Micro-Apprentice: Guiding Volunteers with Online Expert Strangers

ABSTRACT

Many organizations, such as non-profits, often rely on a strong volunteer workforce. However, volunteering is generally done by novices who, without appropriate guidance, may produce low quality work that does not help the organization nor the individual volunteers, who do not get to gain the experience they wanted or enhance their professional portfolio. Structured tutorials are easily sourced and may work for paid workers, but fail to encompass the professional development that one-on-one mentoring from experts can provide, and can also be too restrictive for intrinsically motivated volunteers. To improve the usefulness of volunteer work, we designed Micro-Apprenticing: a system that facilitates the process of giving expert advice to novice volunteers. Micro-Apprenticing uses chatbots to recruit experts from social media, who then provide volunteers with task-specific advice and professional tips in short bursts of time. We explore how people respond to this type of guidance via a field deployment focused on volunteer work in graphic design. Our results show that volunteers who were guided with Micro-Apprenticing produced work that was perceived by specialists as more useful than other guidance mechanisms, such as tutorials. Follow-up content analysis revealed that the unique benefits of Micro-Apprenticing include obtaining suggestions from experts on key topics, instead of forcing volunteers to follow a rigid methodology. We conclude with design recommendations for future interfaces that crowdsource and guide volunteer work.

INTRODUCTION

Volunteers from non-governmental organizations (NGOs) can help deliver critical services to communities [21]. But of all the useful services that NGOs envision, a majority are never completed [20, 53]. These volunteering efforts often fail because the work produced is of lower quality than is needed to be useful [35, 47]. The problem is that most volunteer tasks require a certain level of expertise to complete, but the expertise variance in most volunteer workforces means many participants lack critical skills [2, 44].

Several researchers and practitioners have studied ways to train and guide volunteers to produce quality work [15, 47, 57]. One popular solution has been to use tutorials [24, 23, 30], instructional programs that provide step by step information on how to do any task. Tutorials generally define rules and guidelines from the start to lead apprentices to success [30, 45]. Some tutorials incorporate penalties when apprentices practice infringements to the guidelines or rules [50]. We might then just question, if NGOs need to provide some guidance to their volunteers, why not simply provide volunteers with relevant tutorials that could help them to do their work? There is already a vast amount of information online that could be sourced and used as on-the-job training (e.g., wikihow) [25]. These tutorials are usually free and easy to use. There is no need to have any additional staff or humans in the loop to help in the guidance. Thus, tutorials could be cost-effective solution to volunteer training for NGOs with significant resource limitations.

We argue that the two unique characteristics of volunteer work yield unique requirements for which structured and specified guidance is a poor fit. The first characteristic is the *pro bono*, typically intrinsically motivated [14] nature of volunteer work. Because they work *pro bono*, volunteers value flexibility in the work schedule and rules they have to follow [19]. Further, because volunteers are likely to already be intrinsically motivated to work, detailed regulations might not be needed [55], as volunteers will likely focus more on producing notable work instead of playing the system. Thus, we believe that volunteers would benefit the most from short guidance that leads them towards the path of success but does not stress them with excessive rules. The second key characteristic is the desire for professional development when volunteering. Previous studies suggest that volunteers are more likely to produce quality work when through the experience they help the community and also personally benefit (e.g., the work helps their career) [15, 47, 57]. This suggests that successful guidance of volunteers should encompass more than just advice specific to the task at hand, but also include aspects of encouragement and broader skill development [27].

These key requirements suggest that personalized mentoring from industry specialists and specialists who work for NGOs would be the most useful form of guidance for volunteers. The key challenge however, is that, while providing advice may be less taxing than completing the task itself, mentorship is still a significant time investment that experts may not be willing or able to provide [32, 22, 7].

To overcome these issues, we introduce MICRO-APPRENTICING, a system that facilitates the process of giving expert advice to novice volunteers by recruiting experts from social computing platforms to contribute task-specific "micro-advice" to volunteers in a flexible and transient way. MICRO-APPRENTICING has the following workflow, see Fig. 1: (1) Given a volunteer task, the system finds relevant experts to provide guidance; (2) MICRO-

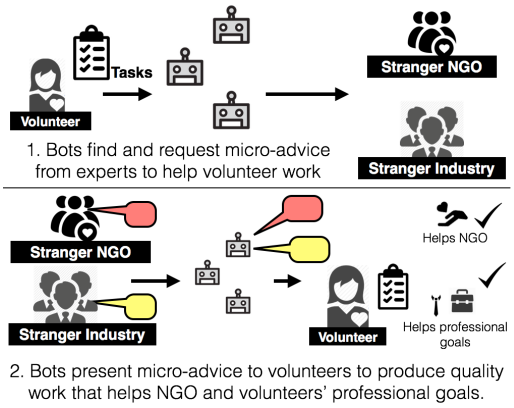

Figure 1. Micro-Apprenticing uses chatbots to find relevant experts who can provide micro-advice to volunteers whom they do not know (strangers). The goal is for this advice to guide the volunteers to produce quality work, where quality is measured in terms of being useful for the NGO and volunteers' careers.

APPRENTICING requests advice from these experts; (3) experts provide micro-advice that is presented to volunteers; (4) Volunteers conducts and submits the work. MICRO-APPRENTICING addresses the problem of expert availability and search/coordination costs by deploying chatbots onto successful social computing platforms. This approach, first, allows us to more easily access diverse pools of experts. This can help NGOs have more on-demand guidance for any type of work they may need completed. Second, it enables experts to not have to download any new tool, as they can easily help volunteers or an NGO via simple social media text messages. Additionally, as the bots bring to the experts the opportunity to provide advice and help an NGO, experts do not have to make an extra effort to find ways to help.

To validate MICRO-APPRENTICING we first conduct a **live deployment** to study the feasibility of using online bots for mobilizing strangers to provide micro-advice. Once we identify that Micro-Apprenticing is operable, we do a **field experiment** to compare MICRO-APPRENTICING with other types of guidance, such as tutorials. Our deployment showcases the viability of MICRO-APPRENTICING, and our field study demonstrates that requesting micro-advice from online strangers improves volunteer work.

This paper makes the following contributions:

- MICRO-APPRENTICING: A system to source micro-advising opportunities to online experts to guide quality volunteer work.
- An empirical study that validates the unique need for micro-advising over structured on-the-job training to improve volunteer work quality.

RELATED WORK

Micro-Apprenticing's system design is based on different areas: (1) Improving Crowd Work; (2) Skill Development for Crowd Work; (3) Eliciting Feedback from Online Strangers; and (4) Interfaces for Coordinating Volunteers.

1. Improving Crowd Work

Researchers have recently tackled the problem of designing work flows to ensure quality with scalable processes. Dow et al. [13] and Chan et al [5] showed how task-specific guidance helped workers to produce better results. Oleson et al. [40], proposed the use of "gold standards" to detect low quality work and give crowd workers feedback. Morris et al.[36], showed how workers produced higher quality via timely tips. Micro-Apprenticing builds on these ideas to think how we should design systems that now drive volunteer crowds to produce quality work. Volunteers can be different than crowd workers, as they are usually more heterogeneous and work pro-bono [44].

2. Skill Development for Crowd Workers

Another important problem that researchers have been tackling is the design of mechanisms through which crowd workers can learn new skills while they work. This is critical, as a great number of individuals use crowdsourcing platforms as their main form of income [17], but never have an opportunity to learn new skills through the experience or advance their career. Crowdsourcing tools like Atelier for Upwork [49] or LevelUp for Photoshop [12] designed different work flows to teach crowd workers programming skills and photo editing skills, respectively. Several of the design ideas from these crowdsourcing platforms have seen their way into volunteering efforts. For instance, 3D printing communities have been organically organizing themselves to help novices to appropriate the 3D printing technology and learn relevant related skills [31].

Note, however, that in contrast to Atelier and LevelUp, we consider a setup where experts volunteer their time (are not paid), and where they provide simply micro-advice instead of investing significant time in either completely doing the task themselves or providing full fledged mentoring. Given that NGOs have limited resources generally, it was especially important to have a setup where experts would participate without injecting an extra cost to the organization.

3. Eliciting Feedback from Online Strangers

There have been several investigations on the viability of systematically obtaining feedback and information from strangers online, and then using that information to benefit others [38]. Several human computation workflows have successfully drive strangers to share their knowledge and help others learn [54]. These studies have found that online strangers can indeed provide quality information [39], even when asked by online bots [43]. Researchers have also started investigating the type of feedback that is possible to manually obtain from different online sites, especially crowd markets, friends, and forums [58]. In online forums, strangers tend to give process feedback about a design, i.e., feedback on how to complete the work. We motivate the design of Micro-Apprenticing on some of the key findings of this previous research: 1) it is possible to drive online strangers to provide useful contributions [39], even when online bots invite them

to a cause [43]; 2) when asked for feedback, online strangers are likely to give procedural guidance [58]. Together, this leads us to hypothesize that we could actually encourage strangers to advise volunteers, and this advice would be useful for completing the work. We also incorporate into Micro-Apprenticing's design, notions that large classes of students in MOOCs can be used to provide other students with rapid feedback of their submissions to improve their work [29]. We believe that by similarly leveraging large crowds of online strangers, we can readily provide human guidance to volunteers to improve their performance.

4. Interfaces for Engaging Volunteers

NGOs are constrained by limited financial resources that affect long-term technology planning and access to technical expertise [21]. Resource limitations, low media literacy, and the lack of proper strategies to make use of technology [51, 42], prevent NGOs from using technology to effectively coordinate volunteers and produce quality services [53, 6, 33, 18, 4, 28, 10]. Recently, business-oriented social networking services, like LinkedIn[1], have also incorporated volunteering opportunities along the job listings they offer. However, such platforms follow an approach similar to traditional online volunteering interfaces. As a result, they offer volunteers no guidance as to how to complete the work. In our work we offer volunteers a way to connect and receive short guidance from experts to improve their work.

MICRO-APPRENTICING

To improve the quality of volunteer work, we propose to guide volunteers with micro-advice from experts. We present Micro-Apprenticing, an online system that uses social media chatbots to tap into the net of online experts and request they provide short rapid guidance to volunteers. Strangers on social media can give volunteers a note on what technology to checkout, or common pitfalls to avoid. While this advice is not extensive, we believe that human guidance can offer the necessary motivation and direction the volunteer needs to better succeed.

While there are many possible ways to contact experts, and request their participation in a cause, we focus our approach on contacting and guiding them to help on social media. We select social media because it facilitates identifying and contacting people with a certain profile [16]. For instance, detecting people with a particular specialization. We use online bots to find and directly ask strangers on social media to provide advice about a volunteer task given their expertise. In doing so, the expert helps a cause or NGO without having to download any new application or invest their time finding opportunities to help the community.

Micro-Apprenticing Components

Micro-Apprenticing is an online system that orchestrates experts to provide micro-advice to help volunteers' work. Micro-Apprenticing has two main interfaces (See Fig. 2):

NGO Interface. This interface is for NGOs to effectively source micro-volunteering opportunities to experts. Experts micro-volunteer advice to a volunteer's work. Figure 2.a presents an overview of this interface. NGOs first select the type of experts from which they would like to obtain advice (Fig.2.b). Micro-Apprenticing bots then go out and find such experts on social media and request they micro-advice the work of a particular volunteer (Fig. 2.c). NGOs can monitor the conversations between bots and experts (Fig. 2.c and 2.d) and also view metrics regarding the amount of micro-advice that experts have provided to more effectively orchestrate them.

Volunteer Interface. This interface focuses on sourcing tasks to volunteers. Figure 2.e presents an overview of this interface. Volunteers are first presented with a series of volunteer tasks they can do. Volunteers select their desired task (Figure 2.e) and are then presented with the latest advice experts have given to other volunteers working in a similar area (Figure 2.g). We consider this initial advice helps volunteers get a glimpse of the state of the art, and will be helpful as they start their designs. Volunteers can submit their work at whatever phase they want to get personalized feedback from experts (Figure 2.h)

Micro-Apprenticing: Bots to Trigger Expert Advising

The advantage of having experts participate in a collective effort, is that they can bring quality. The problem is that experts lack time. One of our objectives was to design a mechanism through which specialists could easily volunteer and help an NGO. We considered that experts would likely not be able to do complex and time-consuming volunteer tasks, such as "design a poster for the NGO's fundraiser". But experts would have time to do micro-tasks, such as "provide micro-advice to help a novice make a poster for the NGO." We considered that this type of human advice would be more useful to volunteers than simply following a structured and detailed tutorial.

We designed micro-volunteering opportunities for experts that simply aimed at obtaining some type of feedback or advice from them. Based on the literature that volunteering can be improved by offering NGOs and individual volunteers ways to grow [44], we aim for the advice from experts to also cover this duality. For this purpose, Micro-Apprenticing aimed to obtain advice from both industry and NGO experts. We also considered in our design process that experts are usually scarce, difficult to find, and would likely not have time to seek out volunteering opportunities themselves, i.e., they would not have time to figure out where they could help. To address this challenge, we bootstrap autonomous chatbots to already successful social computing systems to more easily find specialists and invite them to help an NGO by sharing advice. By bootstrapping on vibrant social computing systems, NGOs can more easily overcome the cold-start problem and expose a larger number of experts to their cause [16].

LinkedIn bots

We considered we could access a large network of experts by bootstrapping onto social media that had experts clearly embedded and labeled in them. We therefore decided to use Linkedin, a business-oriented social media platform that is mainly used for professional networking. The advantages of LinkedIn is that people state their current job positions

[1] `https://volunteer.linkedin.com/`

Figure 2. Micro-Apprenticing interface (a) NGOs dashboard: Integrates metrics and tools, (b) Bot Panel: Gathers experts on LinkedIn by crawlers and contacts them by chat bots , (c) Messages Panel: Shows last messages between bots and experts (d) Linkedin messages: Messages are synced between LinkedIn and the Dashboard, (e) Volunteers interface: Tasks platform, (f) Tasks area: Here volunteers look for tasks. (g) Advices area: Here volunteers receive the micro-advice from experts h) Submission area: here volunteers submit their work.

and education, which makes identifying specialists easier. However, the disadvantages of LinkedIn is that there is no public API to easily gather the data of people to more easily target experts. We therefore created our own crawler bots for Micro-Apprenticing to mine LinkedIn information. Our bots only need to receive keywords related to the experts, e.g., *"design"* or *"Peta"* to find people whose current job title has those keywords embedded. We consider these individuals are the experts we seek. Our crawler bots gather data of K persons whose job title includes a certain keyword (the NGO can specify K.) Once we have our list of potential experts who could advice others, we then release our LinkedIn chatbots to directly ask these individuals to provide advice to the work that a volunteer has conducted. The chatbots share directly in their message a screenshot of the volunteer's work to make it easier for experts to provide feedback. Given that LinkedIn also lacks a chatbot API we designed and coded our own chatbots. We anonymized and share our code in a public repository[2]. Micro-Apprenticing will take full advantage of when platforms and companies move forward to ease interactions with bots, as has occurred with Facebook, Microsoft, Twitter, and Slack [41, 8, 52]. Figure 2.c shows Micro-Apprenticing's interface for using bots to find experts, and request they advise volunteer work.

EVALUATION

This paper hypothesizes that volunteers will produce higher quality work if they receive short advice from experts. Our evaluation focuses on the two main components of this claim. First, is it even possible to get strangers on social media to provide expert advice to the work of volunteers? Second, does Micro-Apprenticing yield higher quality volunteer work than structured tutorials?

To respond these questions, we first conduct a **public deployment** of Micro-Apprenticing to investigate its real world viability. Second, we performed **field experiments** to measure the quality of volunteer work that is produced under Micro-Apprenticing and contrast it to other types of guidance (e.g., tutorials). Fig. 3 shows the steps of our evaluation.

[2] `https://github.com/anonymous0010/micro-apprenticing`

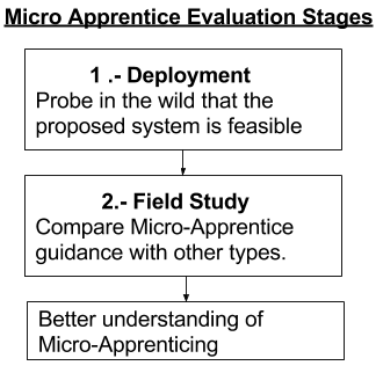

Figure 3. Micro Apprentice Evaluation Stages .

1. Micro-Apprenticing Deployment

To examine Micro-Apprenticing's viability in orchestrating strangers to provide advice to volunteers, we did a public deployment. We studied the number of experts that responded to bots, and qualitatively characterize the guidance they provided and compared with guidance encountered in tutorials.

General Deployment Method

We deployed Micro-Apprenticing in the wild and had 46 individuals sign up to be volunteers. Since we wanted to study how the real world guidance from strangers qualitatively compared to tutorials, half of the volunteers were guided with Micro-Apprenticing and the other half with tutorials. Each volunteer completed 2 design tasks from real world NGOs taken from `VolunteerMatch.org`. For our deployment, we gathered all the tasks that involved designer skills, e.g., designing posters, t-shirts, flyers, brochures or logos. Each task took around 30 minutes.

We released Micro-Apprenticing's LinkedIn bots to request guidance for these volunteers, from strangers who were either industry or NGO experts. We considered an industry expert was a person whose current LinkedIn job title included the word *"designer"*, and an NGO expert was a person who stated in their LinkedIn profile to work in either an *"non profit organization"* or *"non-governmental organization."*

Next, our bots tried to contact and request advice from these identified experts. However, to contact strangers on LinkedIn, the bot first needed to friend the individuals. Our bot sent out 300 friend requests to industry experts and 371 to NGO experts. Approximately two-thirds of these potential experts accepted these requests (59% of requests to professionals, and 69% to NGOs). To the set of individuals who accepted our bot's friend request, the bot then sent a message directly requesting for advice. The bot send 177 messages for industry experts and 256 for NGO experts. Of these, 26% received some type of reply by professionals and 18% for the case of NGO experts. Note that we have different number of requests to NGO and industry experts because our bot sends requests until it obtains enough responses to cover all the volunteers (46 NGO advisors and 46 industry advisors to cover 23 volunteers who submit 2 designs.) Experts on LinkedIn who responded typically did so within the first 24 hrs.

	Industry Experts	**NGO Experts**
Friend Requests Sent By Bot	300	371
Advice Requests Sent By Bot	177	256
Participating Expert Advisers	46	46

Table 1. Summary of the replies and interactions that Micro-Apprenticing bots received from experts during our deployment.

Our bots presented themselves as bots, and directly asked people whether they wanted to contribute micro-advice to volunteers doing particular design tasks. The bot from the start sent the person screenshots of the design work volunteers had produced, along with a description of the task. We opted to embed the image to the message to have less barriers for the expert. An example message was *"A volunteer made this poster for this NGO. Could you give to him some advices to improve his work? #Thanks"*. For professionals we also included information about the volunteer's professional goals and asked that they take that into account when providing the advice to personalize the tip. For the case of NGO experts, we provided information about the mission of the organization for which volunteers were working for. For both cases, we provided experts with information about the task itself. Figure 2 shows an example screenshot (with anonymous data of the interaction.)

General Deployment Results

Table 1 shows the number of replies and interactions that Micro-Apprenticing received from experts. Overall, the results highlight that by bootstrapping onto successful social computing platforms, such as LinkedIn, our system is capable of obtaining expert micro-advice for all volunteer work.

Deployment Method: Uncovering Guidance Styles

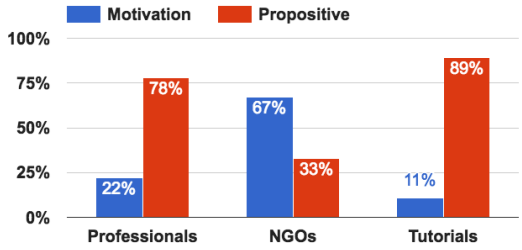

Figure 4. Results from our deployment showcasing the different styles of micro-guidance given by experts and tutorials. NGO experts are who gave the most motivation.

Our goal was also to understand the differences and similarities in the type of guidance given by our system and tutorials. We conduct qualitative content coding over all the written guidance to uncover the different type of guidance styles that are present. For this purpose, we first read each micro-advice that professionals and NGO experts provided, as well as each tutorial. Volunteers performing under the guidance of tutorials worked in particular with WikiHow[3] tutorials on how to design a poster, flyer, t-shirt, brochure and logo. After reading the different types of guidance, one of the authors then began to extract categories describing the advice. Another author then analyzed the emerging categories and helped to adjust them. At the end of this step we had identified the different guidance styles (categories) present in tutorials and Micro-Apprenticing. We also wanted to understand how much each guidance style was used in tutorials and in Micro-Apprenticing. We therefore aimed to categorize all micro-guidance (either a step in a tutorial or a response from an expert) into the different guidance styles we identified. For this purpose, we hired three college-educated individuals from Upwork to independently code all the micro-guidance of professionals, NGO experts, and tutorials into the categories we found. We first asked two coders to pick the "most relevant" category for each micro-advice. These individuals categorized 216 tips from professionals, 161 from NGO experts, and 86 tips from tutorials. For the tutorials, the coders agreed on 91.03% of the micro-advice (Cohens kappa: 0.77), for the professionals they agreed on 89.71% (Cohens kappa: 0.77) and finally for the NGO experts they agreed on 85.19% of the tips (Cohens kappa: 0.61). We then asked a third coder to label the tips upon which the first two coders had disagreed. We then used a "majority rule" approach to determine the category for those tips. At the end of this step we had how much NGOs, professionals and tutorials used each guidance style.

Deployment Results: Uncovering Guidance Styles

We found that professionals, NGO experts and tutorials had two main guidance styles.

Propositive Style Guidance. This guidance focused primarily on giving propositions, instructions, or suggestions to volunteers on how to complete the task. Figure 4 shows how much this, and other guidance styles, were used by NGOs, professionals and in tutorials. Professionals and tutorials primarily

[3] `http://www.wikihow.com`

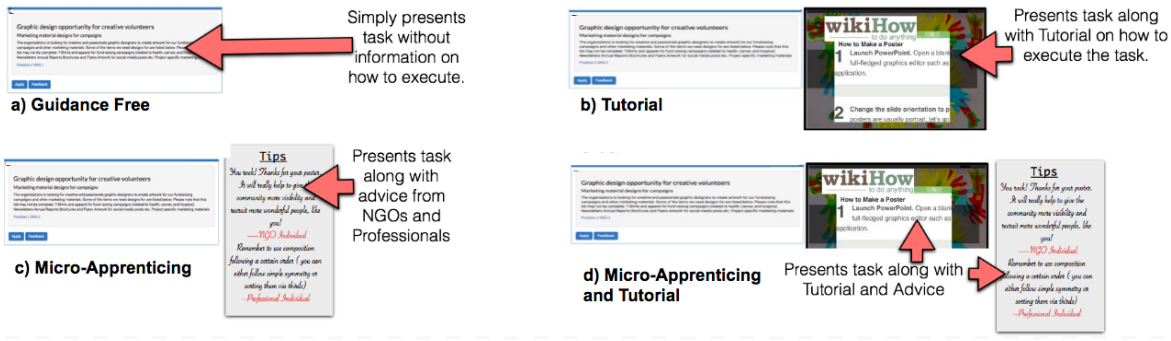

Figure 5. Overview of the different types of guidance mechanisms we studied in our field study.

provided propositive guidance. But NGOs, rarely gave volunteers direct propositions about their work.

What seemed to differentiate the Propositive guidance given by tutorials from the guidance provided by humans, is that tutorials had very specific instructions on what volunteers should do. For instance, they specified the type of software that should be used, where exactly the person should click. The word that most distinguished the advising of tutorials was *"microsoft"* and *"click"*. An example micro-guidance from tutorials: *"Make it BIG! The lettering in the headline should be bigger than any other lettering on the flyer [...] You'll want the headline spaced evenly across the entire width of the page. If it doesn't fit nicely, consider centering the text."*. Professionals, on the other hand, seemed to be not as specific. The words that professionals used the most were about general design topics, such as *"composition management"* or *"color palettes."* Professionals did not seem to tell volunteers exactly what they should do; but rather guided volunteers into new topics they should investigate. For instance, one professional suggested: *"Lookup "kerning tips." Also check-out composition literature to improve your design structure."* Professionals in general seemed to encourage volunteers to learn new topics on their own. They did not specify what tools to use, but rather hinted about important areas that could be useful for the person. This guidance from NGOs focused primarily on suggestions of how they could improve their work to have more impact in the community. For example, an NGO expert provided the following micro-advice: *"Nice design. I like that you added the link to the NGO's website. But you should also add their social media accounts, that helps get more members."*

Motivation Style Guidance. This guidance style is about providing phrases to stimulate desire or energy in people to continue producing volunteer work. It aims to motivate the volunteer. It was surprising that all guidance types had some motivation, even tutorials. For instance, we found that usually the initial steps of a tutorial and the last ones tried to motivate the individual to do the task. For instance, the following micro-guidance was given to people to encourage they start designing their own t-shirts: *"Designing your own t-shirt can be a fun, creative activity, and may even bring you some money if you decide to sell your designs."* However, as we see in Fig. 4, tutorials focused mainly on giving propositions on how the work should be completed. NGO experts were the only ones who provided more motivation than propositions. One of the most used words by NGOs is the term "world," emphasizing how the work of volunteers was having large scale impact. An example of advice granted by NGOs: *"Awesome. Thanks for the great work! I can tell you put a lot of effort into this. I think your poster will be super useful to get us a lot of new folks. If everyone in the world were like you, things would be very different. Thank you for making the change!"* The motivation guidance from professionals seemed to focus more on encouraging people to not give up and continue practicing their skills: *"I really like what you did with the typography [...] You are headed towards the right path."*

2. Micro-Apprenticing Field Study

Once we observed through our deployment that Micro-Apprenticing in the wild was feasible, we investigated just how effective this type of guidance was in comparison to others, e.g., tutorials. This helps us to better measure the success of Micro-Apprenticing, and also further understand its strengths and limitations. For this purpose, we conduct field experiments and study how useful Micro-Apprenticing is in helping volunteers produce quality work.

Field Study Method

To study the effectiveness of Micro-Apprenticing to produce quality volunteer work, we conducted a between-subjects study where we exposed different groups of volunteers to different guidance types. We studied the quality of work that volunteers produced under each guidance type. To study quality we use a similar approach to that proposed by previous work [39, 59], where survey questions around usefulness were used to measure the quality of a response that strangers gave on social media. In our case, and using also social theory on quality volunteer work [46], we consider that quality volunteer work is work that is useful for an NGO (that the NGO could actually use), and that is potentially useful for the volunteer's professional career. For this purpose, we asked volunteers, people working in NGOs and industry to rate how much the work that a volunteer produced under a particular type of guidance helped an NGO and the volunteer's professional career, given the goals of each. We build different interfaces that adopted popular crowd and volunteer

guidance methods [13, 36, 12] to compare the effectiveness of their approach with Micro-Apprenticing. Fig. 5 showcases the different guidance we considered and our original Micro-Apprenticing guidance. In the following we present more details about each guidance.

Guidance-Free. This guidance simply presents tasks to complete, without providing volunteers with any information or tips about how the tasks should be done (i.e., there is no guidance). Most online volunteering platforms follow this approach, as well as Amazon Mechanical Turk, a popular crowdsourcing platform for dispatching micro-tasks to crowd workers. Figure 5.a presents our guidance free interface that simply presents relevant volunteer tasks to do.

Tutorial. This guidance uses tutorials to shepherd volunteers. We base our design on previous crowdsourcing research and real world volunteering that via tutorials lead crowds to produce quality labor [12]. This type of guidance, has become a common crowdsourcing approach to ensure quality crowd work [12, 40]. Figure 5.b shows this interface and how it presents volunteer tasks along with a relevant tutorial to do the work.

Micro-Apprenticing. Our proposed guidance system that we described previously.

Tutorial with Micro-Apprenticing. This guidance explores mixing tutorials with Micro-Apprenticing. Several researchers have speculated that in the future some of the most effective ways to orchestrate work will be by mixing different types of guidance [34, 26]. Inspired by these ideas, this interface intermixes tutorials with advice from professionals and NGO experts (see Figure 5.d).

Field Study: Participants. Using university mailing lists, social media, and word of mouth we recruited volunteers for our field study, and people from industry and NGOs who could rate the work that volunteers produced. Through this process we recruited 100 volunteers, 20 raters from industry, and 20 for NGO raters.

We first administrated to volunteers a pre-survey to better control for volunteers' work quality and avoid introducing bias from skills that participants might have acquired previously. We balanced all conditions with participants who had similar skills and professional goals. Note that for our field study, all participants had professional goals related to graphic design. In our pre-survey to volunteers we also asked them about their previous volunteering experiences. However, we decided to not constrain the type of volunteering experiences to which they had been exposed as NGOs usually operate with heterogeneous workforces. All volunteers we recruited had not received any formal training in design, but were considering a career in the area. All of the people we recruited to be raters of the volunteer work, self-identified as either experienced professionals or experienced NGO leader and had over 3 years in their field. All raters from industry worked in areas related to graphic design. NGO raters worked in different NGOs but they all had in their organization design related tasks, and they understood what type of designer work might be useful for an NGO. NGO and industry raters were asked to grade the work of volunteers. Industry raters in a 1-5 Likert scale rated how much the work of the volunteer might help the person's professional design career; and NGO experts similarly rated how much the work could help an NGO.

Volunteers and industry and NGO raters were randomly assigned into one of the four conditions. Each condition had 25 volunteers, 5 raters from industry and 5 raters from NGOs. Each industry or NGO rater only evaluated the work of 5 volunteers. Rating a total of 10 designs each. Volunteers were each sourced the same 2 design volunteer tasks. Specifically, 1) design a poster for an NGO; and 2) design a t-shirt for an NGO. These two design tasks were drawn and randomly picked from real tasks on volunteering platforms (they were especially taken from `volunteermatch.org`). Each task that was given to volunteers takes approximately 30 minutes to complete. But volunteers were given the opportunity to finish all tasks over the course of three days if needed (similar to the timeline given by NGOs). Volunteers on Micro-Apprenticing interface were all presented the same most recent advice from NGO and industry expert. This advice was taken from the latest advice experts provided in the deployment. Volunteers on Micro-Apprenticing could also submit their design as frequently as they wanted to obtain micro-advice. All volunteers in this condition only submitted their work once to obtain feedback. Volunteers submitted each of their designs on the platform as they finished. After they finished a task, volunteers completed a questioner about their perceptions on how much they felt their work was useful for the NGO, and how much they felt it helped their professional portfolio. Participants completed questions on a 5 point Likert scale. In parallel, we had the NGO and industry raters evaluate the work volunteers produced for each task. All NGO and industry raters were unaware of the interface that volunteers had used, and were only exposed to the work that volunteers produced under one particular condition.

Field Study: Results

All volunteers were able to finish and submit their two tasks. Volunteers took a median time of 48 hours to submit their final designs. We did not see differences in the amount of time it took volunteers to submit their work. Figure 6, and tables 2 and 3 present the median scores that volunteers, NGO, and industry raters in each condition gave to: (a) how much they felt the volunteer work helped the NGO; (b) how much they felt a particular task helped volunteers for their professional goals. Volunteers responded both questions based on their own perceptions; NGO raters responded only about: (a) on how much the work might help the NGO; and industry raters only responded about (b) on volunteers' career goals. To provide adequate ratings, NGO raters and volunteers were given the goals of each NGO. Similarly, professionals were presented with the career goals of each volunteer they evaluated. Everyone also provided written feedback to each of their ratings.

We observe that Micro-Apprenticing's interface was the one most highly rated by NGO raters. This interface was the only one that prompted NGO raters to give the work of volunteers the highest score (a rating of 5). A non-parametric ANOVA

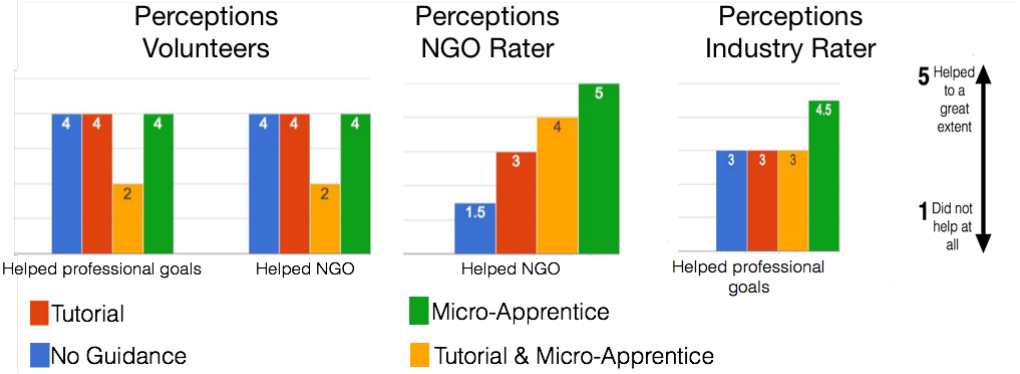

Figure 6. Results from our field study on Perceptions of Volunteers, NGOs, and Professionals on the volunteer work and how much it helped an NGO and the volunteer's professional goals. Overall Micro-Apprenticing's interface was the one that aided volunteers the most to produce work that served NGOs and volunteers' professional goals.

	No Guidance Median	**Micro-Appr.** Median	**Tutorial** Median	**Tutorial with Micro-Appr.** Median	**p-value**
Volunteers	3.35	3.80	3.63	3.05	0.1106
NGO experts	2.54	4.40	2.92	3.51	5.3E-8

Table 2. Results from our field study on people's perception of the usefulness that the volunteer work had on the NGO for different guidance interfaces. Overall, across guidance types, volunteers did not perceive a significant difference, but NGO experts did see a difference ($p < .05$). The interface that produced the most useful work for them was Micro-Apprenticing's interface.

	No Guidance Median	**Micro-Appr.** Median	**Tutorial** Median	**Tutorial with Micro-Appr.** Median	**p-value**
Volunteers	3.61	3.65	3.22	2.80	0.0254
Professionals	2.56	4.40	3.18	2.95	0.0004

Table 3. Results from our field study on people's perception of the usefulness that the volunteer work had on the volunteer's professional goals given a certain guidance interface.

test (The Kruskal Wallis test by ranks) over the ratings given by NGO raters was significant. This indicates that in the case of NGOs, the median rating that they gave to at least one type of guidance is significantly different than the median ratings given to other guidance interfaces ($P < .05$, Table 2). We then did a series of non-parametric pairwise comparisons to identify where these differences lay. In particular, we used a Mann-Whitney U Test with bonferroni correction. For all those tests we found that Micro-Apprenticing had significantly higher ratings ($P < .0083$) than each of the other guidance interfaces. Note that we decided to use the non-parametric ANOVA test because this method helps determine if there are any statistically significant differences between groups of an independent variable over an ordinal dependent variable, and this is our case. We have a group of independent variables (the different guidance interfaces) on an ordinal dependent variable (the ratings from NGOs are non-numeric concepts on how useful the volunteer work is for an NGO).

Professionals also rated Micro-Apprenticing the highest. They considered that this guidance was the most effective for driving volunteers to produce work that helped their career goals. A non-parametric ANOVA test presented that the median ratings that professionals gave out was significant ($P < .05$, Table 3). We also conducted a series of non-parametric pairwise comparisons to identify where these differences lay. For all those tests we again found that Micro-Apprenticing had significantly higher ratings ($P < .0083$) than each of the other interfaces. This indicates that the guidance which industry raters believed was the most effective was the Micro-Apprenticing.

A non-parametric ANOVA test showed that there was no significant difference on how much volunteers felt that their work helped an NGO ($P > .05$, Table 2). However, another non-parametric ANOVA test showed that there was a significant difference on the median ratings that volunteers gave to how much a certain guidance interface helped their professional goals ($P < .05$, Table 3). We then conducted a series of non-parametric pairwise comparisons to identify where these differences lay. Surprisingly, volunteers had preferences that differed from those of NGO and professional experts, especially in terms of what guidance interface they preferred. For volunteers the interface they rated the highest was the no guidance one. However, we only observed a significant difference in the ratings that volunteers gave between interfaces that lacked guidance and interfaces that had excessive guidance, especially the interface that combined Micro-Apprenticing and tutorials ($P < .0083$).

This study demonstrated that the guidance that best compromised all three groups was the Micro-Apprenticing, as it was the highest rated by NGO and industry experts, and volunteers did not have a major preference for a particular type of advising. Micro-advising from expert strangers will allow volunteers to produce quality work that is useful for NGOs and also for their individual selves.

Limitations

The insights from this work are limited by the methodology and population we studied. While our deployment allowed

us to start to understand how experts would respond to bots asking them to guide strangers, we cannot extrapolate to how experts would respond if this approach gained popularity and was widely used. In such case, it might be relevant for these approaches to consider not pinging experts so frequently to avoid being ignored or labeled as spam.

Additionally, while we recruited real world experts and all tasks were taken from real world NGOs, our results might not yet generalize to populations at large. Further analysis is needed to understand how systems that leverage expert strangers play out in advising that involves different types of tasks and also individuals with different backgrounds and expertise. Experiments that compare the type of guidance that experts generate for different tasks and different specialization areas would help quantify the effectiveness of using online bots and expert strangers to guide volunteer work more broadly. Future experiments that control for the social media platform or online ecosystem could be conducted to further understand what type of platform might facilitate accessing expert knowledge for on-demand guidance. Similar to [39, 43], the goal of this paper was to shed light on the type of guidance that helps volunteers to produce useful work in a short period of time to get more immediate usable results. Future work could conduct longitudinal studies and engage in in-depth interviews with volunteers.

DISCUSSION

Our two step evaluation let us to identify that: (1) Micro-Apprenticing is possible (deployment study); and (2) Micro-Apprenticing is better for guiding volunteers than traditional methods (field study).

The main insight from **our deployment** is that experts are willing to provide micro-guidance to a person whom they do not know (a stranger). We were able to systematically use our online bots to obtain expert guidance for all volunteers in our deployment. We also observed that the micro-guidance that emerges in the wild from experts is different than the guidance from tutorials. Tutorials were much more specific about what the volunteer should do, especially what software to use and what actions to take. Experts, on the other hand, shed more light of the general areas the person should consider and learn about. Expert guidance, surprisingly, appeared to give the volunteer more freedom about how to do a task (no need to use a specific tool), and rather focused on guiding volunteers to pickup specific concepts. Additionally, human guidance seemed more focused in motivating the volunteer. The motivational guidance from NGO experts seemed especially tailored to retain volunteers, while professionals focused on motivating volunteers to continue improving their skills. Given that previous research in education [11] has also shown that motivational guidance is an effective technique to improve the performance of learners, for future work we will explore how to systematically best leverage different styles of motivation to help volunteers improve their skills and participate in community work long term.

The main insight from **our field study** is that Micro-Apprenticing is more effective than tutorials in helping volunteers to produce quality work. This finding is in line with research in education [37, 11, 9] that has identified that students prefer face-to face classes than online tutorials. Face-to-face facilitates more spontaneous responses, communication and interaction. Micro-Apprenticing is likely also more effective than tutorials because it provides more instant responses than tutorials, which are usually static without easy exchanges. Notice however, that unlike face-to face, Micro-Apprenticing does have some delays in its interactions. Not all experts responded immediately to the bots' requests for guidance. Similar to [29], in future work we will explore the time windows that are best suited for volunteers to receive guidance from experts. For future work we will also explore providing volunteers with guidance from peers. This might lead to more timely feedback as a larger mass of peers might be more readily available. Such approach is also promising considering that research in education [48], has found that guidance from experts and peers can be similar.

Through our **field study** we also observed that volunteers in general preferred options that had less guidance embedded in them. This finding contrasts with the behavior of regular learners [9], i.e., people focused primarily on learning new skills and who are not neccesarily volunteering for the community. Learners, typically, do not have any strong preferences for one particular type of guidance [1]. However, in the case of volunteering we might have observed differences because volunteers are working without payment and consequently prefer to work on their own terms [19].

It is difficult to design systems that give volunteers the liberty they want, while also ensuring quality. Through its micro-guidance from strangers, Micro-Apprenticing covers the unique needs of volunteers to ensure quality work that benefits all parties involved. Micro-Apprenticing's design also promotes volunteers' intrinsic desire to grow/learn/explore vs. their desire to simply do a good job on the task. In our deployment we observed that experts covered more concepts that volunteers should investigate, but did not seem to force volunteers to follow a methodology. Micro-Apprenticing seems to provide the best room for exploration and guidance to ensure quality work and still provide comfort to volunteers.

In our vision of Micro-Apprenticing, experts are given a platform where in short bursts of time they can share their knowledge to guide large crowds to complete complex tasks. We believe that it may be possible to lead experts to provide useful micro-advice beyond our deployment: opportunities include obtaining on-demand advise for emergency response, accessibility, scientific discovery, citizen science, and micro-advising in a variety of areas. However, perhaps more complex advising might not be possible to resolve in one text message. We believe that it may be feasible to break advising of more complex tasks into smaller chunks that could be completed serially by experts. This would enable experts to provide guidance for more difficult and long tasks through multiple short quick messages.

In Micro-Apprenticing's design, the motivation of novice volunteers to use the platform is clear: they gain real world professional opportunities and help the NGO from Micro-Apprenticing. The incentives from expert strangers are not

as clear. Are mentors motivated in providing micro-advice that impact an NGO or is their motivation in helping individual volunteers to advance their professional careers? Moving forward, we would like to explore the best way to motivate the continuous micro-participation of experts. This is especially important as having a large network of reliable experts can facilitate the completion of complex tasks. We believe there are important design opportunities in thinking how to best present the progress and impact that a stranger is having in the life of a volunteer and in an NGO, while still keeping the volunteers' privacy as well as the privacy of the organization. We believe that a key aspect for long term participation of experts is showing them the impact of their advising and also matching them with micro-advising opportunities that cover their intrinsic motivation. We also believe that an interesting future research area is to study perhaps how tutorials could better leverage information from experts [56], perhaps via sequential updates to content. This may allow groups to improve over time (e.g., regarding materials expert produce). Micro-Apprenticing also facilitates applications with expert contributors distributed across the globe [35]. Such applications could especially empower developing countries or countries with refugees where many of their experts leave their home state. Such experts could then be granted a platform to more easily contribute and help in their country's growth. Micro-Apprenticing not only facilitates participation from distributed expert workforces, its design is tailored for dynamic and transient strangers, who the system does not need to know anything about previously. This can help power a variety of crowd powered applications. For instance, systems like VizWiz [3] that leverage crowd workers to provide responses to visual questions, could leverage approaches like Micro-Apprenticing to have a constant flow of experts who can contribute and help the visually impaired in specialized areas. This approach might be more cost effective than using crowd workers. Additionally, the volunteers could be picked by their specialization to allow blind users to formulate more complex questions.

CONCLUSIONS

We introduced Micro-Apprenticing, a system that uses online bots to orchestrate experts to provide micro-guidance to volunteers. This micro-guidance helps volunteers to produce quality work. Micro-Apprenticing covers some of the unique traits of volunteering to offer a solution that gives volunteers the freedom and openesses they might crave, while still ensuring that their work is usable for NGOs. An online deployment of Micro-Apprenticing showed that online experts are willing and do help guide volunteers whom they do not know (strangers). Field experiments provided evidence that Micro-Apprenticing's human advising lead volunteers to produce higher quality work from both the standards of NGOs and the industry.

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