Design Practices and Guidelines for Empowerment

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ABSTRACT

Increasingly, digital applications and services have become tools to combat inequality and empower people. However, it is unclear what the design practices are that lead to empowering systems and designs. To address this question, we conducted a structured literature review of 33 publications that were specific to the design of digital tools and were a subset of papers used to develop the HCI empowerment framework. We analyzed the specific design practices that were associated with the psychological components of the empowerment framework—"feeling", "knowing", and "doing". We extend the HCI empowerment framework and contribute the following design practices and guidelines for empowerment: *give individuals autonomy; tailor to individuals' cultures, experiences, and values; connect individuals to knowledge, resources, and options; provide individuals with frequent feedback; divide and conquer tasks;* and *encourage collaboration and participation*.

Author Keywords

Empowerment; psychological empowerment; design practices; framework

CCS Concepts

•**Human-centered computing** → *Empirical studies in HCI;*

INTRODUCTION

According to scholars, global inequality is decreasing [64] as a result of Western technological advances in medicine, transportation, and communication raising standards of living [104]. Paradoxically, the West is seeing an increase in inequality that is driven by technological advances [64]. In the United States, there is a growing income gap between the top 1% and the rest of the country [104]. While factors such as globalization, de-unionization, and the declining value of minimum wage contribute to the growing income gap [6], robotics and advances in communication technology have replaced less skilled workers and require more educated workers to operate [1]. Nevertheless, technology is still looked upon as a solution to address such inequalities.

Today, numerous digital applications and services empower individuals, organizations, and communities to accomplish their goals and launch powerful campaigns and social movements like #MeToo and #TimesUp at a worldwide scale. For example, the #MeToo hashtag went viral in 2017 after reaching 85 countries with 1.6 million tweets and brought attention to a 10-year-old social organization [75]. Furthermore, millions of students are able to accomplish their educational goals by taking classes online—more than 6.3 million U.S. students took at least one online course in the Fall of 2016 alone [38]. As called out by Schneider et al., the vision to empower people with technology has even appeared in top technology companies' mission statements (e.g., Microsoft and Fitbit) [89].

Along these lines, Human-Computer Interaction (HCI) researchers have conducted empirical investigations to understand how technology supports social movement organizations like Hollaback! to combat street harassment [30], studied citizen journalists' use of Twitter in Mexico to report acts by drug cartels to increase safety among citizens [65], and underlined the empowering capacity of Do-It-Yourself (DIY) and making [2, 66, 99]. HCI researchers have used empowerment model as a lens to examine how social media empowers individuals and communities [7, 53]. More recently, Schneider et al. contributed an HCI Empowerment Framework to help structure HCI empowerment literature [89]. However, when it comes to developing applications that empower and even those technologies that disempower, we are missing a complete and concrete set of design practices and guidelines. Therefore, we begin our investigation by asking the research question, "What are the design practices that lead to systems and designs that empower?" We set aside the second question, "What have been the design practices that lead to systems and designs that disempower" for future research.

To understand what design practices lead to empowerment, we conducted a structured literature review of 33 CHI publications based on a corpus of 54 CHI publications collected by Schneider et al. to develop the HCI Empowerment Framework [89]. To contribute specific design practices and guidelines that were connected to empowerment, we focused on those papers that included the design of a technical system or tool. As a result,we excluded 21 papers from their original corpus. We found that effective empowering practices include *giving individuals autonomy; tailoring to individuals' cultures, experiences, and values; linking individuals to knowledge, resources, and options; providing individuals with frequent feedback; dividing and conquering tasks;* and *encouraging collaboration and participation*.

Our findings build on past research in HCI and social science. We contribute an extension to the HCI empowerment framework, which provides a set of design practices and guidelines for empowerment. In this way, we provide a practical component for future HCI researchers, designers, and practitioners.

Going forward, our aim is to provide concrete practices for design interventions that could address rising inequalities.

BACKGROUND

Before discussing related work, we define *power* and *empowerment* for background context. As suggested by the term itself, *empowerment* is fundamentally about gaining power [41, 59, 81, 95]. However, no consensus on the definition or the origin of *power* has been reached, and power is still a strongly contested concept within the social science literature [58]. Modern scholars tend to understand power as a "thing"—a *capability* that may be possessed by individuals or society as a whole [110, p.1]. On a more individual and personal level, power has also been seen as "something – anything – that makes or renders somebody able to do, capable of doing something. Power is *capacity*, potential, ability, or wherewithal" [9, p.8]. Similarly, Weber regarded power as the *capacity* or probability of an individual within a social relationship to realize his will, even against the opposition of others [109, p.1111]. On a societal level, Parsons identified power as the "generalized *capacity* of a social system to get things done in the interest of collective goals" [76, p.181].

For a long time, empowerment has been a key focus in various disciplines, including psychology, political science, health and education, and social work, and at the core of empowerment is the work of improving human lives and striving for positive change [25]. Bandura articulated empowerment as a process by which one's belief in their self-efficacy is enhanced [10]. Therefore, to empower refers to the strengthening one's efficacy or weakening one's belief in their own powerlessness. Because empowerment can occur at the individual, organizational, and community level, there is no universal measure—gaining power often means different things to different stakeholders [82, 114].

RELATED WORK

We begin our related work with a discussion of a set of design principles as well as familiar frameworks and models often used to empower marginalized groups. We then provide a brief discussion of past HCI work related to empowerment, and the HCI empowerment framework. We identify the need to understand system practices that lead to empowerment.

Strategies for Empowerment in HCI

Shneiderman first introduced the concept of empowerment to HCI in 1990. He emphasized the need for researchers to enable users to achieve their personal and organizational goals while keeping higher-level societal goals in mind [93]. Since this charge, HCI research has focused on topics including social justice, social change, and equality (e.g., [12, 32, 29, 35, 84]). Researchers have also contributed frameworks and practical guidelines to encourage the development of technologies to support disempowered and powerless publics. These include socially-just design [31, 32], user-centered design and participatory design, value sensitive design [20, 37], and ability-based design [112]. Although empowerment is one of the core theories in the domains of social justice and social change, very few past studies have contributed structured frameworks, guidelines, or theoretical foundations for designing interactive systems that empower. We aim to bridge this gap.

We learn from this existing research that designs should support users' equality, autonomy, and control, while addressing their social, rational, and emotional needs to empower [74]. Li et al. found that social media can empower communities by supporting the dissemination of information, calling for civic participation, and drawing attention from internal and external stakeholders [53]. Schneider et al. made the very first attempt to introduce structure and clarity to the emerging body of work on empowerment in HCI [89]. These authors constructed the HCI empowerment framework, which we discuss in the next section. Schneider then reflected and summarized three design principles that contribute to empowerment in health and wellbeing technology [88]: (1) offer choices, (2) offer valued alternatives, and (3) acknowledge both experts' and users' perspectives.

The HCI Empowerment Framework

Schneider et al. contributed an empowerment framework to use as a lens to analyze notions of empowerment within HCI [89]. This framework builds heavily from Zimmerman's psychological empowerment model, which provides researchers and scholars with a series of measurable and amendable variables that can be used to predict community participation and develop the setting-specific measures of empowerment [25]. Specifically, this model provides a complete picture of an individual who perceives their capability and capacity to impact a specific environment (intrapersonal), understands how social systems work within that environment (interactional), and take behavioral actions to exert control in that environment (behavioral) [114].

In addition, the psychological empowerment model provides an "open-ended construct" with "observable phenomena" that constitutes one's empowerment, and it specifies a series of variables that can be effectively measured [115, p.587]. It has also inspired a significant amount of past work in social science particularly in fields that aim to measure empowerment in specific settings [11, 18, 39, 77, 78] and in HCI research [7]. Therefore, we focus on the psychological component of the HCI empowerment framework, which was derived from Zimmerman's psychological empowerment model. In this way, we aim to capture and analyze specific aspects of interactive systems that lead to empowerment.

More specifically, the psychological component of HCI empowerment framework consists of three manifestations. The psychological component category describes *how* a system empowers its users in detail—whether the empowerment is achieved by *feeling (intrapersonal)*, *knowing (interactional)*, or *doing (behavioral)*. The *feeling* manifestation of empowerment can be viewed in different forms, and it includes overlapping concepts such as self-efficacy, mastery, perceived control, and motivation to exert power [89, 114]. The *knowing* manifestation of empowerment in HCI often helps users of a system understand and gain relevant social context, including the power dynamics at play, the possible routes to goal attainment, the resources needed, and the methods to access them [25]. At

the same time, the *knowing* component helps users develop skills that are related to decision making, problem solving, and exerting control. Finally, the *doing* manifestation leads to various coping behaviors such as the exertion of power and taking action. More importantly, the *doing* component of empowerment often allows users of a system to do things that they would otherwise be incapable of doing [63, 89].

METHOD

To investigate our research question, "What are the design practices that lead to systems and designs that empower", we conducted a structured literature review of 33 CHI publications, a subset of Schneider et al. original corpus [89]. For context, Schneider et al. searched the ACM Digital Library for papers using one of the terms "empowerment" (N=37) and "empower" (N=115) at least once. They also excluded posters, keynotes, and workshops, and confined their search to CHI only. We used their initial corpus as a baseline.

Our goal was to understand how empowerment was connected to specific design practices. Hence, we excluded 21 papers that were unrelated to tool design [3, 8, 13, 15, 19, 26, 34, 42, 52, 54, 63, 71, 72, 73, 79, 80, 85, 102, 107, 111, 113].

After finalizing our corpus, the first author analyzed and coded the design practices applied in each paper using an inductive thematic analysis approach [22]. This is an approach for identifying and reporting patterns within a dataset without trying to fit the themes into a preexisting frame. Although it resembles methods used in grounded theory, we did not develop a "theory" or model to explain our data. Note that a paper could have multiple codes depending on the system and design practices adopted. Together, both authors held five discussion rounds of the coded data set. Based on these codes, we identified common themes, which represented empowering design practices. We derived a general set of guidelines from these practices.

FINDINGS

We organize our findings around the manifistations of the psychological components of the HCI empowerment framework—feeling, knowing, and doing. We describe the empowering aspects of systems and design through six exemplary practices that arose through our inductive analysis: *giving individuals autonomy*; *tailoring to individuals' experiences, culture, and values*; *linking individuals to resources, new, knowledge, and options*; *providing individuals with frequent feedback*; *dividing and conquering tasks*; and *encouraging collaboration and social interaction*. These key design practices contribute to empowerment through fulfilling different psychological components, as shown in Figure 1.

We describe each of the key empowerment-related practices using relevant social science literature. We then provide examples to describe design aspects that led to specific empowering practices. Based on these insights, we summarize a series of design guidelines that can help future designers and practitioners investigate and reflect when designing for empowerment (see Table 1 summary).

Feeling

Individuals who are powerless or do not believe they have the capacity to achieve their dreams are less likely to take actions to achieve their goals and therefore less likely to accomplish them. Feeling includes domain-specific perceived control and self-efficacy, motivation to control, perceived competence, and mastery [114]. These can be achieved by the design practices: *giving individuals autonomy and control (A, refer to Table 1)* and *tailoring to individuals' experience, culture, and values (B)*. These design practices help individuals engage in behaviors that could lead to positive and desired outcomes and improve their sense of autonomy and competence.

Giving individuals autonomy

Autonomy refers to the freedom and capacity of an agent to act based on what they know and their objective morality [49]. At the core of the notion of autonomy is an agent's ability and willingness to make choices independently [55]. Therefore, to support one's autonomy means to address problems in one's life that hold up his or her capabilities [74]. Granting individuals with autonomy can help them to gain a sense of control, which can effectively eliminate individuals' experiences of powerlessness brought about by the loss of control over one's process of achieving goals.

Giving individuals autonomy when interacting with digital tools and systems means that individuals are able to control when and how to use the system and to decide what to expect from the system. Instead of following the programmed user journeys and preset goals of the system, individuals can often customize their experiences and use the tool as a platform to address their needs and thus achieve their goals. From this, we argue that to provide autonomy, "Systems should aim to provide individuals with the ability to customize their experiences to accomplish their goals (A.1)."

Among the papers we reviewed, eleven papers adopted the practice of fostering individuals' autonomy and control [24, 27, 36, 46, 50, 61, 62, 68, 69, 74, 92]. In particular, three papers allowed individuals to set up their own goals and objectives of using the system [61, 46, 27]. Six papers enabled individuals to explore the system and reconfigure the rules based on their own needs and preferences [24, 36, 50, 68, 69, 92]. Two papers enabled individuals to control when and where an interactive experience happens [74, 91]. Next, we provide an example of a system that empowers individuals by *improving* their autonomy, and investigate how the design achieves this.

MAPS: The Memory Aiding Prompting System

The MAPS interactive system allows caregivers to create scripts for their clients with cognitive disabilities. These scripts allow their clients to carry out daily activities that they would otherwise not be able to achieve independently [24]. MAPS has two sub-systems for two different user groups: the MAPS-Design-Environment (MAPS-DE) for caregivers and the MAPS-Prompter (MAPS-PR) for clients with cognitive disabilities.

Traditional assistive technologies often aim to create universal solutions to support all clients. Prompting and task segmentation in these systems have been the main techniques to help

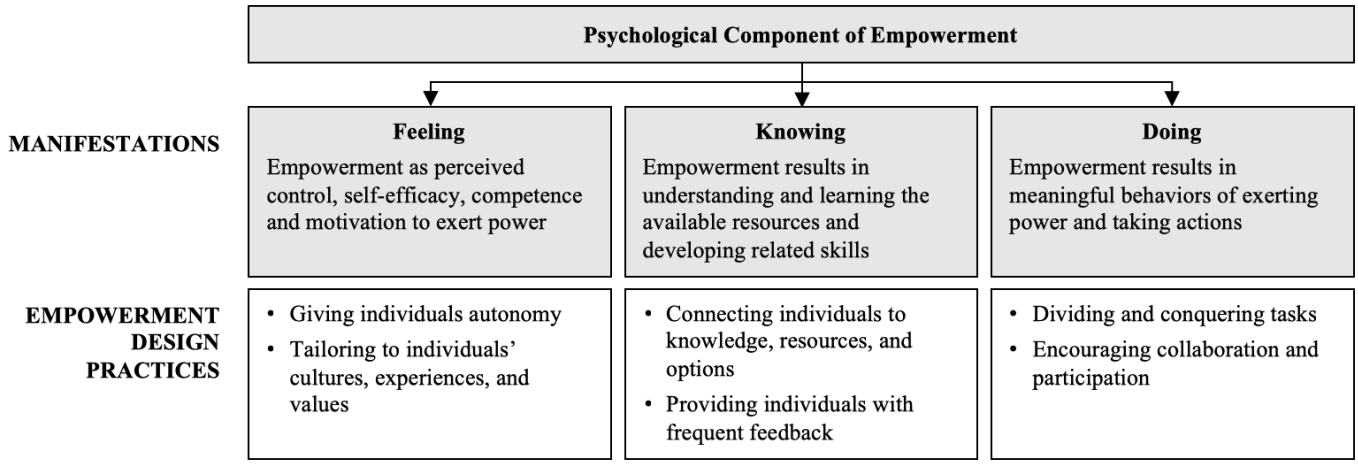

Figure 1. Psychological components and empowering design practices

clients with cognitive impairments extend their abilities and become more independent. However, the support provided by the assistive technology is often not tailored to the client's needs and does not take advantage of the caregivers' intimate knowledge about their clients. In other words, caregivers themselves cannot use their knowledge to contribute to task segmentation and prompting.

MAPS addresses this issue through empowering caregivers to be the "designers" of the task segmentation and prompting. This provides caregivers with the autonomy to decide the specific tasks their clients need to accomplish, the granularity of the segmented tasks, and prompting details. Based on the client's specific needs, caregivers can decompose daily tasks such as housekeeping chores, cooking, and shopping, into a certain number of steps based on their clients' current abilities and capacities. Then, the caregiver can orchestrate a script by taking photos and recording text and audio prompts on MAPS-DE. This script will then be loaded on MAPS-PR to help the client accomplish the steps to complete the task. In one example, a client was able travel to his working place and work independently. However, the client was unable to do his laundry. To help the client fold and put away his laundry, his caregiver was able to break down the task and create a 61-step script to guide him through the laundry tasks (e.g., taking out the laundry from the hamper and then hanging the laundry on hangers). The caregiver took pictures and recorded instructions to illustrate each step into easily and understandable instructions. After testing the script with their client, the caregiver removed those steps their client was able to complete independently. On the other hand, the caregiver provided additional illustrations to ensure their client's success. Relying on MAPS-PR, this client successfully learned "how to fold", a task that was normally ignored by practitioners and designers who designed assistive systems for those with cognitive impairments. In summary, MAPS provided both caregivers and clients the autonomy to act based on their capacity and morality, which they were unable to receive from traditional assistive systems.

In this example, researchers were able to address the fact that technologies have aimed to provide individuals with "universal solutions", which often fail to fit specific individuals' personal needs. As a result, technologies can often be disempowering, especially if they do not provide individuals with control.

Takeaway: To give individuals autonomy and foster their sense of autonomy and control, designers should investigate and evaluate what knowledge and abilities individuals have and how they can be reflected as the control individuals have over the interaction. As such, we take away the guideline, "Systems should allow individuals to apply their knowledge and abilities in controlling the interaction (A.2)."

Tailoring to individuals' culture, experiences, and values

Technologies are not neutral. Past HCI literature argues that modern technologies are laden with cultural, human, and social values [90]. Bødker points out that new human elements, such as culture, emotion, and experience have been increasingly appreciated in the new wave of HCI [17].

What people like, consider important, and value is tightly associated with one's living environment, cultural context, and social relations [87]. Individuals have higher perceived competence, control, and efficacy when dealing with tasks that are more related to their own culture, experiences, and values. As such, digital systems that are relevant and meaningful to individuals often leads to an increase in perceived capacity. From this, we takeaway the guideline that "Systems should aim to be relevant and meaningful to the individuals or groups that are being targeted as 'individuals' (B.1)."

Among our reviewed papers, six explicitly adopted this practice [16, 44, 45, 86, 94, 103]. In particular, three studies designed educational interactive games for kids from the developing world through gaining insights from local traditional games' rules and settings [44, 45, 103]. One study invited senior citizens to contribute their experiences and knowledge in re-creating technologies [86]. The other two papers described designs that incorporated virtual characters that were racial minorities and women [16, 94] to increase relevance among its target audience.

Tree-Tree: An Educational Mobile Game Inspired by Local Games

Kam et al. analyzed 28 traditional village games in India. They designed a cellphone-based game, Tree-Tree, to help children improve their English vocabulary of common Indian fruits [44]. This work extended game-based approaches to enhance education in the developing world.

Kam et al. first conducted a field observation and found that popular western-style mobile games did not work well in India as kids did not find those games intuitive and exciting. Two main factors contributed to such gap: (1) local rural kids had limited access and exposure to western videogames, and (2) local kids had different understandings and expectations, which were not aligned with the current western-style videogames. As such, rural kids did not feel that the popular video games were relatable and culturally meaningful despite the fact that these games had been proven to be effective in supporting children's education. Such mismatches can decrease rural kids' motivation to engage in these interactions. It also increases their sense and perception of normlessness and helplessness, which is negatively correlated to the feeling component of one's psychological empowerment [114].

After collecting and analyzing 28 traditional outdoor and indoor village games, Kam et al. summarized four common game mechanics and elements in these local games and compared them with western-style videogames. For example, they found that the opposing teams were usually pre-determined to be traditional before gameplay and stayed this way throughout the game. Traditional games usually have concrete end goals so that common western-style missions like exploring unknown territory are not meaningful in such context. Based on these insights, researchers designed Tree-Tree, which adopted the common game settings and rules of traditional games. Their evaluation showed that kids could easily relate Tree-Tree to the tradition games that they were familiar with, and they were able to immediately understand the winning conditions and rules of this game. At the same time, kids demonstrated higher capacity when interacting with this game and positive educational results after gameplay.

Takeaway: This study demonstrated the power of tailoring the setting, design, and goals to individuals' familiar and relatable cultures, values, and experiences, which allowed them to stay in their comfort zone. This can provide better support to individuals in leveraging their familiar past experiences to achieve positive outcomes including enhanced self-efficacy and motivation. In addition, tailoring to individuals' personal context and adding human values to design is especially helpful when designing for minority and underserved individuals and communities, and for those who are not familiar with modern digital technologies. Therefore, the guideline we take from this example and others is that "Systems' settings, designs, and goals should tailor to individuals' culture, value, and experiences (B.2)."

Knowing

The knowing part of the psychological empowerment suggests that individuals need to develop critical awareness. This component bridges the feeling and doing components; it connects "perceived control" within the feeling component and "exerting control" within the doing component [96]. Zimmerman defined critical awareness as the understanding of the social context, the particular norms and values of the environment and the awareness of the available and appropriate options and choices to achieve their goals [115]. At the same time, the knowing component of empowerment also supports individuals in developing important skills such as problem solving and decision making, and leadership. Zimmerman argues that these skills can be developed in situations and settings where individuals must make decisions [114]. These important skills are the contributing factors to individual's independence and control over events in their lives. More importantly, these skills empower individuals to become their own best advocate.

As such, to fulfill the knowing component, interactive systems should help individuals to build up (1) critical awareness towards their environment and accessible resources, and (2) necessary skills for them to handle and mobilize resources. Specifically, past HCI studies have demonstrated two main design practices that can support the knowing component: *linking individuals to resources, new knowledge, and options (C)*, and *providing individuals with frequent feedback (D)*.

Linking individuals to knowledge, resources, and options

Cattaneo and Chapman defined knowledge as "an understanding of the relevant social context, including the possible routes to goal attainment, the resources needed, and ways to obtain them [25, p.653]." According to Kieffer, linking individuals to information that support their goals and providing them with knowledge about the appropriate resources are key to improve their critical awareness and enhance the sense of empowerment [48]. As such, we contribute the design guideline that "Systems should link individuals to information that supports their goals (C.1)."

Among the papers we reviewed, nine papers empowered individuals by connecting them with helpful resources and information [4, 5, 7, 16, 50, 86, 94, 97, 98]. Five studies focused on using digital systems to improve individuals' accessibility to available information that they had limited access to or knowledge of so that individuals could expand their options or have options for future actions [4, 5, 86, 94, 98]. For example, Suzuki et al. designed a system for mentors to provide their mentees with helpful online MOOC training opportunities to expand their mentees' skillsets [98]. Three studies provided a platform for individuals to access consolidated information from various origins [7, 50, 94]. For example, Shroff et al. came up with design concepts that allowed semi-literate women from India to receive consolidated information, such as NGO events and gender equality workshop material, through SMS [94]. Finally, three studies used digital tools to connect individuals with the information and resources that were tailored to their specific needs [16, 86, 98]. Bickmore et al. designed a virtual nurse for patients with low health literacy at the time of discharge [16]. Instead of giving general instructions, the virtual nurse would have daily conversations with patients and explain what they needed to do based on their personal diagnoses.

Labella: An Augmented Wearable and Smartphone System

Almeida et al. designed and evaluated an augmented system, Lebella, which promotes pelvic fitness among women and

their intimate bodily knowledge [4]. To prevent incontinence and improve their overall health and wellbeing, women must understand their own intimate anatomy. However, women often have misconceptions and low literacy on intimate parts of their body and could benefit from empowering their personal health and well-being.

Barriers to achieving this level of awareness include the following: (1) women's limited options and channels to access related information, (2) existing resources and images are not specific to the individual, and (3) stigma of the female body brought about by complex social-cultural constructions.

Lebella is a platform that connects women to the information and knowledge that is relevant to their pelvic fitness. Lebella enables women to explore intimate parts of their bodies with on-body underwear for embodied interaction, which allows for embodied discovery. Individuals can see the augmentation of their perineum, an illustrated mirrored image of their external genitalia, pelvic floor, and muscle structure. The researchers found that enabling women to "look" at their own body this way supports "hidden" self-knowledge. The system also prompts women with techniques to exercise their pelvic floor muscles, and it illustrates the relaxing and contracting of those muscles. Also, Lebella also suggests the best practices of incorporating this exercise into women's daily routines.

Designers of Lebella adopted humor in their final design, which provided women with a certain level comfort to help break the corresponding emotional and social taboo and stigma. Researchers noted that having humorous interactions can help women accept "awkward" messages to break the taboo. Such interactions allow digital systems to provide individuals with knowledge and resources that are often blocked with social-cultural constructions. This example illustrates the use of digital tools to provide individuals with alternative methods to obtain resources that individuals cannot otherwise access.

Takeaway: Designers should investigate the factors that contribute to individuals' lack of resources and then bridge this gap accordingly. In particular, designers should evaluate whether the lack of resources is caused by the limited availability of resources, limited accessibility to the existing resources, lack of awareness of the importance of certain domain knowledge, or the challenges relating to general information that is not relevant to specific individuals. Based on the determining factor, designers can then strategically provide individuals with useful information and improve their critical awareness. Therefore, we contribute the guideline that "Designers should investigate what resources individuals need (C.2)", and "Systems should aim to provide methods to obtain necessary resources (C.3)."

Providing individuals with frequent feedback

Providing individuals with critical feedback can help them to develop important skills and competence, which is one of the key elements of the doing component of psychological development. This is also key to one's access to knowledge, resources, and options.

Getting feedback and developing new skills to accomplish desired goals and tasks is closely tied to the other psychological empowerment components. Learning new skills can effectively help individuals to improve their perceived self-efficacy and capacity. This supports the *feeling* component. At the same time, learning new skills can also encourage individuals to take actions that will in turn further refine their skills. This supports the *doing* component. As such, we summarize the design guideline that "Systems should provide individuals with constant feedback on their progress (D.1)".

Among the papers in our corpus, six provided individuals with frequent feedback [16, 23, 28, 36, 68, 98]. Three studies provided a channel to illustrate individuals' progress on achieving their tasks and allowed their mentors or advisors to keep them on track [16, 23, 28, 98]. One study enabled the system to provide individuals with instant feedback once they triggered an error [36]. Further, the last study explicitly adopted a method to provide delayed feedback to individuals to encourage self-exploration and learning on erring [68]. We analyze this study next.

ANIMATE: A Tutoring System

Nathan designed and evaluated an interactive tutoring system, ANIMATE, to teach students how to understand and solve mathematical word problems. The system guided students in constructing an animated situation model and a valid problem schema [68]. A problem schema is an implicit mental structure that is generated through the process spanning from reading the initial problem to coming up with a solution [83]. Helping students to construct a formal problem schema supports students in understanding the relationship between the specific problem and the necessary cognitive tasks associated to the problem solving process. In this way, students are able to apply a similar problem schema in their future problem solving processes.

Compared to traditional tutoring systems that provide students with rigid steps to solve mathematical problems, ANIMATE enables students to address each task or problem in their own style and pace, and allows students to assess their own performance. When given a word problem (e.g., calculating the time until two vehicles meet), students can use ANIMATE to organize the problem information into a graphical arrangement of nodes and arcs that illustrate the relationships between variables and their values. With minimal guidance on how to construct such network problem schemas, students have the freedom to approach the problem from different perspectives based on their understanding and knowledge. Once students feel their problem schemas are valid, they can run the animated simulation on ANIMATE to get feedback on whether their model works as expected.

Takeaway: In the example above, the system encourages individuals' independent exploration and learning by erring. It provides individuals with an environment that helps them to get frequent feedback on their performance, diagnose their problem solve errors, and put themselves back on track without impairing their learning process. In this way, individuals can leverage the system's feedback to assist their personal development. Deriving from this example and others, we

summarize the design guideline that "Systems should offer feedback that facilitates individuals' learning process (D.2)."

Doing

The doing manifestation refers to the actions taken or participation necessary to directly impact outcomes [114]. "Getting involved" and participation are critical to enhancing one's sense of empowerment. These help individuals feel and experience the affinity with others [14]. Lord and Hutchison pointed out that individuals can often experience and benefit from social interaction, because it mitigates social isolation [57]. The doing component of psychological empowerment is tightly connected with the other components as it is motivated by one's beliefs about their capacity, informed by their knowledge and resources, and carried out applying necessary skills learned [25]. As a result, to support the doing component, interactive systems should (1) facilitate one's action taking and (2) help individuals to participate and get involved in social activities and social groups. Two main design practices have been adopted by past HCI studies to achieve these two objectives: *dividing and conquering (E)* and *encouraging collaboration and social interaction (F)*.

Dividing and conquering tasks

Divide-and-conquer is a popular problem solving paradigm, which refers to breaking down a problem or task into a series of sub-problems and sub-tasks until these sub-problems and tasks are simple enough to be addressed.

Having concrete and achievable goals leads to successful learning [56]. Scaffolding a big problem or task enables individuals to have higher perceived control over smaller and simpler goals. This supports individuals' ability to apply what they have learned to conquer each goal. Focusing on smaller tasks helps to keep individuals on track. At the same time, achieving one goal makes it easier to achieve another one [67]. This is because individuals can refine their skills during the process of completing small tasks, and achieving small but constant milestones provide them with the opportunity to receive frequent feedback if possible. More importantly, individuals can gain a sense of accomplishment through continuously tackling smaller goals. This in turn helps individuals to improve their sense of capacity [25]. Overall, dividing and conquering can effectively support individuals in taking more concrete actions. We takeaway the design guideline that "Systems, especially goal-based systems, should assist in breaking down tasks into achievable steps (E.1)."

Of the papers we reviewed, four adopted the dividing and conquering design practice [24, 28, 98, 108]. Among these papers, three allowed a more experienced and knowledgeable individual, such as a career mentor or a professional caregiver, to break down the problem into chunks and supported those who were disempowered to complete the task [24, 28, 98]. Also, one study applied the method of dividing the challenge into tasks with various difficulties to facilitate individuals' action taking. At the same time, individuals demonstrate their ability level by tackling tasks of varying difficulty levels [108].

Atelier: A Micro-internship Platform

Suzuki et al. designed and implemented Atelier, a micro-internship platform, that allows crowd workers to develop their employment skills with mentors and paid real-world work experiences. Atelier connects interns (crowd workers) with mentors (crowd experts) who are more experienced on Upwork, a well-known crowdsourcing marketplace [98].

In an online survey with 96 Upwork crowd workers to investigate crowd workers' current career development stage, Suzuki et al. found that crowd workers often faced difficulties developing their skills because of the heavy competition and financial constraints. In particular, individuals with limited skills and domain knowledge face a high cost for skill development due to the deep learning curve and the large amount of time they have to spend on learning. This leads to fewer available work hours and lower wages. Additionally, those with limited experience and reputation often have a hard to time landing work even if they successfully learned the new skills that were necessary to obtain employment. Because employers tend to hire crowd workers based on their past working experience, ratings, and certifications, newcomers face difficulties getting hired. Further, even if inexperienced crowd workers are successfully selected, they may not work as efficiently as needed given their limited expertise and face difficulties making meaningful progress. Therefore, such barriers often discourage crowd workers from taking actions to expand their skillset and successfully find and complete tasks.

To address this challenge, Atelier pairs inexperienced crowd workers with crowd experts in the same domain and enables mentor and intern pairs to complete tasks as a duo. This mechanism allows mentors to apply for tasks with their qualifications and allow interns to work closely with them to complete the task. The platform allows these stakeholders to collaboratively break down selected crowdsourcing tasks into detailed milestones based on the mentor's professional experience and the intern's current skills and abilities. The mentor guides crowd workers on how to complete each macro-level milestone by providing detailed steps. Atelier then generates a checklist that reflects each step and ultimate milestone so that crowd workers can check off milestones as they complete and mentors can monitor their intern's progress and provide support if needed. Overall, Atlier divides and conquers smaller tasks and goals to help interns move forward, produce high-quality deliverables, and understand the best workplace practices.

Takeaway: In the above example, the system assists individuals' action taking by inviting experts to break down the task into manageable chunks for novices. More importantly, the Atelier system has a support mechanism in place to ensure that individuals can receive support when needed. Such a mechanism prevents individuals from becoming discouraged and giving up. As such, this leads to the design guideline that, "Systems should provide support when individuals are faced with challenges regarding specific steps (E.2)."

Encouraging collaboration and participation

Collaboration exists when individuals, groups, or organizations complete tasks together to achieve a goal [60], and it is an important form of social interaction. As discussed earlier, participation and collaboration are critical in fostering social

Psychological Component	Design Practice	Design Guideline
Feeling	A. Giving individuals autonomy	A.1. Systems should aim to provide individuals with the ability to customize their experiences to accomplish their goals A.2. Systems should allow individuals to apply their knowledge and abilities in controlling the interaction
	B. Tailoring to individuals' culture, experience, and values	B.1. Systems should aim to be relevant and meaningful to the individuals or groups that are being targeted as 'individuals' B.2. Systems' settings, designs, and goals should tailor to individuals' culture, value, and experiences
Knowing	C. Connecting individuals to knowledge, resources, and options	C.1. Systems should link individuals to information that supports their goals C.2. Designers should investigate what resources individuals need C.3. Systems should aim to provide methods to obtain necessary resources
	D. Providing individuals with frequent feedback	D.1. Systems should provide individuals with constant feedback on their progress D.2. Systems should offer feedback that facilitates individuals' learning process
Doing	E. Dividing and conquering tasks	E.1. Systems, especially goal-based systems, should assist in breaking down tasks into achievable steps E.2. Systems should provide support when individuals are faced with challenges regarding specific steps
	F. Encourage collaboration and participation	F.1. Systems should aim to facilitate the collaboration between individuals, groups, and communities F.2. Systems should aim to lower the barriers to participate in collective action

Table 1. Recommended Design Practices and Guidelines for Empowerment

capital and helping individuals to exert power and influence and play key roles in reducing social isolation [57, 14]. At the same time, collaborating with others and participating in groups can help individuals access resources and develop a more diversified skillset. This helps in terms of increasing and perceiving increased individual capacity. Therefore, we put forward that "Systems should aim to facilitate the collaboration between individuals, groups, and communities (F.1)."

Among the past HCI studies we reviewed, eleven digital interactive systems incorporated collaboration to accomplish goals [7, 23, 21, 43, 50, 61, 86, 94, 98, 100, 105]. Interactive systems can encourage individuals' to collaborate with others in both digital and physical spaces. More specifically, they can connect individuals who have similar needs and goals. For example, online platforms can connect parents with special-needs kids and fundraising and advocacy activities [7]. Interactive systems can also enable individuals to collaborate with individuals who have more experience and skills [98]. Further, digital systems can extend collaboration to physical spaces and increase engagement in community organizations, group activities and design processes [23, 21, 43, 50, 61, 86, 94, 100, 105].

Viewpoint: A Public Voting Device

Democracy-related technologies have focused on facilitating elections, such as making it easier to place and count votes [51, 40]. In contrast, Taylor et al. designed and implemented a public voting device, Viewpoint, that allows individuals from disadvantaged and marginalized communities to voice out their public service concerns and become more involved in policy and decision-making processes [100].

Traditional forms of civic engagement, such as town hall meetings, are time-consuming and inefficient. As such, modern media and technologies have been playing increasingly important roles in civic engagement and communication. However, members from disadvantaged communities are often excluded from such social interaction [57]. For example, the proliferation of internet-based voting and civic engagement systems can exclude individuals with limited access to the Internet and computers such as senior citizens, people with lower digital literacy and education attainment, or people with low income. As such, these underserved and disadvantaged populations are often excluded from the dialogue and disempowered from taking actions to exert influence over improving public service provisions in their communities.

To overcome these barriers, Taylor et al. implemented Viewpoint, a physical information appliance so that they could place it in public spaces such as grocery stores and gas stations. This allowed a wider public to interact with the system. Viewpoint has a simple interface and a straightforward interaction mechanism so that individuals with limited digital skills can easily understand how to use it. Specifically, Viewpoint consists of a screen and two large physical buttons. The screen displays one question related to local public services posted by local elected officials and community organizations. individuals can simply press a "Yes" or "No" button to declare their opinions. At the same time, individuals can see the real-time statistics of the voting results of this question.

The Viewpoint deployment successfully engaged members from two local disadvantaged groups to participate in the decision-making process. It also helped local community groups receive votes from the public like never before. Participating in the dialogue and making the community's voice heard also enhanced a sense of collective efficacy in the community, which can potentially contribute to further actions.

Takeaway: This example encourages individuals' participation in collaborative and collective actions by mitigating and lowering the barrier to participation. It demonstrates how to use technologies with simple interfaces and interactions to engage disempowered individuals and supports social interaction. We

put forward the design guideline that "Systems should aim to lower the barriers to participate in collective action (F.2)."

DISCUSSION

Our empirical findings suggest that the *feeling* manifestation of the HCI empowerment framework's psychological component has been primarily achieved by the design practices: *giving individuals autonomy* and *tailoring to individuals' culture, experience, and values*; the *knowing* manifestation primarily achieved by *linking individuals to knowledge, resources, and options* and "*providing individuals with frequent feedback*; and the *doing* manifestation has primarily been supported through *dividing and conquering tasks* and *encouraging collaborations and participation* (see Table 1).

Our design practices and guidelines are relevant across various types of system designs and lines of research. Together with the existing HCI empowerment framework [89], these design practices and guidelines can serve as a practical rubric for future HCI researchers, designers, practitioners, and potentially users themselves.

We would like to highlight that the feeling, knowing, and doing manifestations of the psychological components are interdependent and interconnected and that there is no time order or hierarchy order among these three manifestations. Past studies suggest that empowered individuals often have a combination of a sense of control (feeling), critical awareness of the available resources and their surroundings (knowing), and concrete action taking and involvement in their communities (doing) [115]. At the same time, these components can hold different weights in an empowered agent. As such, an interactive system that successfully fulfills all feeling, knowing, and doing manifestations would result in a highly empowering system. However, we find that incorporating any of these manifestations could be effective.

Overall, our findings extend Schneider et al. empowerment framework in HCI, a theoretical contribution, and provide practical design guidelines to designers and practitioners. We also confirm and extend Schneider's most recent work, which provides a set of principles for designing empowering health and wellbeing technologies. In the rest of our discussion, we summarize and discuss these guidelines. We provide examples to demonstrate how to apply the HCI empowerment framework and our guidelines in practice. We then discuss how works outside of our original corpus fit into our framework to contextualize our findings and the limitations of our work. Finally, we conclude our paper with a discussion of future work.

In order to determine which psychological components to target and which design practices to follow, designers should first evaluate the line of research their system belongs to and then decide whether the system should focus on feeling, knowing, or doing. In particular, Schneider et al. HCI empowerment framework provides eight lines of empowerment-related research that are mapped to different manifestations of the psychological component [89] (Table 2). Given a specific manifestation (feeling, knowing, or doing), designers can refer to the corresponding empowerment design practices and their detailed guidelines as summarized in Table 1.

To illustrate how to apply the HCI empowerment framework and empowerment guidelines, we use PosterVote [106], which aims to promote grass-root social movements among activist communities. This study aligns with the 8th line of research, "Community Empowerment" because it aims to help disempowered communities confront the ones "in power" [89]. This line of research aligns with the *doing* psychological component in Table 2. This allows researcher to investigate and evaluate which design practices can better support their targeted psychological components by referring to Table 1. In the example of PosterVote, researchers can choose to "divide and conquer tasks (E)" and/or "encourage collaboration and participation (F)" to help activist communities collect community members' votes to apply pressure on local authorities. Researchers can lastly refer to the detailed corresponding empowerment guidelines to inform and evaluate their system design. In particular, PosterVote applies the design practice of "dividing and conquering tasks (E)" by breaking down the grassroot social movement task into four main steps—setting up the agenda, deploying the voting installations in the community, allowing people to vote on the installation, and collecting votes data (Design Practice E.1). PosterVote also applies the design practice of "encouraging collaboration and participation (F)" by (1) enabling less engaged citizens to voice out and contribute to activist communities' effort (Design Practice F.1) and (2) incorporating simple design and interaction to motivate wider public participation regardless of their digital literacy (Design Practice F.2). In this way, PosterVote covers most design guidelines that exist under the Doing psychological component. However, if researchers would like to further improve the PosterVote system, they could look into incorporating missing guidelines. For example, PosterVote can have support mechanisms in place if individuals are faced with challenges achieving one of the four main steps discussed above (Design Practice E.2).

Overall, our empowerment practices and guidelines provide a practical component to the HCI empowerment framework. As illustrated in the above example, our empowerment practices and guidelines offer more complete and structured guides to help stakeholders (1) brainstorm design ideas, (2) design and develop new empowering technologies, and (3) evaluate and improve on existing systems.

Providing a Holistic Understanding of Empowerment

Applying Empowerment Guidelines to Practice

This study confirms and extends the existing literature on empowerment theories and on HCI design for social justice, social change, and equality. Our empowerment design practices and guidelines share and adopt many interests and techniques from related approaches to system design—social informatics, socially just design, participatory design, user-centered design, value sensitive design, and ability-based design, as mentioned in our related work. Most of the core values of these design principles are reflected in empowerment design practices and guidelines. For example, social informatics and value sensitive design emphasizes cultural contexts and human values

Line of Research	Feeling	Knowing	Doing
1. Empowering Experiences	●		
2. Skills and Education		●	
3. Self-enhancement			●
4. Holistic Approaches	●	●	●
5. Empowerment through Design Process	●	●	●
6. Technology for Development	●	●	●
7. Protective Technology			●
8. Community Empowerment			●

Table 2. Lines of research and corresponding psychological component. Adapted from [89]

respectively, and they are effectively reflected in the empowerment practice *tailor to individuals' cultures, experiences, and values*. The design practice *give individuals autonomy* captures user-centered design's focus on individuals and their needs, and Participatory Design is central to the empowerment practice of *encouraging collaboration and participation*.

We view our empowerment practices and guidelines as being holistic in nature. They span various domains, and provide an overarching structure for future empowerment design in HCI research. These practices and guidelines are derived from a systematic review of a corpus of past HCI studies in education (e.g. [68]), health and wellness (e.g. [16]), civic engagement (e.g. [100]), and community development (e.g. [43]).

Past research that proposed design principles for empowerment has focused on a specific technology domain (e.g., health and wellbeing technology [88] and social media [7]). In conducting three case studies on empowering health and wellbeing technology through the perspective of the Capability Approach [91, 70]. Schneider reflected and summarized three design principles for empowerment design [88]: empowering designs should (1) offer valued choices, (2) offer valued alternatives, and (3) acknowledge both experts' and users' perspectives [88]. We find that all three principles are consistent with our findings, particularly with the design practices of *linking individuals to knowledge, resources, and options* (knowing) and *tailoring to individuals' culture, experience, and values* (feeling). Further, we identify one more design practice for both the feeling and knowing components and emphasize two practices under the doing component, which were not covered in Schneider's work. We believe that the exclusion of the doing component might have contributed to these results. The work is based on the author's own personal reflections after analyzing three case studies whereas we contribute a more holistic analysis in our work. Notably, Schneider has taken "disempowerment" and "disempowering qualities" of systems into consideration when summarizing design principles, which we did not assess in our review. However, the overlapping findings suggest that our practices and guidelines could be used in this context. Further research is needed nonetheless.

Overall, our study contributes to the HCI and DIS communities by expanding the HCI empowerment framework and extending the theoretical framework to designing empowering interactive systems in practice. We contribute empowerment practices and guidelines and provide a theoretical foundation to these design practices and guidelines. This study brings us a step closer to answering Schneider et al.'s call to develop design guidelines and identify best practices that can lead to effective empowerment [89].

Limitations

We acknowledge that our corpus was heavily based on the corpus constructed by Schneider et al. in their survey [89], which was limited to CHI papers (no posters, keynotes, or workshops) that used one of the terms "empowerment" and "empower" at least once. As such, many works, including those published in and after 2018 and in other venues including DIS were excluded from our corpus. However, we use PosterVote [106], an example from the DIS literature, to demonstrate how to apply our empowerment practices and guidelines. We recognize that our empowerment practices and guidelines may not be exhaustive, and we hope to address this limitation going forward by replicating this study across a wider set of studies from various venues.

Next, we acknowledge that our contributions include guidelines that serve primarily as a checklist and are not measurable. We should clarify that developing a universal measure of what outcomes of empowerment would entail is both infeasible and has no meaning conceptually. As we stated earlier, the meaning of empowerment is context and population specific [115]. Measuring the outcome of each design practice and overall empowerment of interactive systems requires future researchers to engage with specific groups in particular contexts, especially when designing empowering systems for marginalized populations.

CONCLUSION AND FUTURE WORK

In this study, we conducted a systematic review of 33 HCI studies that focus on the design of empowering interactive systems. We analyzed and summarized six common empowering design practices and mapped them to the HCI empowerment framework's psychological empowerment components. Drawing insights from social science literature and our empirical study, we identified a series of empowerment guidelines that can help future HCI designers and practitioners to brainstorm, develop, and evaluate interactive systems that empower. However, this is just a starting point, and there is no universal measure for empowerment. Moving forward, we plan to investigate system factors that have led to the disempowerment of individuals, especially those from marginalized populations [29, 33, 47, 101].

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