Tech Help Desk: Support for Local Entrepreneurs Addressing the Long Tail Computing Challenges

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Even entrepreneurs whose businesses are not technological (e.g., handmade goods) need to be able to use a wide range of computing technologies in order to achieve their business goals. In this paper, we follow a participatory action research approach and collaborate with various stakeholders at an entrepreneurial co-working space to design "Tech Help Desk", an on-going technical service for entrepreneurs. Our model for technical assistance is strategic, in that it is designed to fit the context of local entrepreneurs, and responsive, in that it prioritizes emergent needs. From our engagements with 19 entrepreneurs and neighboring support personnel, we reflect on the challenges with existing technology support for non-technological entrepreneurs. Our work highlights the importance of ensuring technological services can adapt based on entrepreneurial constraints and maintain broad technical support for entrepreneurs' ever-evolving computing challenges.

Additional Key Words and Phrases: entrepreneurs,

1 INTRODUCTION

Starting a local business can lead to individual and community benefits, including building long-term wealth, creating desirable nearby jobs, and addressing local needs [26, 59]. Today's local entrepreneurs must navigate an increasing array of technological tools to achieve their business goals (*e.g.*, creating a polished website, syncing files with an assistant, scanning receipts to track expenses) [9, 32, 39, 49]. Increasing technology requirements create particularly strong barriers for entrepreneurs in minoritized and resource-constrained communities [65] due to historical inequalities in financial, social, and more recently digital resources (*i.e.*, the "digital divide" [63]). The COVID-19 pandemic accelerated technology expectations for local business owners [19, 57], magnifying the effects of existing technology barriers [12].

While decades of research and design efforts aimed to make the technology used by entrepreneurs less expensive and easier to use (*e.g.*, WSYWIG website builders, social media, and desktop printing), technology barriers remain persistent

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for people in resource-constrained or "lean economies"[1] [9, 39, 62]. Recent work has explored technology support for workers from lean economies such as digital literacy classes for returning citizens seeking jobs [62], and social supports including workshops and meetings for entrepreneurs creating tours [39]. Such programs provided support for people with similar businesses or technical experience, but they may be less useful for busy local entrepreneurs who have heterogeneous businesses and technology goals.

To understand and address the computing challenges faced by local entrepreneurs in a lean economy, we followed a Participatory Action Research [11] approach to design and run "Tech Help Desk", an on-going service[2] that provides technology help to local entrepreneurs. Tech Help Desk was co-designed with community stakeholders from Community Forge: a local entrepreneurial hub that provides resources for local entrepreneurs in a small Midwest city in the U.S., *Wilkinsburg, P.A.* , including co-working space, accelerator programs, and community events. Tech Help Desk's *strategic* and *responsive* approach to technological support in the workplace uniquely provides need-driven technology support for immediate entrepreneur requests (*e.g.*, uploading PDFs for business registration, or connecting to a printer or scanner for taxes). By extension, Tech Help Desk addresses a critical gap in the existing ecology–an ever-evolving collection of resources [76]–of local entrepreneurial support. During the design, deployment and study of Tech Help Desk, we asked the following research questions: *(RQ1)* what are the technology challenges faced by local entrepreneurs?, *(RQ2)* what are the existing resources and workarounds that local entrepreneurs use to overcome their technology challenges?, and *(RQ3)* what are features of technology support that may be more effective than common workplace approaches for technology support?

Our engagements with 19 local entrepreneurs and support staff revealed how local entrepreneurs were strategically and responsively addressing their computing challenges by curating an ecology of support: building networks of trustworthy friends and mentors, seeking out business coaches, enrolling in business accelerators and courses. Still, the deployment of Tech Help Desk revealed a long-tail of day-to-day computing challenges that entrepreneurs were not yet able to address, due to a mismatch between support and entrepreneurs' technology challenges. For instance, a single local entrepreneur used Tech Help Desk services to address a range of technology challenges including: freeing storage space, editing a PDF document, posting to a listserv, navigating local files, learning keyboard shortcuts, removing malware, setting up cloud services, accessing necessary hardware, automating social media posts, and updating products on a website. In total, we worked with entrepreneurs to address 56 unique computing challenges across, on average, 35 distinct computing tools per entrepreneur. Tech Help Desk's strategic and responsive approach was critical to match the local entrepreneurs' resourceful and discerning approaches to growing their business in a digitized landscape.

This paper makes the following practical and conceptual contributions. First, drawing on our participatory approach, we present a model of technical support that is strategic in how it is attuned to local entrepreneurial contexts, and responsive in how it dynamically prioritizes emergent needs. Our work demonstrated that strategic support in the form of flexible and personalized one-on-one sessions was critical to matching entrepreneurs' learning goals with the demands of running a small business, where we recognized the wealth of resourcefulness they already possessed. Second, we offer a detailed case of this model through Tech Help Desk, illustrating how this strategic and responsive form of support can help address the many day-to-day computing challenges entrepreneurs need to resourcefully overcome (i.e., the long tail of computing challenges). Third, towards practicality, this paper also contributes a deep investigation of other entrepreneurial support approaches and programs within the region, and how the Tech Help

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[1]For the remainder of the paper, we use "lean economies" as the preferred term which highlights the resiliency and innovation of residents located in communities with few resources as done in prior work [27].
[2]Tech Help Desk is an on-going project, but this paper reports on two and a half years of progress.

Model of Strategic and Responsive Support	Tech Help Desk	
Concern	Choice	Instantiation
Should we provide responsive or standardized support?	Responsive	Individual support and schedulable appointments
Should we prioritize learning or time-saving?	Learning	Side-by-side format
Should we build trust between providers and recipients, or is trust built-in?	Build trust	Relationship building with consistent providers & times
Should we prioritize technical authority or knowledgeable collaborator?	Knowledge collaborator	Knowledgeable, but discloses bounds of expertise
Should we provide one-off or on-going assistance?	On-going	Drop-in, but encouraged follow-ups
Should we prioritize discoverability or privacy?	Discoverability	In-person (when possible), in common area

Table 1. A model for technology support that can be strategically tuned to local contexts and is responsive to the needs of local entrepreneurs (Concerns). In our implementation of this model, our participatory approach informed our priorities (Choice) and how Tech Help Desk embodied these priorities (Instantiation) within Community Forge.

Desk model fits alongside. Together, we present a detailed illustration of how resourceful and discerning entrepreneurs often stitch together multiple programs, social networks, and other resources to address their day-to-day technical needs (i.e., their ecology of support). This will inform researchers' understanding of computing challenges and help to create responsive technical support within an already existing ecosystem for entrepreneurs.

2 RELATED WORK

Our work in technology support for local entrepreneurs interacts with three main areas of research: resources for entrepreneurship, computing pedagogy (e.g., one-on-one instruction), technology support in the workplace.

2.1 Resources for Entrepreneurship

Entrepreneurship research suggests that a business is more likely to be successful if the entrepreneur possesses individual skills and characteristics relevant to starting their business (i.e. "human capital") [53], and social support for networking, information gathering and emotional needs (i.e."social capital") [18, 52]. Human capital for entrepreneurship includes a broad range of knowledge [47] gained through work experience, education, and entrepreneurial experience [53] as well as personal and psychological factors such as self-efficacy, social skills, health and motivation [27]. Social capital relevant to entrepreneurship includes personal networks and formal or informal groups to which the entrepreneur has access (e.g., government, bank, or community-driven organizations, and inter-community or extra-community ties [20]). For people in lean economies, access to both social and human capital (as well as financial capital) can be limited [9, 20]. In such communities, many turn to entrepreneurship out of necessity to make a living, i.e. "necessity-driven entrepreneurship" [40] rather than "opportunity-driven entrepreneurship" [75] — the difference being whether or not people can opt in to entrepreneurship. Access to general resources for entrepreneurs remains a challenge for "low-wealth" entrepreneurs [20]. To better support entrepreneurs pursuing necessity-driven entrepreneurship, there exist calls for flexible funding opportunities [56], entrepreneurship education [58, 61], and incubator opportunities to facilitate social capital growth [41]. In this paper, we explored how to build human and social capital for entrepreneurs overcoming barriers, specifically technology barriers, in a community with a lean economy.

2.2 Entrepreneurial Skill Building for Using Technology

Research suggests that digital literacy is a form of human capital that is unequally distributed [65]. Digital literacy — or, "the ability to use information and communication technologies to find, evaluate, create, and communicate information" [8] — requires not only low-level skills for operating a specific technology (i.e."operational", or "medium-related" skills [6, 71]), but also higher-level skills that relate to the selection and strategic application of technology to reach a goal (i.e. "content-related" skills [71]). Prior work aimed to understand the types of technology challenges faced by entrepreneurs in lean economies using technology for business goals [27, 39, 40, 62–64].

In particular, scholars engaged in participatory action research [11] explored non-technical approaches to facilitating digital engagement which rely heavily on structures of social support such as peer learning [62, 63]. Peer support approaches are particularly beneficial as, by definition, peers have shared experiences which can to provide more contextually-relevant information [37]. Ogbonnaya-Ogburu et al. established a digital literacy class for returning citizens seeking jobs [62], and Pei and Crooks established a class for introducing tablets into an English as a Second Language (ESL) class [63]. In the context of entrepreneurship, Hui et al. introduced social supports (*e.g.*, in person meetings, paper prototyping, tour practice) for entrepreneurs developing tour businesses [39]. To showcase pride in one's local community, Dillahunt et al. facilitated opportunities for entrepreneurs to grow local tour businesses (*e.g.*, by setting the platforms and technical requirements for the tours) [27]. This work uncovers highly-detailed accounts of the technical barriers specific to certain domains such as tour businesses. However, classes and group activities may work better when business goals are homogeneous rather than diverse as these standardized formats of assistance leave less room for customization [42]. To address and adapt to the needs of entrepreneurs who run heterogeneous businesses at differing levels of maturity, we design a model for strategic and responsive social support for resourceful and discerning entrepreneurs navigating help.

2.3 Technology Support in the Workplace

While support structures for local entrepreneurs is an emergent field of study, a range of approaches have been explored to assist employees in overcoming their technical woes including both formal (Help Desks, IT Consultants) and informal methods (over the shoulder learning or water cooler troubleshooting among peers). For instance, Novick et al. conducted interviews and participant observation among knowledge workers to understand how employees resolve their technical issues [60]. They found half of the time people asked colleagues and the other half of the time people went to their organization's in-house help desk. At a help desk, there are full-time employees dedicated to resolving their organization's technical woes, but formal help desk providers have the pressure to maintain an unwavering sense of technical expertise (*e.g.*, to inspire confidence with prepared answers [33], and achieve performance goals [15]). However, such help desks foster reliance rather than resilience to future computing challenges (a critical skill when resources are ever-changing), and their focus on repeated problems may not fit entrepreneurs diverse technology needs.

Several scholars have investigated the benefits and drawbacks of peer learning when addressing computing challenges in the workplace such as among teachers [72] and knowledge workers [70]. Twidale focused specifically on informal learning between colleagues–water cooler exchanges [73]–among knowledge workers who are struggling to resolve their technical issues [70] and found that peers provided a helpful organizational context when addressing their colleague's technical issues. When offering technical support, employees assume either "guru" roles due to their use of technical knowledge to solve colleague's issues [31], or "gardener"/"translator" roles due to their use of collaborative guidance to overcome colleagues' issues [51]. However, the setting of the formal workplace differs significantly from our setting of a co-working space for entrepreneurs. First, entrepreneurs do not work for a shared organization, meaning they do not necessarily have built in colleagues, standard expected working times, or a shared organizational goal. Thus, it may be challenging to form a network of peers and busy entrepreneurs may not have as many built-in incentives to provide on-going technical support to one another. In addition, asking peers for help can have potential reputational costs when admitting a lack of knowledge [46]. Entrepreneurs may be more at risk when asking for help due to a tight coupling between themselves and their business brand, and competition or intellectual property concerns [45]. We explore an approach to providing entrepreneurs with technical assistance that does not rely on peers by default.

2.4 One-to-One Instruction and Technology Support

Beyond the workplace, one-to-one instruction is one of the most effective approaches to education [16]. In formal educational settings, learning is *curriculum-driven* such that all learners first receive the class curriculum that covers necessary knowledge, then learners are provided increasingly targeted support for learning that curriculum through group or one-to-one instruction [10, 24, 28, 38]. Unlike reading and math, technology skills (*e.g.*, typing, spreadsheets, document processing) are not part of standard U.S. curriculum, so students are unlikely to receive one-to-one support.

Instead, people often learn technology for their personal goals in-situ while working on a task, rather than through any set curriculum. To support learning expert software or how to code, prior work has explored ways to remotely connect people to experts or peers with relevant technical knowledge [7, 22, 23, 43]. Joshi et al. connect users of specialized help with another person who uses the software for three minute one-to-one help sessions [43] and Codementor matches students to long term mentors for feedback on writing code [7]. The side-by-side approach of a person screen-sharing while another person serves as a side-kick (rather than the expert fixing the problem directly), can benefit learning and the work itself [13, 34]. Alternatively, tool-specific support forums (*e.g.*, Photoshop Guru, reddit.com/r/photoshop, Adobe Support Community) offer Q&A-based asynchronous peer support. As formulating a query [29] or supplying relevant information [67] is challenging without domain knowledge, some tools propose to help surface general-purpose answers to Q&A in-context of tool use [23, 55]. These tools provide powerful guidance for technology use, yet require downloading a browser extension [23] or setting up additional software [55]. In lean economies where access to technology and technology literacy may be limited, recent work highlights the importance to consider non-technological solutions to facilitate technology use (rather than addressing technology challenges with more technology) [39]. For instance, library staff members can provide in-person one-to-one support for people performing tasks on library computers including seeking jobs or accessing government services [14, 68], and in research Hui et al. provide in-person ("low-tech") technology support for entrepreneurs creating tour businesses [39].

Overall, the broad and goal-oriented technical needs of local entrepreneurs (*e.g.*, "launch a website myself", "keep track of my customers") fall outside of the scope of the purpose, expertise, and time that existing structured services provide — either due to their focus on a specific technology tool or specific goals. Our deployment of Tech Help Desk provides: (1) evidence of the long tail of technology challenges that are not yet addressed by technology-based or social supports, and (2) reflections on how to tailor one-on-one support to meet the business needs of resourceful and discerning entrepreneurs in lean economies.

3 METHODS

Informed by the needs of a local hub for entrepreneurship, we hosted a two and a half year long (and on-going) service providing broad one-on-one help for local entrepreneurs, called "Tech Help Desk". The findings we report are based on the design of and observations during Tech Help Desk sessions along with interviews with local entrepreneurs and others who provide services for local entrepreneurs.

3.1 Location and Site

We conducted our research within a co-working space and community hub for local entrepreneurs based in *Wilkinsburg, P.A.* called Community Forge (Figure 1).

Wilkinsburg, P.A. *Wilkinsburg, P.A.* is a borough of *Allegheny County, P.A.* . The population of *Wilkinsburg, P.A.* is roughly 68% Black and has about 35% of people living at or below the poverty line [1]. *Wilkinsburg, P.A.* immediately borders but is not part of *Pittsburgh, P.A.* , and it is one of the many unincorporated municipalities that acutely struggle with resource deprivation and long-term disinvestment [3]. In 2021, *Pittsburgh, P.A.* was considered to be one of the U.S.'s "Apartheid Cities" [2], as the structures of power within the city continue to perpetuate systemic racial inequality and injustice [54], magnified by the post-industrial blight the region experiences.

Community Forge Community Forge is a former elementary school re-purposed into a space that hosts mixed programming geared towards developing a more equitable economy for *Wilkinsburg, P.A.* and the Greater *Pittsburgh, P.A.* region (Figure 1). Towards this goal, Community Forge provides financial resources, jobs, job training, business development, youth empowerment programs (e.g., courses, summer camps, hands-on-learning), and community outreach events (e.g., food and supply giveaways, music and movie nights, hosts a voting location). Community Forge's business development resources include: coaching and professional service referrals, technical assistance, networking opportunities, financial support, and affordable office rentals (re-purposed classrooms with co-working and individual office space, Figure 1B). Community Forge works with roughly 50 local businesses each year through a variety of programs where 95% of the businesses are Black-owned, approximately 90% of entrepreneurs do not have a college degree, and 80% are first-time entrepreneurs. To spread information about resources available within the space, Community Forge relies on word-of-mouth and social media, as well as working with existing organizations in *Wilkinsburg, P.A.* and *Pittsburgh, P.A.* which support entrepreneurs. Community Forge also hosts quarterly tenant mixers, where the entrepreneurs renting space at Community Forge can mingle, enjoy free food, share updates and hear any announcements with the space.

Business Bloom Program **at Community Forge** Community Forge provides an intensive, year-long incubator program for entrepreneurs called the *Business Bloom Program* that provides financial resources, professional services, and strategic consulting to small business owners. The *Business Bloom Program* also connects entrepreneurs to its network of accountants, attorneys, business coaches, technical support (Tech Help Desk), graphic designers, and–during COVID-19–public health consultants. The stated goal of the *Business Bloom Program* is to assist small businesses in keeping up with the demands of an ever changing COVID-19 business landscape while serving and fostering the growth of minority-owned enterprises.

3.2 Co-Designing Tech Help Desk

Initial collaboration between Community Forge and the researchers' university began when one member of the research team reached out to leaders at Community Forge to introduce himself and to gauge and establish interest in collaborating for a grant proposal[3]. In these initial discussions, community stakeholders emphasized that it was important that our presence within Community Forge brought immediate value for the community members. The directors were clear that starting with any form of data collection immediately upon entering the space would not be permitted, as such an action would extracting value from the space without anything in return. This concern echoes previous calls to prioritize rapport building [48] and to deliver immediate value to stakeholders by prioritizing their needs rather than optimizing for a research agenda [35, 69] when doing community-based research. Community Forge leaders also emphasized the

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[3]The grant proposal focused on leveraging existing community structures to facilitate job mobility within underserved communities (urban and rural) by training unemployed individuals to become online workers.
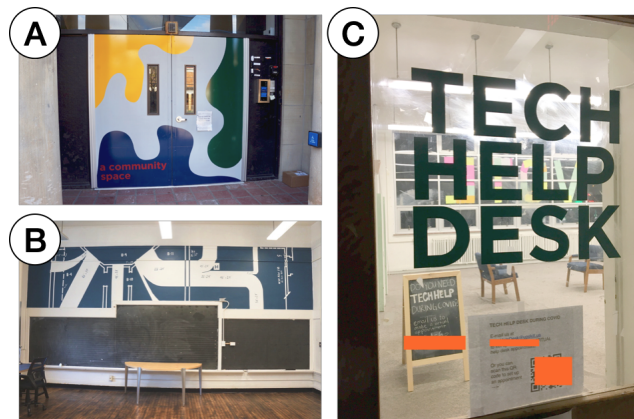
Fig. 1. Photos depicting (A) the front entrance to Community Forge, (B) one of the classrooms in Community Forge, and (C) the Tech Help Desk room.

tenuous historical relationship between the researchers' institution and the surrounding community that Community Forge served. For instance, the researchers' institution had a history of being complicit to the racial injustice in the surrounding area, such issues ranging from public relations [4] to police brutality [5]. Therefore the resulting lack of institutional trust needed to be heavily taken into account when considering next steps.

In June of 2019, we began our discussions with Community Forge members for how the researchers could address challenges the entrepreneurs in Community Forge were experiencing. Community Forge leaders and researchers suggested a few ideas for how the research team could structure their involvement with the space. One idea was to offer a series of courses on technical skills, but given the diversity of entrepreneur businesses within Community Forge , it was not yet clear what technical skills a curriculum should cover. A second idea (similar to the original grant proposal) was to provide a class on how to find jobs within online labor markets such as Fiverr or Freelancer to facilitate job mobility, but few entrepreneurs in the space were interested in pursuing online freelance work alongside running their small business. Another idea was to provide a tool to facilitate peer mentorship among entrepreneurs at Community Forge, but the director of the peer mentorship program did not consider it appropriate to conduct a research study on peer mentorship as they were just establishing peer cohorts within Community Forge. As conversations deepened, the Community Forge executive director shared their experience working on day-to-day computing challenges entrepreneurs would come to them with. As the director had a tight schedule, such requests for one-on-one technical assistance were leaving them exasperated. These reflections, coupled with recommendations from leaders of other entrepreneurial non-profits, led to a consistent starting point: to offer "office hours" in which research team members could answer *any* technical questions while physically present at Community Forge. Regular office hours would allow the research team to provide immediate value for Community Forge and enable relationship building. Community Forge leaders and the researchers agreed that repetition and consistency would be important to build a reliable presence within the space. After three months of discussions and iteration, in September 2019, we opened weekly "office hours" for entrepreneurs in the space, called Tech Help Desk.

When determining how to advertise Tech Help Desk , we did not list a fixed set of technical tasks our providers would offer, but instead left this call open and welcomed all technical challenges. This was because it is challenging to articulate technical issues without the relevant expertise [74], especially when learning specific computing tools [44].

However, during the study, this open-ended call caused confusion as to what type of services Tech Help Desk provided. So, we created a flyer describing all the services providers had offered (See Supplemental Materials).

3.2.1 Timing and location within the building. To determine time and location, we talked to the Operations Manager of the space, who was a constant presence in the facility and had the most in-depth understanding of who was at Community Forge and at what time (including co-occurring programs). As entrepreneurs were most likely to be in the space midweek and midday, we selected Wednesdays 12:00PM-3:00PM for the winter months and 1:00PM-4:00PM for the summer to account for the change in daylight. For the physical location of Tech Help Desk, we initially set up in the atrium, a central area where all tenants pass through when entering or leaving the building. We also tried renting a desk in a co-working room (difficult to share sound space), and a renting a full room (provided privacy for support sessions), but returned to the atrium as it afforded the best discoverability of the three.

3.3 Tech Help Desk Structure and Activity

Entrepreneurs discovered Tech Help Desk through flyers we posted with the monthly schedule throughout the building (See Supplemental Materials for the first version of this flyer), word-of-mouth from prior participants, Community Forge staff, Community Forge newsletters sent monthly, as well as through physical encounters within the space (i.e., walking by the desk). The Tech Help Desk providers traversed the space to introduce themselves to other members and inquire if they had any technical issues. Once initial contact was established, the provider worked with the entrepreneur to determine if an in-person or virtual session would best fit their needs, and if they preferred to schedule an appointment or walk-in (when COVID-19 restrictions were in place and all appointments were remote).

For the session, we asked entrepreneurs to bring a device and charger they could easily access. If they did not have access to a WiFi or data-enabled device, the computer lab within Community Forge provided devices. Entrepreneurs were given the option to opt into the research study, and it was made clear that participation in the research study was not required to receive technical assistance. To help mitigate any pressure entrepreneurs felt to opt in to the study, it was mentioned as a secondary point and deprioritized alongside the other intake information provided to the entrepreneur. In addition, we also encouraged any questions and provided transparency into the research questions and research goals. Tech Help Desk sessions were not recorded, but instead the provider took field notes during and after the session. While note taking, the participant could view the provider's screen (when session was in-person) and see the notes and ask questions. After the session, the provider asked if the entrepreneur would like to schedule a follow-up meeting. The provider then sent a follow-up email describing the tasks accomplished in the completed session, "to do" items the entrepreneur should attempt to accomplish between sessions, and goals for the next session.

3.3.1 Responding to COVID-19. In response to the COVID-19 pandemic, we transitioned Tech Help Desk to remote assistance via Zoom or phone starting in March 2020 (Figure 1C). All participants of Tech Help Desk had Zoom installed on their devices and were comfortable with using Zoom, but two participants preferred a phone call for an initial consultation. In Zoom sessions, participants shared their screen via Zoom, but they were not able to see the provider's screen. We expanded the hours participants could request a help session to Monday - Friday 9:00a-6:00p, acknowledging the heightened stress and demand on entrepreneurs to have a strong digital presence for their small business. When the Community Forge reopened in July 2021, the research team returned to offering in-person Tech Help Desk sessions, but continued to offer remote Tech Help Desk sessions for those who preferred to meet online.

3.3.2   Leading up to and Following the Tech Help Desk session. A pre-session survey asked participants to provide details about their technical questions, their business, their demographics, whether their business was their main source of income or secondary. A post-session survey asked participants to describe the solution implemented with the provider, as well as to provide positive and constructive feedback on the session with the "I like..." and "I wish..." format [36].

3.4   Interviews with Entrepreneurs and Supporters

To gain a rich, qualitative understanding of how local entrepreneurs overcome everyday technology challenges, we conducted semi-structured interviews with Community Forge entrepreneurs and people who have supported Community Forge entrepreneurs (*e.g.*, program directors, business coaches).

3.4.1   Participants. We recruited entrepreneur participants by emailing entrepreneurs who had used Tech Help Desk or participated in *Business Bloom Program* . We also recruited Community Forge leaders and people who served in support roles for the *Business Bloom Program* program (*e.g.*, business coaches, lawyers, accountants, web developers), as well as people who led or served in support roles at other incubator and accelerator programs for local entrepreneurs in *Pittsburgh, P.A.* . In total, we recruited 9 entrepreneurs, and 10 support people (7 support people also owned their own small business) (See Table 2).

3.4.2   Semi-Structured Interviews. Our semi-structured interviews took one hour and we compensated participants $20. We asked entrepreneurs background questions about their business, the types of technology they used as part of their business (*e.g.*, websites, software, hardware, cloud services, and social media), and types of external help they used. We then asked about what types of technical challenges they encountered when starting a business and how they overcame them. We concluded with asking about what resources they would like in the future for solving technology problems. During interviews with people in supporting roles for entrepreneurs, we asked about their organization and the types of entrepreneurial support it provides (*e.g.*, educational, financial, or technology resources). We then asked about their experience with entrepreneur technology challenges and solutions, and about any resources for learning technology they felt were missing. We include full protocols in the Supplemental Materials.

3.5   Data Analysis

For the semi-structured interviews, the research team conducted audio and video recording and took detailed notes. All audio recordings were transcribed (with Descript.com) and reviewed for errors by hand. The research team analyzed these data through a process of open coding to identify initial themes across the interviews and the Tech Help Desk field notes. We later engaged in affinity diagramming [21] over the course of two weeks, where the three out of six authors reviewed each transcript, marked sections that informed and extended this paper's motivations, and printed out the corresponding raw data. Clusters formed around key themes: barriers to using computing tools for entrepreneurs (and whether these barriers were "content", "operational", or 'access' challenges), resourceful workarounds entrepreneurs deduced to overcome barriers, systems of support and entrepreneurs used to facilitate the use of computing tools in their business. All authors repeatedly met during this period to review key findings and iteratively refine a set of analytic memos which expanded on themes emergent across our data [21]. We followed participant quote editing conventions consistent with applied social science research practices [25]. Specifically, we removed filler words and false starts, in some cases re-punctuated and used ellipses to indicate substantial omissions.

3.6 Positionality

We disclose the identities and positionality of the researchers and authors of this paper, as a concern for reflexive design research practice [50, 66]. Tech Help Desk sessions were led by a research team comprising three white women, one from the Southwest U.S., one from the Southeast U.S., and one is a U.S. immigrant from Western Canada; two white men from the rural Midwest of the U.S. and an impoverished, post-industrial part of Eastern U.S.; and one Black man from Eastern U.S whose work focuses on business development, who is dedicated to providing economic opportunities for minority entrepreneurs, and who has experienced racism firsthand during his time in "Corporate America". The research team comprises three researchers who are upper management at the field site, three researchers in a technical department at a private U.S. university (a graduate student and two faculty members, one tenured and one un-tenured), one un-tenured faculty member in a technical department at a public U.S. university, and one individual who ceased their pursuit of a technical career in academia in order to center their community-based efforts to fight the tangible inequities caused by racism, poverty, and devaluing of human life in the U.S.

The five white researchers do not have certain lived experiences that are relevant to this study such as the impact of forms of violence due to racism, ageism, or xenophobia (especially in the context of technology education). Three researchers do not have lived experience of poverty or other aspects of background that employers (or those funding business grants) discriminate against. All five white researchers experience privileges from whiteness, access to formal technical education (e.g., engineering and computer science degrees), and grew up with access to computing devices.

Given the predominantly white research team, we took measures to mitigate power imbalances and to cultivate a more equitable relationship between the research team and Community Forge members (as well as within the research team). For instance, all members of the research team were firmly committed to the Community Forge mission statement, prioritized generating immediate value for the community members rather than optimizing their research agenda, maintained transparency with research practices, depriorizted data collection, and routinely sought feedback from Community Forge members and staff for how to improve Tech Help Desk .

To build relationships with those in the space, the first and last authors attended the quarterly tenant mixers hosted by Community Forge . Research team members spent mixers introducing themselves to tenants and asking entrepreneurs what kinds of technology questions, goals, and challenges they were experiencing. Community Forge staff served as an intermediary for some of these introductions, in order to provide context to tenants as to our presence within the space and facilitate trust building.

4 FINDINGS

4.1 Entrepreneurs Resourcefully Stitch Together an Ecology of Technical Support

We share the ways that entrepreneurs resourcefully sought technical support to demonstrate entrepreneurs' ability in solving technical challenges. In addition, we detail the entrepreneurs' ecology of support to make salient the on-going technical challenges that are not yet addressed, illustrating the need for a model of technical support to match the strategic and responsive approach of entrepreneurs. Overall, entrepreneurs identified and used a range of services to overcome computing challenges including: courses and workshops, social support including peers and mentors, as well as one-on-one support from business-related professionals (*e.g.*, accountants, business coaches).

4.1.1 Courses and Workshops. Several entrepreneurs participated in business courses which were offered at local universities, public libraries, private companies, non-profits, and online. P11, a entrepreneurial support personnel, reflected that offering workshops allowed for larger reach for topics when providers need to *"tell everyone the same*

PX	Gender	Business Category(ies)	Entrepreneur or Supporter
P1	Woman	Community Development	Supporter
P2	Man	Lifestyle and Youth Motivation	Entrepreneur
P3	Man	Law	Supporter
P4	Man	Music and Entertainment	Entrepreneur
P5	Man	Community Development	Supporter
P6	Woman	Peer-to-Peer Support	Supporter
P7	Man	Music and Entertainment	Entrepreneur
P8	Man	Community Development	Supporter
P9	Man	Housing and Development	Entrepreneur
P10	Man	Business Development	Supporter
P11	Woman	Community Development	Supporter
P12	Man	Law	Supporter
P13	Woman	Finance	Supporter
P14	Woman	Bakery and Confections	Entrepreneur
P15	Woman	Community Development	Supporter
P16	Woman	Gifts and Party Planning	Entrepreneur
P17	Woman	Estate Settlement and Food	Entrepreneur
P18	Non-Binary	Events and Entertainment	Entrepreneur
P19	Woman	Stationary and Homeware	Entrepreneur

Table 2. Tech Help Desk and interview participant demographics. Participants were able to opt-out of sharing any aspect of their identity. All but four entrepreneurs who leveraged Tech Help Desk were sole proprietors of their businesses, and the other businesses had less than five employees.

thing". P14 who ran a food business participated in seminars run by a local non-profit covering foundational business questions and technology (*e.g.*, What type of customer are you trying to attract? Will you use cash app or Venmo to accept payments?) This enabled her to immediately improve her use of the technology she was already using (*e.g.*, by using analytics on a social media app).

However, classes did not always line up with entrepreneurs' goals (reported by P1, P5-6, P9, P11, P15). In practice, entrepreneurs' technology needs were time-sensitive and dependent on business stage, domain and their existing knowledge. Further, general-audience classes offered through public libraries and universities were less useful as they were not tailored to the entrepreneurial context (e.g., P11 noted that a general Excel course at the library did not cover how to use Excel for accounting – e.g., templates or formulas for creating a profit and loss).

Even if material in classes may be eventually be useful to their business, entrepreneurs often opted to spend their time on their immediate business tasks instead, as: *"[Entrepreneurs] might've forgotten [the class material] by the time they have that need, especially if it's not required, [and then] they won't attend a session until the need is there."* (P1). Still, P4 who noted that 80-90% of course content tended to be redundant, strategically tuned in through less relevant content because *"there's always something in there you didn't know"*. To use courses to meet their business goals, entrepreneurs planned to take specific classes when they reached that business need (*e.g.*, P7 planned to take a QuickBooks accounting software class when they needed it) and wished for regular local technology classes with on-demand access (P14).

4.1.2 Social Support: Peers and Mentors. Entrepreneurs identified informal opportunities for technical support through their own networks, and incubator or accelerator-style programs.

Several entrepreneurs reported that they had a network of a few trusted peers or mentors with similar businesses tasks who they could contact to work through specific technology challenges. Peers or mentors with similar businesses could provide highly domain-specific technical help, as P4 described seeking on-demand technology support for a last minute filming job from a peer who was on a commercial shoot: *"I kept calling and he went on FaceTime and he went through all the settings [and] he told me what to punch in."* Peer support also provided one-on-one help to work through well-known

technical problems with a better approach. P7 described that he contacted his website company after running into a problem connecting his domain name (a common issue, P1, P6), and the company emailed back instructions, but he still ended up calling his friend due to their shared experience. While peer and mentor support is valuable, existing networks may not have the specific skill needed (*e.g.*, P7 how to use a music platform), and busy entrepreneur peers may have limited time (*e.g.*, P4 sent his peer a gift for providing last-minute tech support); so, entrepreneurs desired opportunities for on-demand help and expanded peer networks. Several entrepreneurs participated in incubator-style programs in which they could meet other entrepreneurs.

To create opportunities to build sustainable support relationships, program leaders noted that they prioritized in-person interactions (*e.g.*, including in-person events like mixers, barbeques and pitch competitions - P8). These events also had short term benefits: *"We just really want to emphasize [getting] comfortable speaking about their business"* (P8). Further, building new relationships in-person provided entrepreneurs with more information about potential support from peers or mentors. For example, P2 preferred to meet only in person for technology support, as physical aspects like body language were important for him to find signals of trustworthiness. Program leaders emphasized that fostering sustainable peer relationships is critical (P1, P5-6, P8, P15), though facilitating cohorts was challenging (P6-5) as a single cohort member can impact the efficacy of the whole group (P5).

4.1.3 One-on-One Technology Support with Business Professionals. Entrepreneurs in our study also identified opportunities for technical support while completing other business tasks with professionals (e.g., business coaches, accountants, lawyers and web developers). They accessed such professionals either through an incubator-style program or through hiring them for a specific job (e.g., complete taxes, incorporated). For the most part, business coaches did not provide support for low-level technical challenges in the course of their work (P6, P10, P12, and P15), but would provide higher level feedback on how to use technology to reach business goals (e.g., whether or not to build a website - P10).

4.2 Tech Help Desk Addresses the Long Tail of Computing Challenges

While the ecology of support entrepreneurs resourcefully created addressed common technical challenges, there were still everyday computing challenges that entrepreneurs were not able to readily address given a mismatch in the design of these support structures and their entrepreneurial approaches. In this section, we describe these challenges entrepreneurs addressed during Tech Help Desk to further illuminate the need for strategic and responsive technical support. We categorize challenges into: (1) *operational* challenges (related to the specific tool at hand, similar to "medium-related" challenges in [71]), (2) *strategic* challenges (related to the strategic selection and application of tools to a specific goal, similar to information and strategy in [71]), and (3) *access* challenges (related to balancing technology costs in time or money with other business expenses). To examine the importance of our side-kick approach which informed the discoverability of challenges, we distinguish between challenges that were: *self-diagnosed* (an entrepreneur-identified issue) versus *diagnosed together* (both entrepreneur and provider working collaboratively to uncover needs).

4.2.1 Self-diagnosed Challenges were Mostly Operational Challenges. Entrepreneurs sought support when they self-identified technical challenges that blocked progress towards a business goal. Of the 31 unique technology challenges that entrepreneurs presented to providers (i.e., self-diagnosed): 17 were operational challenges, 11 were strategy challenges, and three were access challenges. Self-diagnosed operational challenges indicated that a tool did not clearly communicate how to execute desired tasks, suggesting opportunity for improvements to technology design. The 17 operational challenges were related to: the entrepreneurs' websites (P1-2, P5, P7, P14-17), generating digital content (P1-2, P4-9, P11, P15-17), and other types of general hardware and software challenges (P1-3, P5, P6, P8-13, P15-19).

As all entrepreneurs in our study used a website service provider (*e.g.*, Wix, Squarespace, Wordpress), many sought assistance with operational challenges related to these platforms in order to: upload video and photos to their website (P2, P14), navigate an online product dashboard (P2), update branding (P16-17), customize a blog post template (P2), add new product listings to online store (P2, P15-17), understand surprising web tool behavior (e.g., why a customer was charged a high price for shipping for an order placed in their website, P2), and to fix expired security certificates (P7, P11). Entrepreneurs generating digital content sought support to edit videos and photos of merchandise (P2, P4, P7) and to create or edit an existing PDF flyer (P5, P9). Beyond websites and digital content, entrepreneurs sought help for general software and hardware challenges including: downloading software (*e.g.*, Microsoft 365 - P9, Quickbooks - P1, P5), improving device performance (P2, P9), locating software features to complete task at hand (P1-2, P5, P9), and forwarding calls to business phone (P18).

Self-diagnosed *strategic* challenges represented times where entrepreneurs proactively sought out advice on how to effectively use technology towards their business goals. The 11 self-diagnosed strategic computing challenges included: understanding the norms of use for computing tools such as social media platforms (e.g., when/what/how to post) (P9-10, P12), selecting between several options for tools to use (e.g. which website provider or financial software (P13, P17), determining credibility and trustworthiness of computing tools (P2, P9, P16), and building the confidence to make technological decisions that could greatly impact their business (e.g., publishing a new version of their website (P16)).

Access challenges represented that resources should be easier to acquire including fast and flexible capital opportunities [56] and on-demand technology lending. The three access challenges that entrepreneurs shared were: paying for maintenance costs of websites and other software programs (P1, P2, P16), having reliable access to equipment (vinyl, laser, etc) (P15), and having reliable access to data and wifi-enabled devices (P15).

4.2.2 Computing Challenges Entrepreneurs and Providers Collaboratively Identified. Entrepreneurs' demanding schedules made spending time optimizing technology to be in competition with time spent completing essential business management tasks. Thus, collaboratively identified challenges (25 of 56 challenges in our data) presented as moments of recognizing opportunities for improved technology use–or disuse. The 14 (out of 25) strategic challenges identified by entrepreneurs in collaboration with providers included: discovering helpful tools for the task at hand (P1, P5-6, P10-11, P13, P17), considering whether or not to prioritize use of computing tools alongside other business demands (where entrepreneurs often realized that they needed to demote the prioritization of computing tools in order to ensure strong business foundation (P1, P3, P5, P8, P10-13)), optimizing for a minimum viable website (rather than overextending their already limited resources to use more advanced technology (P3, P10, P12)), deciding how much time to spend acquiring computing skills for tools they already use to become more expert versus allocating time learning other tools (P1, P3, P10, P12), and planning their tool usage as their company grows. Beyond the strategic challenges, there were 11 *operational* challenges: how file types impacted uploading ability to online platforms (P5), management of multiple devices and file sharing across devices efficiently (P2), and implementing tenets of good website design principles (P2, P16-17). These collaboratively identified operational challenges indicated that a technology tool was likely inadequately equipped to provide error messages and recognize opportunities for improved use.

By distinguishing the types of challenges entrepreneurs addressed alongside whether the entrepreneur identified them (self-diagnosed) or worked with a provider to identify them (collaboratively diagnosed) illuminated how a side-by-side approach can facilitate further discovery of day-to-day computing challenges through mutual observation during Tech Help Desk sessions. Operational challenges were more likely to be observed by entrepreneurs themselves, as opposed to strategic challenges which were more likely to be diagnosed with the providers' assistance. In the discussion

section, we reflect on why this may the case. In the next section, we detail three entrepreneurs' experiences using Tech Help Desk to address their day-to-day computing challenges.

4.3 Three Vignettes: Addressing Computing Challenges with Tech Help Desk

To illustrate how Tech Help Desk sessions uncovered and addressed a diverse set of computing challenges with entrepreneurs, below are three vignettes of Tech Help Desk sessions which the first author conducted. While each entrepreneur had vastly different technical needs, each vignette showcases how the strategic and responsive Tech Help Desk model addressed diverse computing challenges.

4.3.1 Non-profit Founder Sets Up to Work from Home During a Global Pandemic. P9 (65-74 year old man, 30+ years running his business), the founder of a local non-profit housing and development association, first heard about Tech Help Desk through the Community Forge monthly newsletter in April 2020.

Initial Computing Challenge. P9 wanted to use TechSoup, a third-party platform that offers subsidized software for non-profits, to download Office 365. His prior Office 365 license was soon to expire and he needed to complete tasks at home on his personal laptop due to the lockdown.

Addressing the Initial Computing Challenge. The provider worked with P9 over the course of three one-hour remote Tech Help Desk sessions to install Office 365 via TechSoup on his laptop. P9 shared his screen so that the provider could provide direct guidance. During moments when P9 would enter sensitive information (username and passwords), the provider would close her laptop partially and communicate she was doing so to P9. The provider searched online for all of the steps required to download the software through TechSoup–this was her first time using TechSoup–and shared the documents she found so they could follow along together. The provider helped P9 formulate a request to TechSoup's customer support to retrieve his license information (which he could not locate in his records). The provider and P9 scheduled a follow-up session depending on P9's preferences. Given the urgency of having this software installed, P9 opted for the follow-up sessions to be within the same week. At the end of the third session, using the latest version of Office 365, P9 successfully opened a new Word document on his laptop.

Addressing Additional and Discovered Computing Challenges. P9 reached out to the provider an additional time in 2020 to set up Constant Contact (to reach his customers during the lockdown). In these follow-up sessions, P9 and the provider spent time sharing how they and their loved ones were doing–at this point, the two had spent several hours together and taking the time to deepen the relationship felt important to both. During these sessions, the provider observed how P9 navigated his file system, retrieved documents, and opened the browser and applications. She suggested ways to make P9's laptop more efficient, as well as how P9 could more quickly traverse his file system and find applications. It had not occurred to P9 to attempt to clear disk space, but instead he had accepted the wait time. P9 set up a total of four additional one-on-one one-hour Tech Help Desk sessions to cover technical issues that arose during prior sessions based on the provider's observations and recommendations.

Between P9's prior experience using TechSoup to download software, and the provider's ability to effectively search for, interpret, and actualize online documentation, together the two were able to address P9's technical requests. The collaborative nature of sessions increased with each session, as the provider and P9 prioritized conversational chat at the beginning of each session.

4.3.2 Returning Citizen Sprints to Finalize Website in time for Marketing Event. P2 (35-44 year old man, less than one year running his business), the founder and sole proprietor of his lifestyle and motivation coaching business, scheduled

his first Tech Help Desk session in August of 2021. While in the Community Forge kitchen, the provider ran into P2 and struck up a conversation explaining who she was, what Tech Help Desk was, and to offer technical services.

Initial Computing Challenge. P2 shared that he was trying to finish his website (hosted on Wix) in order to have it ready for an upcoming marketing event. Similarly to P9, P2 felt out of the loop with the many computing tools; P2 shared that he had recently completed a decade-long jail sentence and during this time he was unable to stay abreast with the substantial technological advancements. P2 emphasized that he had leaned on the support of his "mentor slash business coach" as well as a close "tech savvy" friend in order to decide which devices to purchase and how to set up his website.

Addressing the Initial Computing Challenge. P2 wanted to update his website's product page, add a video of a recent speech he had given, and finish his blog posts. Even though the P2 had already set up his website with his friend, he could not remember how to navigate the website's dashboard. The provider loaded his website on her laptop across different browsers and simulated different screen sizes to look for mobile compatibility which he noted in his notebook for future use. The two sat side-by-side viewing each others' screens and the provider created a pretend Wix website on her laptop so that she could familiarize herself with available tools. The initial meeting extended beyond the hours of the Tech Help Desk window, but such flexibility of the provider's schedule was important; P2 expressed needing to be far enough along where he could continue to work on the without her assistance before their next session.

Between the sessions, the provider summarized the tasks completed in the previous session, the tasks they would collaboratively prioritize in the next session (based P2's preferences), and any action items for P2 to complete between sessions. P2 noted that this documentation was helpful for him to stay on task, as well as visualize the progress he has made. At the end of P2's series of sessions, his online store was up-to-date with all of his merchandise (size and color options), and his website included a motivational blog post and embedded video of his first paid motivational speech.

Uncovering and Addressing Additional Computing Challenges. P2 began to ask about more types of technical assistance the provider could offer, as he observed how the provider used her laptop to complete similar tasks. For example, P2 observed how the provider used keyboard shortcuts and asked *"how did you do that so fast?"* After explaining what keyboard shortcuts were, they reviewed this in the next session (and refreshed these shortcuts every session thereafter). P2 has since participated in almost 15 sessions as he returns each week, using Tech Help Desk as a concentrated co-working time for technology improvements across his business.

P2 discovered Tech Help Desk through a "water cooler" encounter in the Community Forge kitchen, as compared to the entrepreneurs in the prior and following vignette who were more formally introduced to the service. Over the course of several sessions, P2's strategic and responsive approach to his business led him to explore the range of possibilities for how Tech Help Desk could help him (learning keyboard shortcuts). Rather than restricting conversation solely to technology, the provider and P2 allocated time for exchanging stories (similar to P9), and P2 often reflected on how his time in jail had impacted his life. Through these stories, P2 shared he wrote a book while being incarcerated which was stalled due to a few technical complications (which they addressed in follow-up sessions). For both P2 and P9, relationship building alongside technical assistance was important as one was not possible without the other.

4.3.3 Party Planner Creates a Website Just in Time for a Bus Ad Launch.

4.3.3 Party Planner Creates a Website Just in Time for a Bus Ad Launch. P16, the founder and sole proprietor of her three-year-old gift and party planning business, had her first Tech Help Desk session in July 2021. P16 was introduced to Tech Help Desk by a Community Forge director during open hours.

Initial Computing Challenges. P16 wanted help with her website to ensure all was up-to-date in time for her business's ad campaign on public buses in *Pittsburgh, P.A.* . Tracing information in her inbox as well as her notebook, she explained she had two websites currently registered.

Addressing Computing Challenges. Together, the provider and P16 discovered that the server P16 was using for one of her websites, donated to her by a friend, was no longer in commission. P16 noted how distressing this period of time was when her website was down: *"I was held hostage at one point with my website. I was so frustrated and it brought tears because that's how I sell my products. And for probably close to three months, my website was down."* Throughout the next four sessions, the provider worked with P16 to curate, refine, and finalize the content to list on her functioning website, implement an intake form for potential customers interested in her event services, as well as update her product listings to include her event services. Importantly, P16 often knew the operations required to execute these tasks, but preferred to sit side-by-side with the provider as she felt more confident to experiment: *"I can sit with [the provider] and click a button and not worry about my whole website crashing." (P16).* By utilizing Tech Help Desk , P16 felt comfortable to engage in more experimentation with her technical decisions, as she knew someone was next to her in case something went awry. Throughout all the sessions, P16 took detailed notes so that she could refer to them later if she forgot why we made certain decisions.

4.3.4 A Reflection on Three Vignettes. All entrepreneurs relied on an ecology of support which they had resourcefully curated to fit their businesses needs across various types of resources (courses, peers and social support, hiring temporary assistance). But at some point, all types of support had a tipping point where this form of support was no longer available (P2 did not want to strain social relationships with repeated help requests, P16's updated budget disallowed hiring technical assistance, and P9's colleague moved away). The provider and entrepreneurs worked together in order address a wide range of technical issues. The collaborative approach facilitated relationship building and exploring additional technical challenges.

4.4 Limitations

We co-designed Tech Help Desk within the particular setting of Community Forge in *Wilkinsburg, P.A.* , in collaboration with community stakeholders. All entrepreneurs in our study were tenants of Community Forge or participants of the *Business Bloom Program* program. This required at least a \$100 per month desk fee or an application to *Business Bloom Program* , thus entrepreneurs needed to have some amount of preexisting capital. In the future, we aim to make Tech Help Desk accessible to more *Wilkinsburg, P.A.* community members beyond Community Forge members, though more work will be needed to facilitate discoverability and scale of the service. While the design of Tech Help Desk may not be fully transferable to new contexts, we encourage future work to explore opportunities to repurpose features of the Tech Help Desk model in community-driven projects for entrepreneur computing support. In addition, the research team was predominantly from a private university neighboring *Pittsburgh, P.A.* , and the entrepreneurs at Community Forge were predominantly entrepreneurs from *Wilkinsburg, P.A.* . As shared identity is an important component of trust, Tech Help Desk can work to improve trust by recruiting or hiring providers (*e.g.*, as an on-ramping job to a support role within a company, or as part of a university certificate program) who have more overlapping dimensions of identity such as place of employment (or status as an entrepreneur), place of origin, socioeconomic status, etc. Finally, the researchers were not entrepreneurs, thus we may be missing context for providing technical support and reporting results.

5 DISCUSSION

This work uncovered how local entrepreneurs running businesses in a variety of non-technology domains leveraged technology-centered and non-technology centered support to address the technology challenges that they encountered. Through our close partnership with Community Forge leaders and community members, we presented a model of technical assistance that is strategic, in that it is designed to fit the context of local entrepreneurs, and responsive, in that it prioritizes emergent needs (Table 1). The two and a half year (and on-going) deployment of Tech Help Desk demonstrated its support for entrepreneurs addressing computing challenges including troubleshooting support, support for planning and executing a technology project, and support for uncovering opportunities to improve the efficiency of their technology tasks. Our approach enabled us to gain knowledge about the long tail challenges active entrepreneurs are currently facing (**RQ1**), what resources and workarounds they use to overcome those technology challenges (**RQ2**), and how technology assistance programs can support them in these tasks (**RQ3**). Our complementary interviews with entrepreneurs beyond Tech Help Desk and individuals who support entrepreneurs as accountants, accelerator managers, business coaches, and lawyers beyond Community Forge provided greater depth to our understanding of where and how technology support happens outside of Tech Help Desk.

We highlight three key trade-offs we made to effectively instantiate our model in the context of local entrepreneurs in a co-working space (Table 1, rows 1-3): (1) responsive rather than standardized support for entrepreneurs solving the long-tail of computing challenges, (2) long-term learning rather than short-term efficiency for entrepreneurs balancing technical demands with other business needs, and (3) prioritizing trust and relationship building over provider flexibility for discerning entrepreneurs navigating support.

5.1 Responsive rather than standardized support for the long tail of computing challenges

Conversations with Community Forge stakeholders highlighted the importance of the researchers in the space providing immediate value for the community, so we prioritized responsive technical support through Tech Help Desk's individual support sessions. We identified unique benefits of providing responsive support within the context of an entrepreneur community. First, entrepreneurs who visited Tech Help Desk or participated in interviews described that they used or planned to use a variety of other existing services for standardized support such as digital literacy classes or accelerator programs, unlike prior work that provided course or group support for people who may not have access to it [39, 62]. Still, entrepreneurs used the responsive support provided by Tech Help Desk for time-sensitive computing challenges not clearly addressed elsewhere or, the *long tail of computing challenges* (*e.g.*, clearing files off of a computer, transferring image files across devices, and removing an image from a Wix website). In the future, responsive support that has access to the dynamically changing needs of local entrepreneurs can inform the curriculum for local courses and incubators. In interviews, participants noted that while existing technology support was offered in courses or incubators, it was primarily oriented towards program goals or a curriculum (similar to tiered curriculum support in education [10, 24, 28, 38]), and thus lacked capacity to support long tail challenges. Incubator leaders referred entrepreneurs to us for technology support outside of their incubator's scope, and entrepreneurs visited us when other courses ended. In the future, we could also refer entrepreneurs to courses or services as relevant. Finally, entrepreneurs leveraged Tech Help Desk's hybrid drop-in and appointment schedule to stop by for a single session (*e.g.*, to clear off files to fix a slow device), or to schedule repeated follow-ups (up to 15 sessions total) to work through a single or emergent set of computing challenges. This scheduling format accommodated varied experience levels.

We also uncovered unique challenges of providing responsive support. First, the novelty of Tech Help Desk's broad and responsive support demonstrated a challenge in communicating its purpose and scope. Entrepreneurs initially approached Tech Help Desk with needs outside scope including making a website for them (we did not complete tasks for entrepreneurs) or supporting trademark and legal issues (we did not have legal expertise required). As miscommunication can mean wasted time for busy entrepreneurs, we updated our flyer to describe the side-kick style and list examples of help we provided (see flyer in Supplemental Material). Second, scaling responsive support to multiple entrepreneurs per provider at a time is challenging. In particular, entrepreneurs' goals and experience levels are diverse, and scaling necessitates less responsiveness to these factors as entrepreneurs would spend less time directly working with the provider. To limit demand, we advertised only within Community Forge (rather than to the surrounding area *Wilkinsburg, P.A.*). In practice, providers worked with one entrepreneur at a time, or two if they arrived at similar times (in which case entrepreneurs occasionally used the opportunity to meet each other). Future work could explore one-to-three (or higher) support by providing a co-working room where the provider can circulate and peers can work together. Finally, tracking the outcome of highly responsive support like Tech Help Desk is challenging compared to standardized support, where programs may conduct pre- and post-tests for courses or evaluate business success along program goals. Program organizers (P5 and P8) shared that when they facilitate referrals to external resources for technical issues, it is currently either challenging (for website development) or nearly infeasible (for coaching) to manually track and document whether or not the referral was successful. As tracking impact is important for non-profits [17], future work should explore how to deliver and document responsive support to benefit both entrepreneurs and program goals.

5.2 Collaborative learning for resourceful and discerning entrepreneurs

Our design of Tech Help Desk involved the resources of a few volunteers to provide an opportunity for support a few hours a week (as opposed to an organization that can provide around-the-clock support [60]). Given that entrepreneurs adapt to changing business needs between and after visits to Tech Help Desk (*e.g.*, adding a product to a website), we opted to promote learning via a side-kick approach that has been found to be successful for technology learning (*e.g.*, paired programming [34], over-the-shoulder learning [70]).

The design and deployment of the side-kick approach within Tech Help Desk revealed nuances about the implementation and benefits that differ from prior work. First, we initially aimed to demystify technological problem solving by expressing when we did not know how to solve the problem at hand and then collaboratively solving the problem along with the entrepreneur. In practice, we found it was also important to establish ourselves as knowledgeable at the start (*e.g.*, by sharing past experiences and education, knowledge about alternative technology [27, 48]), as entrepreneurs looked for signals to discern that we would not waste their time by leading them astray. In this way, we served as both a "guru" in terms of our knowledge, and a "gardener" in terms of fostering a collaborative approach (rather than prior work where employees picked one role or the other [31]). Second, given the diversity of tools and technology experiences of entrepreneurs, the side-kick shared screen approach offered the chance to collaboratively discover ways for entrepreneurs to optimize their technology use across a wide range of tasks (*e.g.*, from discovering alternative tools for their work to accessing additional files in a list). In fact, 25 of 56 of the unique computing challenges in our data were collaboratively diagnosed. While independently diagnosed challenges prompted a visit to Tech Help Desk via a notable error or blocker towards business goals (*e.g.*, computer slows to a halt, or not able to update website with new product), collaboratively diagnosed challenges represented non-blocking improvements for efficiency (*e.g.*, scrolling through files

vs. using a work-around) or alternative strategies to using technology (*e.g.*, using a website builder to create a minimum viable web presence rather than building a new web application from scratch). Future researchers and program directors may consider side-by-side technical support as an approach to inform future standardized support or referrals.

The side-kick approach was not always best for entrepreneurs seeking technology support while proactively managing their time. Entrepreneurs juggling many roles within their company several times visited Tech Help Desk or scheduled an appointment, but selected to not attend or complete the session due to dynamically shifting demands on their time (*e.g.*, an important phone call, an assistant in need of help). While side-kick style support allowed entrepreneurs to learn technical skills to maintain any changes made during the session, busy entrepreneurs may benefit from additional opportunities for delegated, rather than learning-centered, support for particularly rare or one-off tasks that are unlikely to require maintenance (*e.g.*, initial device set-up like setting up a printer). In addition, entrepreneurs occasionally identified that they would prefer to delegate a task (*e.g.*, launching a website, designing a logo) to use their time completing a core business product or service that would be more difficult to delegate. This judicious use of time was also encouraged by the business coaches that we interviewed. In this case, our model still can support entrepreneurs – for example, one entrepreneur leveraged Tech Help Desk to help identify and assess a professional to hire for website development. Future work may consider how to adapt Tech Help Desk's model for later stages of business where delegation may be more frequently necessary.

5.3 Prioritizing trust and relationship building over provider flexibility

When a discerning entrepreneur considers working with a support person, establishing trust – or the belief that engaging with a person is unlikely to cause harm [30] – is a necessary prerequisite [27]. While help desk providers in traditional workplace settings benefit from institutional credibility when establishing trust [46], our research team was from an institution that historically had a tenuous relationship with community members at our field site [4, 5]. In our study, entrepreneurs also noted they felt their lack of technological expertise made them vulnerable to being disrespected, overcharged, or scammed. To engage in support relationships with entrepreneurs despite prior institutional and technology related harms, we prioritized building trust with Community Forge entrepreneurs.

We identified several strategies for building trust to facilitate technical support in an existing community and space for entrepreneurs. First, the design and deployment of Tech Help Desk benefited from a cascade of trust. That is, we initially established trust with community leaders by dramatically changing our research agenda in response to existing needs of the community space (such change often occurs when appropriately weighing community input above researcher input during community-based research [48]). Building trust with community leaders and providing a community-driven service prompted to Community Forge leaders to then refer entrepreneurs to us; and, these referrals in turn facilitated trust between the entrepreneur and Tech Help Desk provider. Second, entrepreneurs who used Tech Help Desk and Community Forge leaders reflecting on attributes of Tech Help Desk that facilitated trust cited the reliable and long-term nature of technical support. The reliable time and place enabled ease of referral and getting to know Community Forge members when lulls occurred. Finally, the reliability also encouraged entrepreneurs to use their own technical skills more. For example, one entrepreneur described that she felt she could now change her website without fear of breaking it for a long time, as she could always visit Tech Help Desk the next Wednesday if needed.

However, it is difficult to tell when Tech Help Desk did not succeed at building trust. When entrepreneurs did not approach Tech Help Desk or return for a follow up (which happened on three occasions), it is unclear as to why that happened. For example, entrepreneurs may have no longer needed technical help because they addressed the
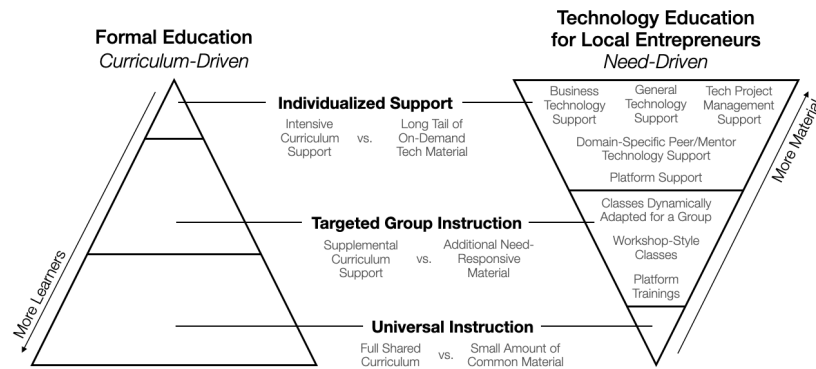
Fig. 2. A comparison of the traditional Multi-Tiered System of Support [38] for formal curriculum-driven education compared to our model for need-driven technology education for local entrepreneurs.

issue quickly, or hired a technical employee (as was the case with one entrepreneur we worked with). However, it is also likely that in some ways we failed to build trust. In the future, we will experiment with alternative approaches to understand the reasons entrepreneurs did not use or continue to use Tech Help Desk services (*e.g.*, by asking collaborating community leaders to talk to entrepreneurs for potentially more frank responses). Finally, prioritizing consistency and relationship building made it challenging to introduce new providers to the project (a months- to years-long rather than drop-in volunteer activity). Future work may explore new incentives for long-term technical support volunteers (*e.g.*, course credit).

6 CONCLUSION

Today's local entrepreneurs must navigate an increasing array of technological tools to achieve their business goals. To understand and address the computing challenges faced by local entrepreneurs in a resource-constrained community, we co-designed an on-going technical service, called Tech Help Desk, with a local entrepreneurial hub–Community Forge–in *Wilkinsburg, P.A.* . Our participatory approach revealed how entrepreneurs were strategically and responsively addressed their day-to-day computing challenges by curating an ecology of support, yet many challenges went unaddressed. To keep pace with local entrepreneurs and ever changing technological advancements, Tech Help Desk mirrored the strategic and responsive approach entrepreneurs took to building their businesses in order to address the long tail of computing challenges. Our work informs researchers' understanding of computing challenges and helps to create responsive technical support within an already existing ecosystem for entrepreneurs.

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