often. We then performed an affinity analysis of instructor responses to identify themes [2]. This consisted of coming up with 10 initial categories about the difficulties with fostering student-user interactions, and then further clustering them into five final categories based on similarity and frequency of occurrence.

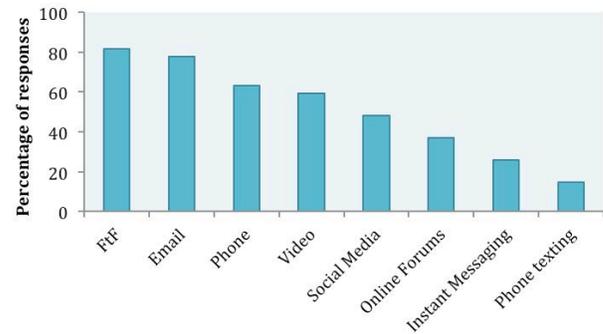


Figure 2: Percent breakdown of how students use different media to communicate with potential users.

Results: Classroom practices

Instructors report that students mainly interact with users, clients, experts, and peers, in order to obtain feedback, test concepts and prototypes, and perform observations, interviews, and surveys. These findings are expected and reflect established practices in human-centered design [21]. Unlike established practices, we found that students have started to use new communication channels such as online forums, social media, phone texting, and online chat to solicit feedback and ideas (Figure 2). About half of the instructors report that students interact with less than 10 people throughout their design process, and the majority of instructors describe their students interacting with users every couple of weeks or less.

Challenges in the classroom

We also asked design instructors to describe challenges they faced in fostering student interactions with people outside the classroom. We performed an affinity analysis of the open-ended responses and identified five main challenges: anxiety with contacting strangers, geographic barriers, time constraints and coordination, motivating user participation, and lack of etiquette from the student.

Anxiety with contacting strangers

Instructors describe getting students to contact people outside their comfort zone as one of the biggest challenges. They describe their students as “afraid” to talk to “real people.” Six of the 27 instructors said their students experienced “reticence,” “discomfort,” and “reluctance” when interacting with strangers, which could stem from a “fear of speaking with someone that they do not already have a relationship with.” Interacting with users through online crowd platforms could lower the barrier to making these connections by offering a safer avenue for communication, such as soliciting feedback anonymously to limit face threat [3,32]. Face threatening acts include strong negative emotions, disapproval, and criticism—things that may happen when receiving design feedback.

Geographic barriers

Instructors also find it difficult to connect students with geographically distant users. A design instructor explained that there has always been an “energy barrier to getting students to go off campus.” Another design instructor said the “hardest part” about fostering user interactions is “making the connection.” Students’ reluctance to travel to meet users could be a factor of feeling uncomfortable in an unknown environment or not having enough time. Instead, many students test their prototypes on roommates or other local acquaintances who may not be able to provide the same depth of insight as a real user.

Time constraints and coordination

Students are often limited by busy course schedules and extracurricular activities, while target users often have little time outside their jobs. Instructors report that students have trouble “coordinating schedules” and finding time to interact with people outside class. Due to troubles in coordinating schedules, setting up an interview or testing session may not happen quick enough for the students’ fast-paced design iteration cycles, causing students to make the majority of design decisions without consulting outside opinions. Soliciting feedback through online crowd platforms may provide a quick way to assess user opinions when pressed for time.

Motivating user participation

Instructors also struggle to find enough users who want to help with student projects. An instructor of a service design course reported that “building a constructive online community [to give feedback] takes time and lots of effort.” Some professors partner with companies in industry who, in exchange for providing a real world design challenge and mentorship, expect students to dedicate their project to support the company’s interests. While online communities face similar problems of motivating users online, HCI researchers have studied how to motivate users extrinsically through payment and intrinsically through personal interest in a topic.

Lack of etiquette

Instructors describe students having poor interview skills and “lack[ing] confidence and humility in engaging with users,” which could sour relationships and close off future interaction opportunities. For instance, an instructor of an interaction design course described how some of her students do not “follow up [with users]...at the end of the semester.” If students do not send updates or respond to messages, users would be less motivated to participate in the design process in the future. We argue that scaffolding interactions online could help support repeated, long-term relationships between students and users.

Reflection

These findings suggest that there is an opportunity to use online crowds to address challenges with involving people

outside the classroom. Our survey results show that students feel uncomfortable talking to strangers, have trouble connecting with geographically distant users, struggle with motivating users to participate, have limited time to meet in-person, and lack proper etiquette to support ongoing interactions. Instead, they tend to consult personal acquaintances who are often not representative of the user population or forego user testing altogether. Addressing these challenges is crucial to improving human-centered design instruction. In the next study, we describe how *crowd-based design activities* provide a new way for students to interact with users online to supplement their design practice.

STUDY 2: CROWD-BASED DESIGN ACTIVITIES

We present and test 10 initial *crowd-based design activities* to scaffold student-user interactions. Inspired by research in Learning by Design [28], we created activity-based interventions helping students collect and analyze data from online crowds to inform their design decisions and practice. Learning by Design involves having students learn about a certain topic through a design challenge, such as playing with toy cars to learn concepts of force and speed [28].

Participants and Procedure

We tested activities on 172 students in two undergraduate courses, three graduate courses, one mixed undergraduate/graduate course, and one summer studio over the course of two years [9]. Class sizes ranged from 12 to 48 and covered topics of service, web, and product design. Not all students tried every activity. Student design experience ranged from none to over four years. Activities were performed in groups of 2-5 people. All activities were created following a research through design approach [44], in which we prototyped over 50 activities, internally tested 20 with our research team, and then deployed the best 10 in classroom settings. We iterated on each activity after each individual testing session. Each activity had the following structure: 1) introduction of method via short lecture and/or handout, 2) students try out the method on a sample design challenge or their course project, and 3) students reflect on the activity individually and as a class. Activities lasted from 30 minutes to 1 hour.

Analysis

During the activity, we observed students and took notes on how they interacted with social media. We also collected data on activity impressions via open-ended surveys and discussion. We performed an affinity analysis [2] of the open-ended survey data and discussion notes for each activity in order to identify benefits and disadvantages of crowd-based activities. We did not have a coding scheme prior to data collection as it was determined by how students reacted to each activity. Data for each activity was coded separately.

Activity Name	Crowd Platform	Description
Needfinding:		
Foruming and Understanding	Reddit	Survey Reddit users to understand issues with a certain product, service, or experience
Tweet Dispositions	Twitter	Search and collect existing tweets to identify user pain points
Review the Reviews	Yelp/UrbanSpoon	Search and collect existing reviews to identify user pain points
Ideating:		
Crowdstorms	Mechanical Turk	Employ Turk workers in coming up with ideas for a design challenge
Bulletin Board Brainstorms	Reddit	Foster discussions with Reddit users to identify new ideas for a design challenge
Prototyping:		
Which Wireframe?	Mechanical Turk	A/B test wireframes with crowd workers
Analytics Wizard	Google Analytics	Perform page view analytics on web prototypes
Many Minds	Mindswarms	Seek video feedback on storyboards
Pitching:		
Facebook Feedback	Facebook	Survey Facebook Friends about quality of project pitch
Kickstart This!	Kickstarter/IndieGoGo	Create a project page with video and text description

Table 1: Description of ten crowd-based design activities tested in a classroom setting.

Activities

The following activity descriptions are three out of a set of ten (see Table 1) that have been designed and tested over the past two years to introduce the use of online platforms in the design process. Activities were introduced during all stages of the design process, from understanding the problem space to getting feedback on the final design presentation. We outline in a previous paper the benefits and disadvantages to using *crowd-based design activities* at different stages of the design process[9].

The activities involved 12 different online platforms, including service review platforms (Yelp, UrbanSpoon), social networking platforms (Facebook, Twitter), online forums (Reddit), crowdfunding platforms (Kickstarter, IndieGoGo), and crowd work platforms where people are paid to perform online tasks (Mechanical Turk). While we do not have space to elaborate on each activity in detail, we describe three that represent a range of how students solicit ideas and feedback online at different stages of the design process. Insights gained from testing all ten activate motivate our emergent framework outlining the design space for future activities.

Tweet Dispositions

Inspired by design techniques of using cultural probes [16], *Tweet Dispositions* uses Twitter to better understand user needs by having students collect and analyze tweets describing a certain product or service experience. Unlike a summary report or statistics, tweets provide insight into in-

the-moment thoughts that may not be easily captured through observation or interview methods.

In this activity, students were given a mock design challenge to improve the public bus riding experience. Students brainstormed keywords, such as #publictransportation, to facilitate their search for relevant tweets. Students collected a range of opinions from Twitter users who tweeted about public transportation. For example:

First time taking #publictransportation to work – I feel like a professional!

Bus stop is always packed with people. Ends up taking 20 minutes to get everyone on! #angrycommuter #sortof

These tweets uncovered design opportunities for reconsidering the bus ride as a professional experience or redesigning bus stops to minimize boarding time. Following data collection, we taught students how to perform an affinity analysis of tweets to identify common themes, such as “cleanliness,” “scheduling,” and “privacy.” We then discussed how these themes could inform design ideas to improve the bus riding experience. Student teams identified between 15 and 46 useful tweets in 10 minutes, and clustered them into four to nine design opportunities.

Students described the data as “in the moment,” “honest,” “diverse,” and “easy” to collect. This could be because bus riders are able to post sentiments on Twitter while riding the bus, as opposed to being interviewed post-experience or publicly while riding the bus. Furthermore, seven out of the 13 teams were able to collect tweets from over 30 people in 10 minutes, allowing for a large sampling of user sentiments in a short amount of time. However, students were concerned that the data was “less personal” and “less descriptive.” These disadvantages could be an effect of Twitter’s 140-character limit and not being able to observe the users in person. Furthermore, students were concerned that their population sample was biased towards people that were young and tech-savvy and that the data was skewed towards complaints and exaggerated statements.

Tweet Dispositions allowed for quick data collection from a large population without needing to travel off-campus. However, the trade-offs include less in-depth and more negatively skewed user data. In the future, we plan to pair this activity with in-person observation as well as improve methods to gather a more balanced set of user sentiments. We also tested a similar activity called *Review the Reviews*, where students read Yelp and UrbanSpoon reviews to understand likes and dislikes about a certain service like waiting in line at a store or restaurant. Similarly, *Foruming and Understanding* asked students to read Reddit posts to identify common discussion topics for a problem space.

Bulletin Board Brainstorms

Following techniques based on co-design [41] and ideating with lead users [24], *Bulletin Board Brainstorms* uses Reddit—an online bulletin board system where users post and

comment on content—to support brainstorming between students and potential users. Students chose to perform the brainstorming activity on their course projects rather than a mock design problem. In the activity, students generate questions, such as “How might you make the shuttle service more appealing?” Students then posted their questions on relevant subreddits—forums organized by area of interest—and fostered a brainstorming discussion by asking follow up questions. Example responses included:

Heated/covered stops for when it's cold and raining/snowing.

Add a shuttle stop at one of the major grocery stores.

The student teams asked questions on one to three Subreddits, and received between 1 and 26 responses, with an average of 11 responses per question thread in less than a week. Students described the experience as “being able to interact with people from all over who are interested in the subject.” They liked that the brainstormed ideas were related to “direct experiences rather than just speculation.” Many described the data as rich because they could hear “anecdotes full of information.” However, similar to *Tweet Dispositions*, students were frustrated that the Reddit users were “biased to a certain age, demographic, and type.”

Bulletin Board Brainstorms allows for anonymous interactions between students and motivated users. Reddit users contribute to online forums out of their own self-interest, and many see themselves as experts. While this self-selection biases the population, it allows students to easily find and interact with knowledgeable users that may be difficult to locate or meet with in person. In the future, we plan to test strategies for identifying other useful online user groups as well as how to best format questions to encourage discussions. We also tested a similar activity called *Crowdstorms* where students employed Mechanical Turk workers to come up with ideas for a design challenge, such as ideas for a new web app to track medication schedules.

Facebook Feedback

Facebook Feedback leverages one's social network by asking for pitch feedback via a survey posted on one's Facebook Timeline. Although Facebook connections are mainly limited to friends and family, it often allows students to quickly tap into a larger social network than what may be easily available in person.

In this activity, students use Google Forms to create a survey in which they post a video or text format of their presentation followed by survey questions about their presentation content and quality. Responses to the survey were anonymous. Students typically received feedback in less than a day. People offered feedback on the presentation style as well as the design concept. One project team received the following feedback on their project description:

This was a lot of information to understand at once in a huge block of text. I would piece it out and maybe have a simple graphic for steps 1-3.

They also found that users liked giving feedback on the design concept, even though the teams explained that the design was finished and that they only wanted feedback on the presentation language. For example, one respondent commented on the idea behind a taxi service that allows friends and family to “gift” rides:

It depends on your audience, but as someone who might use this, I felt annoyed that it seemed like only parents, friends, or others would contribute to my cab fare. What about me?!

Students found that their Facebook friends provided insights that they did not get from team members or classmates. Perhaps a lack of familiarity with the project topic allowed Facebook friends to provide a fresh perspective. Students reported taking into consideration the feedback to include “more description on the process” and to work on improvements in “transitions” and “wording.” However, some students were reluctant to tap their social network because they “do not like linking [their] online social life to [their] academic life.”

Facebook Feedback provides a way to solicit feedback quickly from a fresh perspective. However, students were reluctant to engage with friends publicly online and received relatively few responses. In future iterations, we plan to investigate how factors, such as anonymity and social capital [25], affect students' and Facebook friends' willingness to participate. Other similar activities include *Many Minds* and *Which Wireframe?*, where students solicited feedback about their prototypes from crowd workers on Mindswarms and Amazon Mechanical Turk, respectively.

Reflection

These examples describe how *crowd-based design activities* provide access to users online to understand user needs, solicit ideas, and gather feedback. These activities are not free of challenges, but they address some of the issues identified by instructors in Study 1. Interacting with users online helps overcome geographical barriers by allowing students to communicate with anyone around the world with Internet access. For instance, in *Bulletin Board Brainstorms*, students were able to seek ideas from people who had personal experience with a the design space. In addition, students were able to interact with people on their own schedule by posting questions and collecting responses later [20,37]. Furthermore, the activities scaffold user interactions by helping students format questions and foster discussion. They teach students how to collect useful data while following community standards (i.e. Rediquette [50]). We also found that many students were much more comfortable interacting with users online than in-person as it provides them time to think about what to say and craft an ideal post. We hope that online design methods will help students become more comfortable with contacting strangers in-person by providing them a lower-risk way to prepare.

Furthermore, we expected students—most of them growing up using the Internet—to be naturals at using different

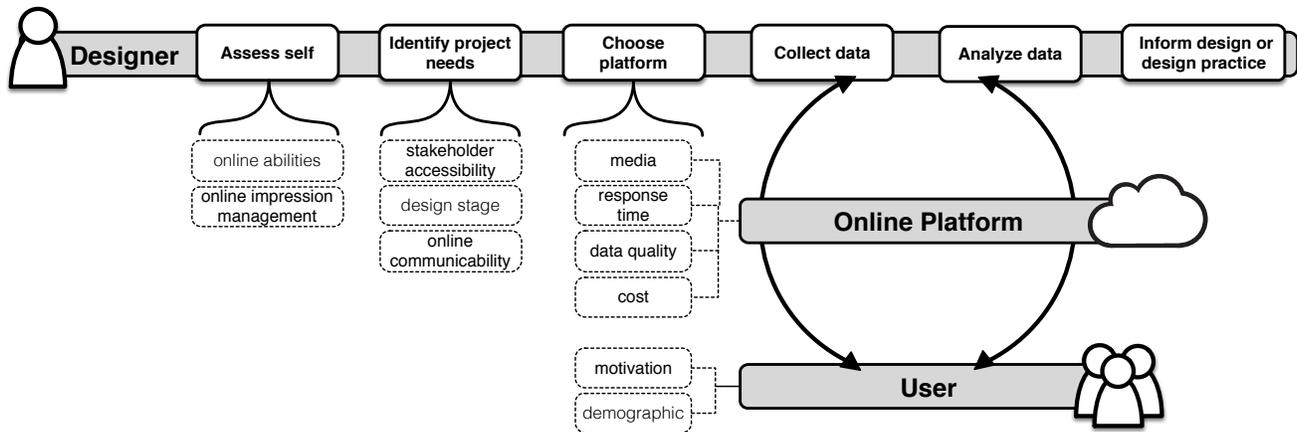


Figure 3: Crowd-based design activities support student skill development in assessing oneself, identifying project needs, choosing the platform, collecting data, analyzing data, and informing the project design or design practice. These areas make up the design space for creating future activities.

online platforms. We were concerned that soliciting feedback and ideas online would be too simplistic. However, after testing, we found the opposite to be true. Some students were more adept at navigating online platforms than others [22], particularly between the undergrad and masters students. Many had trouble understanding how to foster fruitful discussions online or did not know how to make the leap from online data collection to synthesizing findings and forming design decisions. These skill gaps motivate the need for *crowd-based design activities*, which aim to scaffold student skill development in using online crowds to inform their design work.

CROWD-BASED DESIGN ACTIVITY FRAMEWORK

Taking into consideration the lessons learned from creating and testing crowd-based design activities, we present an emergent framework (Figure 3) outlining the design space for interacting with users online. We find that in order to effectively orchestrate the interaction between students and the users through an online platform, instructional activities must support student skill development in assessing their self abilities, identifying project needs, choosing the platform, collecting and analyzing data, and using the data to inform their design work. We discuss these tasks in light of related HCI literature and present design considerations for each.

Assess self

Students' abilities and mentalities can range widely from student to student. As with any class activity, students and instructors must set expectations and understand how much preparation is needed to perform tasks effectively.

Online abilities

When testing our activity called *Bulletin Board Brainstorms*, we found that students in the undergraduate courses were more adept with using Reddit than students in the graduate courses. While many assume the Internet generation is inherently tech savvy, studies show that students' Internet literacy and behavior varies widely [22]. Age, race,

gender, and socio-economic status have been shown to affect the extent to which people use the web for everyday tasks, such as money management or seeking information about schoolwork [22]. Since online abilities affect how well students can leverage online platforms, instructors may want to survey student online expertise at the beginning of the course in order to tailor their instruction accordingly. For instance, we ask what social media platforms students used most in order to design activities that use these platforms or teach skill-building in others.

Online impression management

When testing *Facebook Feedback*, some students were hesitant to post a survey about their project work on social media and asked for less public options, such as listservs or specific groups of friends. Some social media users feel more comfortable asking for help and sharing information than others [1,25]. People may be less willing to perform certain online tasks to preserve social capital or to only act in ways in line with their online identity [8]. To account for student impression management, it may be best to provide alternative avenues for feedback, such as online groups where seeking feedback is the norm, or anonymous communication channels, which has been shown to lead to more uninhibited behavior [42].

Identify project needs

As identified by our previous work [9], project characteristics such as design stage, user, and topic complexity can determine when online crowds are more or less useful.

User Accessibility

As described in Study 1, users can be hard to access in-person for a variety of reasons, from avoiding conversations about a sensitive topic, like illness, to simply being outside one's personal network. Students designing for employees of nonprofits found it useful to understand their basic responsibilities by asking questions on Reddit forums in the *Bulletin Board Brainstorms* activity. Social media has been shown to provide access to user data for niche populations

[33], such as people with specific jobs or interests. We suggest students search for online forums or social media groups that attract people representative of the project's target end users.

Design stage

When testing the Mechanical Turk-based activities, *Crowdstorms* and *Which Wireframe?*, we found students liked generating ideas from a large, diverse population when they were still searching for ideas, but preferred seeking feedback from a smaller, more focused group of users when testing prototypes. These difference in preferences could be due the different challenges students face at different stages of their project, thus affecting which platforms could be most useful [9]. For later stages of the design process where in-depth feedback is needed, we suggest using platforms that allow for a back and forth rich transfer of information [6], such as video conference calls or discussion threads.

Online communicability

When testing *Facebook Feedback* and *Kickstart This!*, student groups creating a web application found it easier to communicate their idea online than other groups designing a physical service. Project communicability can be affected by a variety of aspects, such as the familiarity of a project topic or whether the concept can be expressed accurately online. While we suggest that students should leverage online platforms that allow for discussions between users and designers, more work needs to be done to understand how to best share more complex and tangible prototypes online.

Choose platform

Choosing the right platform gives access to specific user groups as well as diverse populations of users. Students must also take into consideration platform characteristics that affect communication affordances and data quality

Motivations

HCI researchers have studied how different online communities promote intrinsic and extrinsic motivation [18]. Psychologists show that intrinsic motivation, such as those driven by interests, often produces higher quality results than extrinsic motivators, such as money [40]. Although paid crowd-work platforms can produce a lot of data, it is often low quality [27]. Intrinsically motivated platforms may produce less data, but at higher quality. We observed similar findings when testing activities and suggest students explain how projects connect with user interests for intrinsically motivated users, and pay at least minimum wage for extrinsically motivated crowd workers, such as on Amazon Mechanical Turk.

Demographics

During *Bulletin Board Brainstorms*, students learned to identify specific user populations by searching for relevant

online forums related to their project topic. Subpopulations can be defined by race, gender, age, interests, or expertise. Homogenous platform demographics could either skew the type of feedback and ideas generated or provide valuable insight into a certain population. In order to target specific subgroups, we suggest making students aware of platform filters and search functions, such as Twitter Advanced Search or Facebook Graph Search, which allow users to identify specific types of posts and users.

Media

Depending on the project needs and available technology, students must decide on a balance between data that is both useful and easy to analyze. For instance, watching videos may provide rich visual insights into user interests, but collecting and analyzing this data would require learning to use video annotation software and a large computer database. Tweets, on the other hand, are easy to collect and analyze, but are limited in the level of insight that they can provide. The platform media, such as text or video, determines how users and the crowd communicate and what can be collected as user data [39].

Response time

Certain activities, like *Tweet Dispositions* have no response time because it involves collecting existing online data rather than communicating with the crowd. The speed at which students can receive data online varies for a variety of reasons, including how the crowd is incentivized, the number of people active on the site at a certain time, and whether the communication is synchronous or asynchronous [20]. When students have to wait for responses, we suggest instructors ask students to collect online data as homework, so that teams can come to class prepared to analyze and apply the data.

Data quality

Collecting data online is risky because anonymous online crowds can be held less accountable for low quality work [27,38]. Quinn and Bederson list 11 features of quality control for human computation tasks. These features include reputation systems, which allow people to be rewarded for good work, and defensive task design, which involves using screening questions in surveys [38]. Furthermore, HCI researchers have created various tools to improve crowd work quality, such as incorporating feedback [10] and peer management [29]. Students found that they received higher quality responses from crowd workers when they provided scaffolded response forms, such as rubrics and surveys, filtered for reputable crowd workers, and followed up with people when appropriate.

Cost

Designers are increasingly turning to crowd work platforms to solicit feedback and ideas [45]. From our testing experiences on Amazon Mechanical Turk, we paid an average of \$15 for 25 responses collected over one day. Students who

paid less than \$0.25 per minute in the activities *Crowdstorms* and *Which Wireframe?* received less than five responses after two days. For courses without a disposable budget, instructors could explain in the beginning of the course that each team would have to spend around \$20 collect feedback online. This amounts to about \$5 per student if the work in teams. We believe this reasonable compared to the amount students often have to spend on art materials, textbooks, or software, which typically ranges from \$30 to over \$100.

Collect data

Students must be skilled at navigating the platform in order to retrieve data, such as using search filters and understanding platform language. For instance, in *Tweet Dispositions*, we helped students filter for tweets from average Twitter users rather than companies, who typically only posted links to articles. In *Foruming an Understanding* and *Bulletin Board Brainstorms*, it was necessary to teach students how to search for and post on subreddits [50]. One could imagine in more advanced activities, design students would learn to use platform APIs to collect larger quantities of data to get a more representative sample of users. We suggest instructors introduce a variety of data collection methods drawing from both the social sciences to computer science.

Analyze data

The analysis of online crowd data stems from a variety of research areas including sociology [43], statistics, and computational social science [31]. Students would find a range of methods useful, such as qualitative data coding for uncovering themes in online text data, and statistical t-tests for identifying differences in A/B tests. Students could also learn to use different types of software, from text coding software like HyperResearch, to programming libraries for natural language processing. Although many of these skills have a sharp learning curve, we argue that learning these analysis methods is becoming more necessary in order to systematically design products and services informed by the growing amount of user data available online.

Inform design or design practice

It is necessary to synthesize user research in order to gain insights for a design problem [2]. For instance, ideas generated with online users to helped students decide their design direction; feedback from Facebook friends helped students improve their pitch. Furthermore, online needfinding informed in-person field observations, while online brainstorming informed the creation of in-person interview protocols. We suggest students use these crowd-based activities concurrently with in-person methods in order to understand how using the crowd can support and enhance existing design practice.

DISCUSSION

Designers are increasingly calling for more authentic human-centered experiences in design education [19]. Initial

response to this series of *crowd-based design activities* showed that crowds were useful in getting a quick broad overview from authentic user sentiments, conversing with hard-to-reach users, and gathering quick feedback from a fresh perspective under time constraints, thus addressing many of the student-user orchestration issues identified by instructors in Study 1.

Design practitioners already take advantage of opportunities to connect with users online, as there has been a growth in the number of online tools to help designers solicit feedback and ideas [45,46,47]. For instance, UsabilityHub [45] allows designers to upload web prototypes and test where on the webpage people click most, while Mural.ly allows designers to create and test online a concept mood board, a collection of images to capture the design “feel” [46]. However, most of these tools are not free, costing between \$29 and \$50 per month, suggesting that they cater towards more professional designers rather than novice design students. Applying these techniques in the classroom is not necessarily new. As identified in Study 1 (Figure 2), students are already connecting with users through various online communication channels, such as on social media and forums. This study focuses on how to create online design methods and incorporate them in formal design curricula.

In addition, HCI researchers have begun holding tutorials at conferences that introduce the practice of crowdsourcing to generate ideas and solicit feedback for design [26]. Others are designing novel platforms to help students learn the design process and share their work with each other through an online network [13]. The purpose of this work is to introduce to students via activity modules the growing practice of soliciting ideas and feedback online, thus preparing them for real world design scenarios in both industry and academia.

While we have identified benefits for online design methods, we find the data is often not as rich as what could be collected in-person. In-person methods allow for in-situ observation and allow design researchers to pursue certain topics in depth through interviews without having to worry that the interviewee will “sign off” or forget to respond. Similar to how in-person design methods are constrained to in-person social norms and physical boundaries, online methods are constrained by the technological environment as well as a different set of online social norms. For instance, designers cannot verify the identity of the “user” being studied online. People could easily pose as someone else, which would lead to false data. However, in-person design methods face similar challenges as users, during interviews, sometimes lie to the researcher to save face or make the right impression [7].

While many instructors are excited about involving online crowds in their classroom design process, some are worried students will limit all interactions with users to online interactions. We recommend that instructors help students understand how online interactions can inform in-person de-

sign practice. For example, performing needfinding on Twitter could help students prepare for in-person field observations by informing their initial understanding of major pain points. Ideating with Reddit can help spark initial ideas that could be further explored in interviews. Soliciting feedback from Facebook helps students to quickly filter for glaring errors before delivering their work during final presentations.

LIMITATIONS AND FUTURE WORK

We acknowledge that platforms change and new platforms emerge, which could change the affordances of the activities. Furthermore, our observations could be biased due to self-report since we tested the activities in our own classrooms. As this is an exploratory study, we plan to update and refine our activities and activity framework after distributing and testing the prototypes to other instructors. Furthermore, we plan to supplement our activity design and framework by better understanding online user study practices in industry.

We also plan to explore the affect of anonymity and social capital on design feedback quality. Seeking feedback anonymously online could limit face threat [32] and help students feel more comfortable seeking feedback. In addition, understanding how students use social media and preserve or build social capital online would help us better understand individual-level factors for differences in feedback quality.

Furthermore, following the call to create a more globally connected network of design students and instructors [11], we created a platform to enable the distribution and co-creation of new crowd-based activities (see crowddriveninnovation.com). We hope that this platform will provide an online space where instructors can share their experiences and evaluate activities to inform improvements. We also hope to expand the use of crowd-based activities to industry partners.

CONCLUSION

The growth of social media and crowd technologies provides an opportunity to introduce a new set of practices to the design community. By teaching these practices, we supplement in-person design methods as well as address existing challenges, such as geographical barriers and time constraints. We create and test 10 *crowd-based design activities*, and find that they are successful at providing students with quick insights and feedback from real users. Informed by our findings, we present an emergent framework that outlines the design space for creating future activities.

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