Playing Smart

Playful Civic Learning in Human-Centered Smart City Development

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PROGRAM STATEMENT ON THE MASTER OF GRAPHIC DESIGN FINAL PROJECT

This document details a final project, which in design is commonly referred to as a graduate "thesis," at North Carolina State University. The work was defined in a 3-credit course in a fall semester, and executed in a 6-credit course in the following spring semester. The Master of Graphic Design is a terminal professional degree with a research orientation, but like the MFA and MDes, it is not a primary research degree. This is a discovery-based investigation. Cash (2018) describes the process of building scientific knowledge as a cycle between theory building and theory testing. The theory building mode includes (1) discovery and description, (2) definition of variables and limitation of domain, and (3) relationship building (pp. 88–89). This investigation is restricted to the theory building mode. The theory testing mode includes (4) prediction, testing, and validation, and (5) extension and refinement (p. 89). While experts may have been consulted, this investigation does not entail any testing with human subjects, and it does not endeavor to prove anything; all assertions are tentative and speculative.

See: Cash, P. J. (2018). Developing theory-driven design research. *Design Studies,* 56, 84–119.

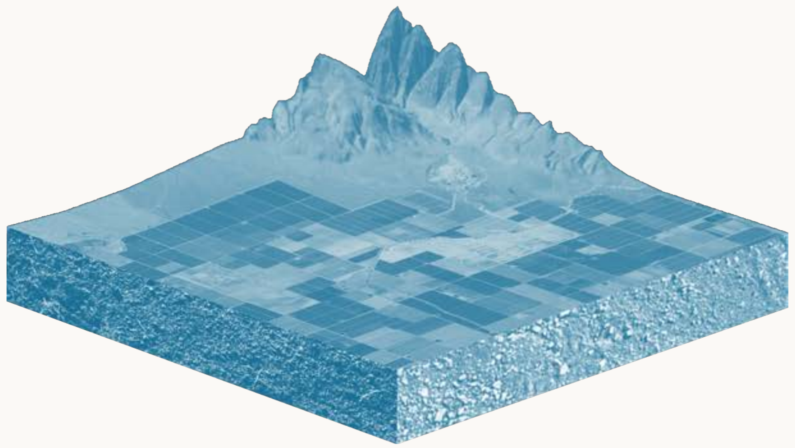

FIGURE 0.01

ENVIRONMENT

The natural world and the resources it provides

ABSTRACT

Ubiquitous and invisible technologies are being implemented into municipal governance internationally at an exponential rate. To ensure a sustainable democracy in these smart cities, they must develop per the values of their citizens. An intervention is needed to establish a base of citizens who are digitally literate and equipped to advocate for their values in this new civic domain. This investigation fills this need with a playful workshop experience encouraging mental model formation, daily routine contextualization, and community discussion through a digital interface and a physical toolkit for hands-on exploration. Mapped onto Kolb's Experiential Learning Cycle, this design investigation instills a lasting understanding of smart technology in citizens, develops their critical thinking skills, and prepares them for resilient advocacy for their values in the development of smart cities.

FIGURE 0.02

INFRASTRUCTURE

The fundamental structures and systems that make up the city

FIGURE 0.03

SMART TECHNOLOGY

The digital twin: ubiquitous, invisible, and esoteric

ACKNOWLEDGEMENTS

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To my committee: Kermit Bailey, Scott Townsend, and Denise Gonzales Crisp, for your guidance, support, and patience to sit through my rambling.

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And to my mom and sister for your love, support, and for giving me something to look forward to at the end of every week.

FIGURE 0.04

POPULATION

The nodes of social systems and generators of data

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FIGURE 0.05

PLAY

The magic circle: where reality and rules of the world are suspended and replaced by a temporary, artificial reality

CHAPTER ONE

INTRODUCTION

"Cities have the capability of providing something for everybody, only because, and only when, they are created by everybody."

— Jane Jacobs, The Death and Life of Great American Cities

MISSING THE FOREST FOR THE TREES

At the turn of the nineteenth century, Germany's economy was threatened by a national wood shortage. New mathematical techniques, however, promised to save the economy through optimization. The natural complexities of the forests, from sporadic tree placement to other flora and fauna, threatened the bare requirements of timber production and were replaced with orderly rows cleared of underbrush. At first, wood production rapidly increased, prompting an international surge in optimized forest production. But after a couple generations, production plummeted irreversibly. By creating a monoculture, the forests were left vulnerable to disease and rough weather. Germany fell victim to a myopic view of the complex and misunderstood system of forests. By making the system more efficient for a specific measurable value, they lost sight of the core value of any complex system: diversity and the creation of inimitable order through an infinity of small acts (Greenfield, 2014; Green, 2019, pp. 144-152).

The future of our cities is vulnerable to this same myopic trap. As cities become smarter — imbued with technology that only speaks in binary — the question becomes: what specific measurable value of cities are we making most efficient and what stands to get cleared out with the underbrush?

SMART CITIES: THE DISCOURSE BEHIND THE TERM

If you were to do a cursory search about smart cities now, you might find a definition like a municipality that uses smart technologies, such as sensors, to collect data and run services efficiently. You may also find visions of the future dreamt up by a series of name brand Fortune 500 companies. Take IBM, for example, which defines the smart city as “one that makes optimal use of all the interconnected information available today to better understand and control its operations and optimize the use of limited resources” (Albino et al., 2015, p. 5). Or take major player Siemens, which imagines “several decades from now cities will have countless autonomous, intelligently functioning IT systems that will have perfect knowledge of users’ habits and energy consumption, and provide optimum service” (Greenfield, 2013, p. 1). Take a look back at these definitions. Notice anything missing? Many established definitions of smart cities disregard the one thing that makes a city a city: its citizens.

Because these imagined urban futures are rhetorical (for now), we are able to extract the values and beliefs that are built into them (Greenfield, 2014). The priority in their development is clear: optimization. But the diversity of wants, needs, and values, and the people that hold them, cannot be boiled down to a binary decision. In fact, vital pieces of the development of cities are deeply inefficient: deliberation, justice, and democracy itself.

The complexities of society and the affordances of smart technologies: the two do not have to be mutually exclusive. But there is a need for

a diverse group of citizens who are able to advocate for their values to avoid a weak and unsustainable monoculture. Caragliu et al. (2011) provide a more nuanced definition of smart city: “a city is smart when investments in human and social capital and traditional and modern communication infrastructure fuel sustainable economic growth and a high quality of life through participatory governance” (p. 6). This investigation aims to do just that: invest in the inherent social capital of cities, educate their citizens on smart technology, and empower them to advocate for their values in the development of smart cities.

CHAPTER TWO

PROBLEM SPACE

2.1 PROBLEM STATEMENT

The participation of citizens in their government is central to the democratic process and acts as the core to most democratic ideals. High citizen participation in local government leads to democratic solutions, services, and development more in line with the expectations, needs, wants, and values of their citizen base (Berntzen & Johannessen, 2016). This continues to be the case as more cities label themselves as "smart" through the active pursuit of modern technology for increasing their citizens' quality of life. Participation between citizens and their government is essential to the development of smart cities (Coe et al., 2001).

Despite the essential role of, and increased calls for this participation, smart city residents have been largely uninvolved in the development of smart cities (Thomas et al., 2016). When citizens have been involved, their participation was limited to feedback on the smart city technology following its conceptualization and implementation by academics and urban designers (Thomas et al., 2016). This level of engagement falls directly in the middle of Arnstein's (1969) ladder of citizen participation (Figure 2.1.01), a rung within the range of tokenism, i.e. efforts that are purely symbolic. Smart cities often do not reach their increased quality of life objectives because citizens have not been properly involved in the definition of those objectives, nor have their needs and wants been heard or considered (Simonofski et al., 2017).

One of the many barriers inhibiting effective flow of participation between city governments and their residents is a lack of appropriate digital literacy. Being informed and educated about smart city technology and its implications is a prerequisite for a citizen to properly advocate for their needs and wants in its implementation (Berntzen & Johannessen, 2016). Furthermore, it is a prerequisite in maintaining the citizen's power and agency (Frohbose, 2020). Unfortunately, the attributes that make this smart technology important for citizens to understand are the same attributes that stand in the way of doing just that. A technology being unobtrusive, seamless, and invisible are some of the exact qualities that make it "smart" in the first place (Frohbose, 2020). The opaque nature of smart devices to technologically illiterate citizens makes it impossible to understand without early, intentional education (Rabari & Storper, 2014). Without digital literacy in smart technology, citizens are unable to properly advocate for their values in smart city development.

A detrimental outcome of this lack of digital literacy is the amplification of already overrepresented voices in the civic participation process (Green, 2019). Because informed citizen input in smart cities is predicated on their digital literacy, those who have had access to learning about smart technology previously are the only ones being heard. Due to actual and perceived societal barriers in technology access, these people are overwhelmingly white, wealthy, well-educated males (Porter & Donthu, 2006). This is the same demographic that has dominated the civic participation space before the introduction of civic technology (van Holm, 2019).

A 2016 survey of 54 cities in the United States found that they had collectively planned or implemented over 800 smart city projects (Green, 2019), with that number continuing to increase. If these cities truly want to grow in line with the needs and wants of their residents, they must first prioritize creating an informed, educated, and participatory set of diverse citizens (Berntzen & Johannessen, 2016).

2.2 JUSTIFICATION

Simonofski et al. (2017) introduce a citizen participation framework that can be used as guidelines for implementation (Figure 2.2.01). They suggest citizen participation in smart cities is composite in nature and can be divided into three categories — Citizens as Democratic Participants, Citizens as Co-Creators, and Citizens as ICT users — each with their own subcategories and necessary criteria. In this investigation, I propose that the Citizens as Co-Creators within the subcategories of Living Labs and Online Platforms have the most potential for design intervention. This is not to imply that the other subcategories need not be fulfilled but that they are outside the scope of this investigation.

The design opportunities of this intervention are two-fold. First, the intervention serves as an educational tool to properly inform citizens on smart city technology and development so that a diverse range of voices can advocate for their values. Education is "among the central aspects of achieving success" with smart city technology (Mahmood, 2019, p. 63). Ratti and Townsend (2011) assert that the sociability aspect of smart city education is the best starting point for a design intervention. Moreover, Rabari and Storper (2014) identify the need for a designed online platform where information about smart technologies can be commented on, discussed, and deliberated over between individuals and public decision-makers. Second, this intervention is a means to activate the experiences and competencies of citizens to propose (and thus record and collect) better, more failure-resistant solutions (Berntzen & Johannessen, 2016). In this investigation, these design opportunities work hand in hand; I suggest that continuous, mediated experiential learning satisfies the requirements for an innovative technology to be understood and adopted.

FIGURE 2.1.01

Arnstein's (1969) ladder of citizen participation

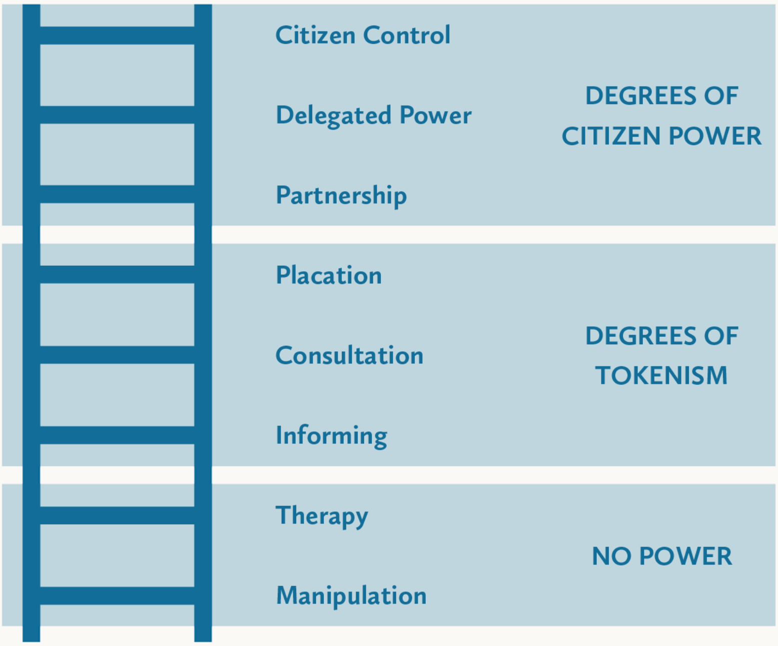
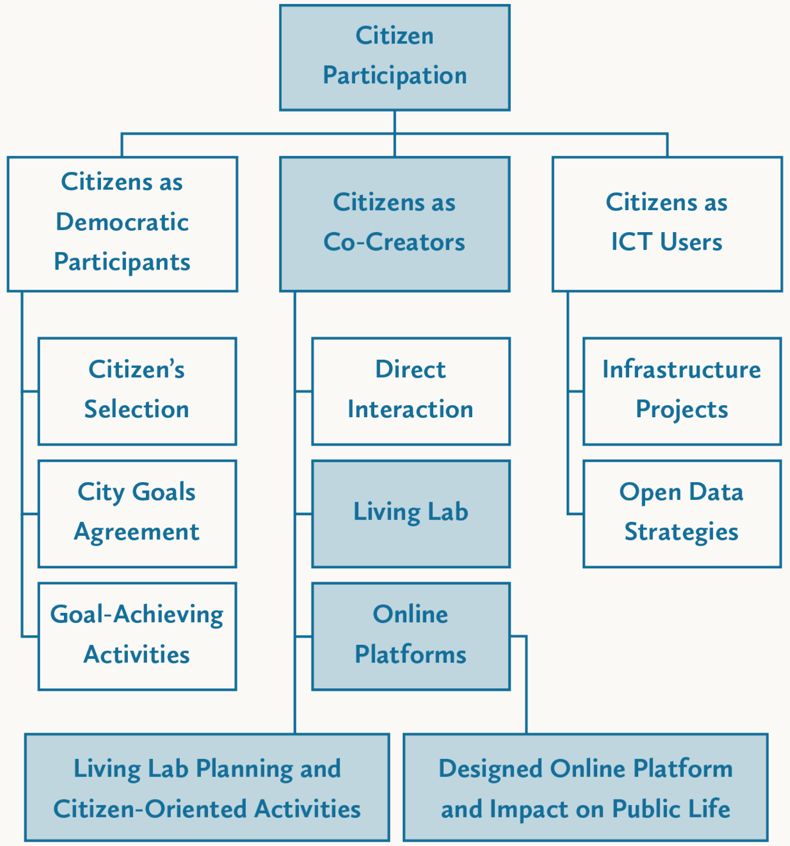


FIGURE 2.2.01

Simonofski et al.'s (2017) citizen participation evaluation framework with the scope of this investigation's design intervention highlighted



2.3 ANNOTATED BIBLIOGRAPHY

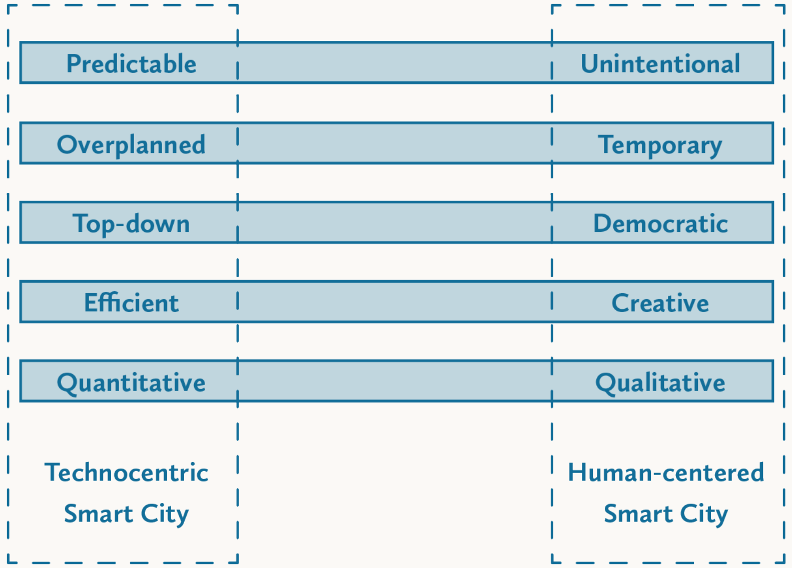
NEW SMART CITY PARADIGMS

There is a dissonance between how thriving cities operate and the primary objective of smart cities as we know them today. Relying on the innovativeness of technology as an end rather than a means, smart cities attempt to predict, control, and make efficient the beneficially messy nature of cities (Greenfield, 2013). Urban studies author Jane Jacobs explains that trying to make cities more efficient so technology can be implemented ignores that what may be perceived as inefficiency to a technologist actually "represent[s] a complex and highly developed form of order" (Green, 2019, p. 152).

In response to these critiques, many urban planners have called for a new form of smart city: the human-centered smart city, see Figure 2.3.01 (Andreani et al., 2019). This new form attempts to embrace the creative and unpredictable nature of humans through a bottom-up approach, using participatory and collaborative technologies to solve urban problems (Oliveira & Campolargo, 2015). These kinds of cities value the lived experiences of citizens over the visual order of their data (Green, 2019).

FIGURE 2.3.01

A comparison of a technocratic smart city and a human-centered smart city (Andreani et al., 2019)



ADOPTION OF TECHNOLOGY

There are multiple theories that explain why certain technologies are adopted. For the scope of this investigation, the Technology Acceptance Model (TAM), the Technology Readiness Index (TRI), and the Diffusion of Innovation Theory (DOI) were studied. Davis' (1985) TAM asserts that an individual's perception of the usefulness and ease of use of a technology will lead to increased intention to use that technology. While the TAM is centered around a specific technology, the TRI measures beliefs on innovative technologies in general (Godoe, 2012). Parasuraman's (2000) TRI illustrates that a person's four technology-related belief structures — optimism, innovativeness, discomfort, and insecurity — determine their predisposition to interact with new technologies. Rogers' (1962) DOI theory explains how an innovative idea or product gains momentum and diffuses through a social system to eventually adopt it. Rogers emphasizes the importance of understanding the innovation's target population, going so far as to establish five adopter categories: innovators, early adopters, early majority, late majority, and laggards. Laggards, he specifies, are often the most likely to need the benefits of an innovation due to their socioeconomic status but are the last to adopt it (Sahin, 2006). Rogers also defined the five main factors that influence adoption of an innovation: relative advantage, compatibility, complexity, trialability, and observability (see Table 3.1.02).

It is important to note that, for all three of these frameworks, it is the *perception* of the technology's respective factors that are influencing the individual, not necessarily the *actual* state of the factors. Using DOI as an example: to an individual, the *perceived* relative advantage is more influential than the *actual* relative advantage.

PLAYFUL CIVIC LEARNING

The study of play in the context of learning has a long history, going back so far as ancient Greece. The benefits of play (the activity) and playfulness (the mindset) have long been recognized in, and inextricably linked to, social and cultural behaviors, literacy and comprehension, emotional intelligence, and creativity in both children and adults (Golinkoff & Hirsh-Pasek, 2006). Because of its pervasiveness in all disciplines, inherent ambiguity, and hypocritical nature, defining "play" has been the subject of many scholarly writings without much consensus (Tanis, 2012). The most agreed upon description of play comes from seminal play theorist Johan Huizinga in his 1938 book *Homo Ludens,* in which he breaks down "play" into its core pieces: it must be fully absorbing, include elements of uncertainty, and most importantly, must exist outside of ordinary life (Gordon, 2008).

Play, especially when structured, goes hand in hand with learning because it contains built-in moments of reflection and sense-making while simultaneously overcoming creative and communicative barriers (Tanis, 2012). These same elements can also be found in pedagogical models like Kolb's Learning Cycle (Kolb, 2014), wherein knowledge is created by having and reflecting on experiences. By extension, these same elements are integrated into deeper, thicker methods of civic engagement, such as civic learning. Civic learning "takes place when citizens can reflect upon acts of [civic] participation and contextualize their actions to understand the end view of that moment of participation" (Baldwin-Philippi & Gordon, 2014, p. 762). Playfulness, experiential learning, and civic participation boil down to the same basic parts.

Because of their similarities, the development and daily use of cities have had a long tradition of playfulness. According to Henri Lefebvre, cities are made of not only their construction but in the social practices and routines they create. By extension, these spaces must be conceived as a product of playfulness "since play is an intrinsic social movement emergent by the relationships between people" (De Souza e Silva & Hjorth, 2009, p. 604). There are hundreds of examples of play and games that can be found in cities, especially with the rise of smartphone mobile games. It is thus not surprising that games have become an emerging research area in the urban planning process. These games, often labeled as "serious games," are beneficial because they allow for stakeholders to explore and discuss creative solutions to real problems by way of a controlled, experimental environment and have a major place in city developments across the globe (Reinart & Poplin, 2014).

BENEFITS OF CIVIC ENGAGEMENT

Social capital is the lifeblood of civic engagement because it creates compounding positive benefits for citizens and their government. While many definitions of social capital exist, Nahapiet and Ghoshal (1998) define it as “the sum of the actual and potential resources embedded within, available through, and derived from the network of relationships possessed by an individual or social unit” (p. 243). For citizens, increased social capital leads to higher productivity, easier achievement of personal goals, better societal quality (Putnam, 2000), and even improved physical health (Uphoff et al., 2013). For a government, especially smaller governance structures like those in cities, increased social capital has numerous socioeconomic benefits and is key to a stable and effective democracy (Häuberer, 2011). Strong social capital is built and maintained through sustained civic engagement (Putnam, 2000), even through digital platforms (Julien, 2015; Mandarano et al., 2010), so it has remained central to smart city development globally (Albino et al., 2015). It is important to recognize, though, that since social capital stems from social, economic, and cultural structures and takes time and effort to form, it is inextricably attached to class, social status, power, and other social stratifications (Bourdieu, 1986).

NEW SMART CITY PARADIGMS	**Against the smart city**	Greenfield, 2013
	The smart enough city: Putting technology in its place to reclaim our urban future	Green, 2019
	Reframing technologically enhanced urban scenarios: A design research model towards human centered smart cities	Andreani et al., 2019
	From smart cities to human smart cities	Oliveira & Campolargo, 2015
ADOPTION OF TECHNOLOGY	**A technology acceptance model for empirically testing new end-user information systems: Theory and results**	Davis, 1985
	Understanding adoption of new technologies: Technology readiness and technology acceptance as an integrated concept	Godoe, 2012
	Technology Readiness Index (TRI): A Multiple-Item Scale to Measure Readiness to Embrace New Technologies	Parasuraman, 2000
	Diffusion of Innovations	Rogers, 1962
	Detailed review of Rogers’ diffusion of innovations theory and educational technology-related studies based on Rogers’ theory	Sahin, 2006

PLAYFUL CIVIC LEARNING	**Play = Learning: How play motivates and enhances children's cognitive and social-emotional growth**	Golinkoff & Hirsh-Pasek, 2006
	Exploring play/playfulness and learning in the adult and higher education classroom	Tanis, 2012
	What is play? In search of a universal definition	Gordon, 2008
	Experiential learning: Experience as the source of learning and development	Kolb, 2014
	Playful civic learning: Enabling reflection and lateral trust in game-based public participation	Baldwin-Philippi & Gordon, 2014
	Playful urban spaces: A historical approach to mobile games	De Souza e Silva & Hjorth, 2009
	Games in urban planning—A comparative study	Reinart & Poplin, 2014
BENEFITS OF CIVIC ENGAGEMENT	**Social capital, intellectual capital, and the organizational advantage**	Nahapiet and Ghoshal, 1998
	Bowling alone: The collapse and revival of american community	Putnam, 2000
	A systematic review of the relationships between social capital and socioeconomic inequalities in health	Uphoff et al., 2013
	Introducing the civic perspective on social capital	Häuberer, 2011
	Bourdieu, Social Capital and Online Interaction	Julien, 2015
	Building social capital in the digital age of civic engagement	Mandarano et al., 2010
	Smart cities: Definitions, dimensions, performance, and initiatives	Albino et al., 2015
	The forms of capital	Bourdieu, 1986

TABLE 2.3.01 - *Annotated bibliography organized by topic*

2.4 DEFINITION OF TERMS

The following are terms that require clarification; mostly consisting of jargon used in the civic government or design disciplines.

Civic Engagement or Participation: The ways in which citizens participate as an individual or group to improve conditions for others and the future of their community. This can include political and non-political activities, such as voting or helping a neighbor.

Digital Literacy: The ability to use information and communication technologies to find, interpret, and create information and to solve problems, requiring both cognitive and technical skills.

Experiential Learning: The engaged process whereby a participant learns through an experience and by reflecting on that experience.

Gamify: To apply game elements, principles, and mechanics into non-game contexts.

Internet of Things (IoT): The network of physical objects embedded with software, sensors, and other technology that can send and receive data through the internet.

Mediation: The intervention of a process. Within the design discipline, this intervention is usually enacted with or through a designed artifact, interface, system, or experience.

Metaphor: A "thing" regarded as representative of something else. In design, metaphors can be used to exploit knowledge a user may already have to make interactions more intuitive, such as a digital file being visually represented by a familiar, physical paper icon.

Multimodal: Having or involving several forms, methods, or ways of being experienced.

Norms of Reciprocity: The expectation that people will respond and repay in kind to another's behavior or actions. For example, people feel obliged to return a favor while responding negatively to harm.

Perceived Affordance: Also simply called an "affordance." A property or feature of an object or interface which presents a prompt on what action can be done with it. For example, an average button has the affordance of being clicked or pressed versus swiped

Play: "An activity can be characterized as play, or described as playful, to the degree that it contains the characteristics listed here: Play is activity that is (1) self-chosen and self-directed; (2) intrinsically motivated; (3) guided by mental rules; (4) imaginative; and (5) conducted in an active, alert, but relatively non-stressed frame of mind" (Gray, 2013, para. 2).

Serious Game: "Games which achieve an explicit, educational function and whose primary purpose is not just entertainment. That does not mean games should not be enjoyable; they can be used to impart knowledge in a playful way" (Abt, 1972, as cited in Reinart & Poplin, 2014, p. 1).

Smart City: "When investments in human and social capital and traditional and modern communication infrastructure fuel sustainable economic growth and a high quality of life through participatory governance" (Caragliu et al., 2011, p. 6).

Smart Technology: Electronic devices that use sensors, software, and wireless communication to collaboratively sense, adapt, and serve users within an environment. Smart technologies are what make up the network in an Internet of Things.

Social Capital: "The sum of the actual and potential resources embedded within, available through, and derived from the network of relationships possessed by an individual or social unit" (Nahapiet and Ghoshal, 1998, p. 243)

Sustainability: The ability to equip and empower communities to support future generations, including but not limited to in the environmental, economic, and social domains.

2.5 ASSUMPTIONS AND LIMITATIONS

ASSUMPTIONS

For the purpose of this investigation, I make several assumptions. First, I assume that the citizen participants will have reliable access to housing and an unfettered internet connection throughout the duration of the workshop. Moreover, I assume that they own a smartphone or computer. I assume that these citizens recognize that their participation will be used in the development of their city and understand that while their personal data will not be stored, their investigative and verbal contributions will be used in aggregate.

I also assume that citizen feedback and discussion about smart technology will be valued and utilized by the city in the near future. The scope of this investigation focuses on citizens, who are motivated by the feeling that their engagement is impactful. This focus does not rule out the benefits the investigation may have on the city, but it is the duty of the government to recognize the value of this citizen participation and employ it to continue this engagement cycle. That is to say, I assume that the government employing this intervention wishes to develop their city in line with the values of their citizens.

LIMITATIONS

Due to the constraints of this investigation, the target participants are limited to citizens who are already motivated to be engaged with their city government. I recognize that garnering civic engagement is a common challenge at any scale, especially locally, but this challenge does not fall within the scope of this investigation. Another limitation is a lack of expertise in city governance. I do not claim to have a comprehensive understanding of the complexities of this field but rather I aim to find where design proves to be a worthwhile intervention. To that end, I recognize that design does not stand to solve all of the issues within the civic space and recommend this investigation be paired with policy changes aligned with the needs of citizens where appropriate. Designed prototypes produced in this investigation are not functional and are purely speculative.

2.6 PRECEDENTS

To establish an understanding of the design space, I researched existing applications, interfaces, and processes related to civic engagement, smart city technology, and playful learning. I evaluated each precedent on its strengths and limitations towards being truly participatory and impactful.

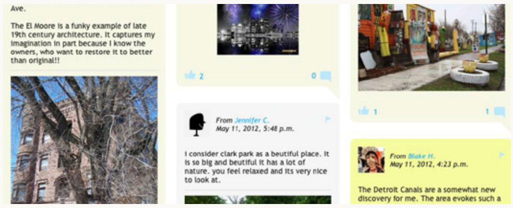


FIGURE 2.6.01

A view of Community PlanIt's dialogue screen where participants interact with each other's shared ideas.

Community PlanIt is an online platform that gamifies the community planning experience. Activities centered around information sharing and collaborative review strengthen communities through increased empathy and understanding. Designed only as a digital accompaniment to previously established community meetings, concerns about lack of proper representation and real-world impact were voiced by the participants (Gupta et al., 2012, p. 20).

FIGURE 2.6.02

The Smart Citizen Kit by the Fab Lab Barcelona at the Institute for Advanced Architecture of Catalonia.

Smart Citizen Kits are a collection of open-source sensors that enable citizens to gather data on their environment and share it on an integrated global platform. Citizens use the kit as a tool to boost civic participation through data collection and analysis. The micro-market targeting of data-aware users combined with the kit's high price point discourages participation from a diverse range of citizens resulting in selection bias on their data platform.

FIGURE 2.6.03

Flaws of the Smart City card deck by the Design Friction design studio.

The Design Friction Kit on the Flaws of the Smart City is a workshop-tailored set of cards divided into three sections: urban places, defects, and interventions. Participants mix these components together to provoke discussions about smart city development and its effects. While this kit does prompt introspective and speculative discussion, the negative tone of the text may result in a skewed view of smart cities from the participants.

FIGURE 2.6.04

A poster developed by Textizen to gather feedback from citizens.

Textizen, and similar apps such as Brigade, Ruck.us, and Countable, take a social media-based approach to reducing the barriers around civic engagement. Developed by private entrepreneurs, they make civic actions like contacting representatives and voting on congressional issues as easy as clicking a button. While technology has the power to lower the barriers around these civic actions, they fall into a trap favoring quantity over quality. Simplifying the process of being civically engaged mischaracterizes the complex nature of government action making it difficult to foster any continued meaningful engagement beyond easy interactions (Tauberer, 2017).

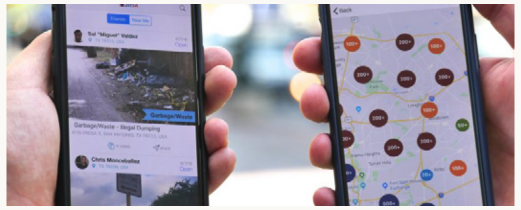


FIGURE 2.6.05

A 311 app built and run by the city of San Antonio.

311 Apps, developed and run by multiple municipalities nationally, serve to make city service delivery cheaper, personalized, and more efficient. Citizens can report problems such as potholes, graffiti, and damaged street signs from their smartphones and track their repair. These apps suffer the same issues as the privately operated examples above: simplified civic interactions do not lead to meaningful engagement in the long run (Green, 2019). This is especially the case with vulnerable populations whose issues may be more systemic in scale (e.g., discriminatory policing or food deserts) and thus do not fit into a streamlined service tool. By treating civic engagement as if it were a customer service transaction — a quick service to one's personal needs — 311 apps further disparage disadvantaged populations who have less control and lower expectations (Green, 2019).

FIGURE 2.6.06

A block of downtown Boston participating in Beta Blocks.

Beta Blocks is a civic experimentation process where permitting on city blocks is temporarily relaxed so that new smart city technology can be installed. Through a series of walking tours in the area, citizens can explore these new installations and have discussions about their experiences.

FIGURE 2.6.07

A Community Land Trust board meeting.

Community Land Trusts are nonprofit organizations that are led by residents, community members, and public representatives that ensure shared equity homeownership and lasting, affordable housing for low-income families. In addition to being a good example of sustainable development and management, community land trusts have established a working model of governance composed of government workers and ordinary citizens. Tenants' unions and renters' rights organizations have similar models.

FIGURE 2.6.08

Participants in the DuBes Game.

The DuBes Game is a role-play simulation game investigating decision-making around sustainable development and urban renewal. This game is one of many serious games developed to facilitate shared understanding across stakeholder groups and gather citizen perspectives. Many of these games, including the DuBes Game, have underdeveloped impact metrics as reported from the players (van Bueren et al., 2007).

CHAPTER THREE

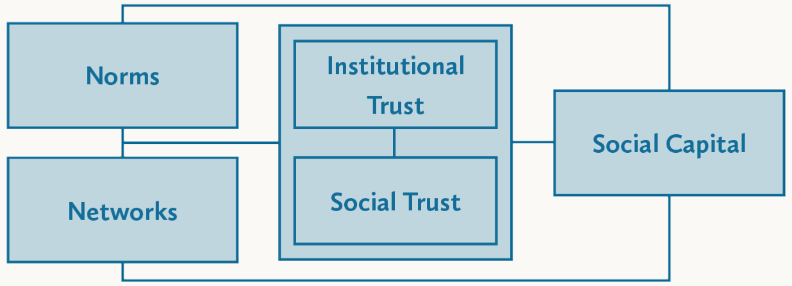
INVESTIGATION PLAN

3.1 CONCEPTUAL FRAMEWORK

The purpose of this conceptual framework is to provide a visual representation of the relationships within and between relevant systems to organize and distinguish their network of ideas. The framework designed for this study is a synthesis of four existing theories: Social Capital Theory, Experiential Learning Theory, Technology Acceptance Model, and Diffusion of Innovation Theory.

FIGURE 3.1.01

Model illustrating the factors that contribute to social capital within the scope of this investigation.



SOCIAL CAPITAL THEORY

The central element of social capital is trust as it is the foundation of all interactions between people (Falk, 2000). This trust can be divided into the horizontal trust of others (social trust) and the vertical trust of societal institutions (institutional trust) (Mohseni & Lindstrom, 2007). Social networks are the point of entry to achieve social capital— a channel through which the benefits of a relationship are received. These networks can be classified as bonds, the links between people of common identities; bridges, links beyond a shared identity; and linkages, links between those at different societal hierarchies (Brian, 2007). Trust and networks both rely on norms of reciprocity to function. To illustrate the network of these elements, I adapted Putnam's (2000) causal relationships of elements of social capital diagram (Häuberer, 2011, p. 59). See Figure 3.1.01.

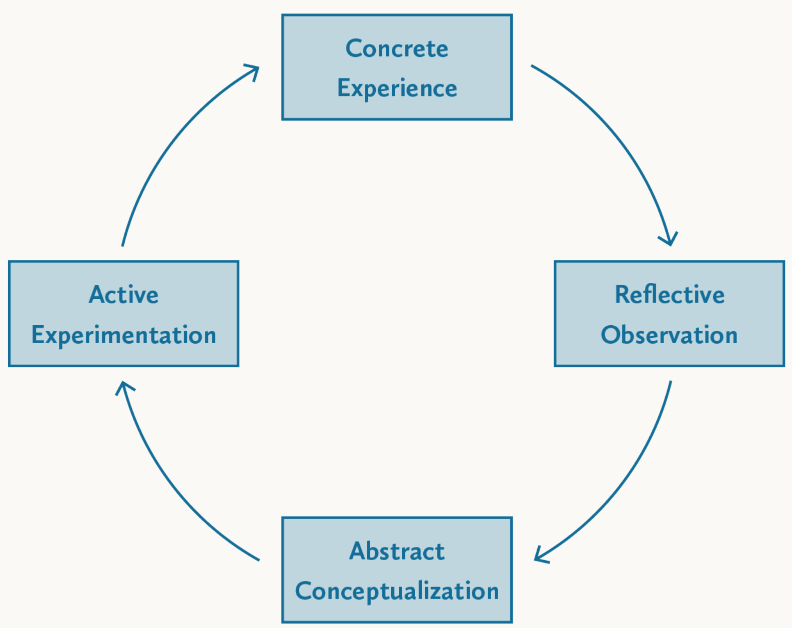


FIGURE 3.1.02

Kolb's Experiential Learning Cycle as a part of his Experiential Learning Theory (2014).

EXPERIENTIAL LEARNING THEORY

Experiential Learning Theory (Kolb, 2014), also known as Kolb's Experiential Learning Cycle, is a holistic model of the learning process "whereby knowledge is created through the transformation of experience" (Kolb et al., 2001, p. 2). The cycle includes two related nodes on grasping experience: concrete experience and abstract conceptualization, and two related nodes on transforming experience: reflective observation and active experimentation. These nodes are defined in Table 3.1.01. See Figure 3.1.02.

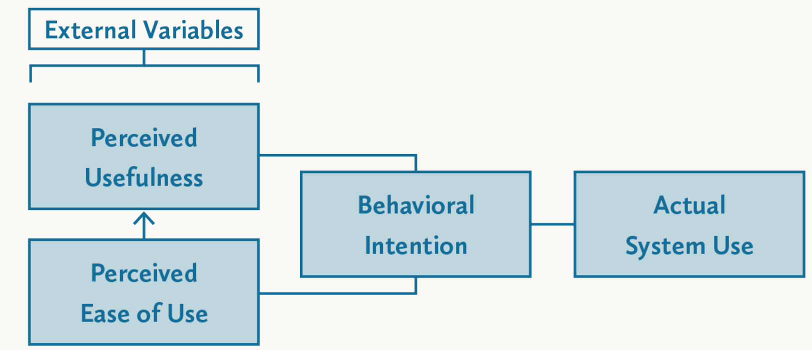


FIGURE 3.1.03

Davis' Technology Acceptance Model (1985).

TECHNOLOGY ACCEPTANCE MODEL

Davis (1985) proposed the Technology Acceptance Model to understand why people accept or reject information systems. The model illustrates that an individual who perceives a technology to be beneficial and easy to use will develop positive attitudes which may eventually lead to the actual use of the technology. See Figure 3.1.03.

As it relates to Social Capital Theory, Gefen et al. (2003) proved that increased trust, especially institutional trust, had a positive correlation with a technology's perceived ease of use and usefulness.

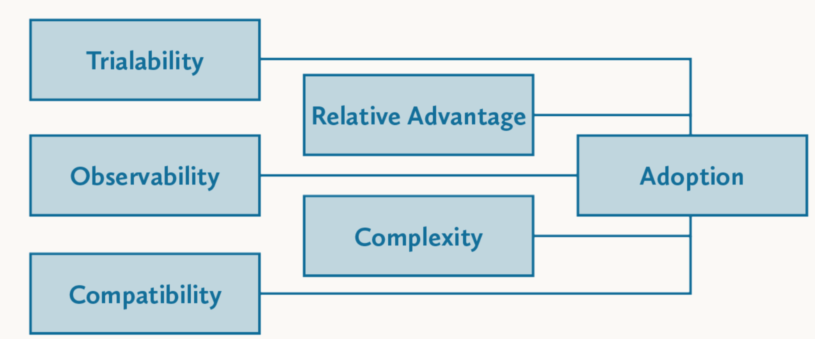


FIGURE 3.1.04

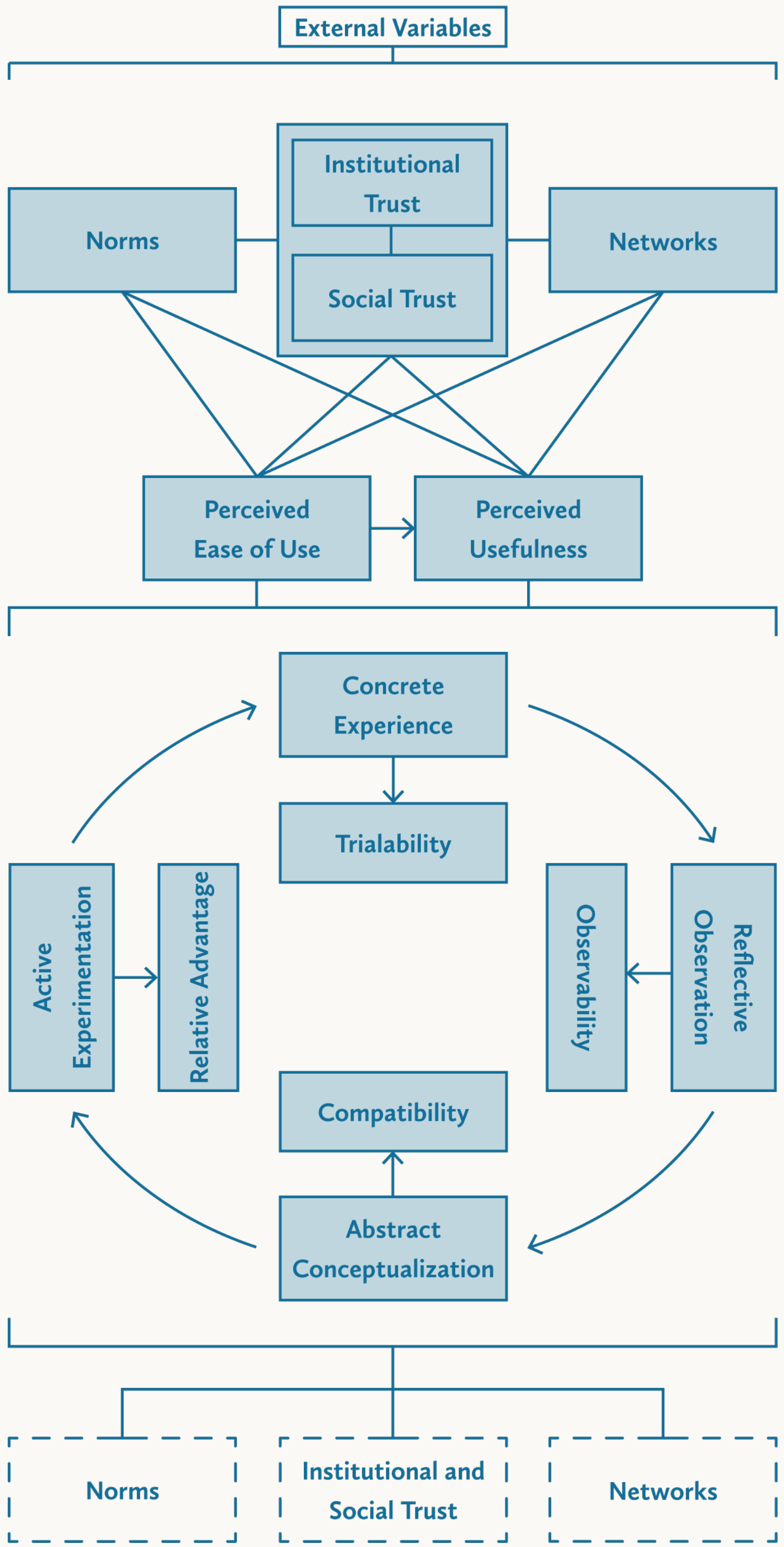
Five main factors that influence adoption of an innovation (Rogers, 1962).

DIFFUSION OF INNOVATION THEORY

The Diffusion of Innovation Theory (Rogers, 1962) explains how a new idea or product gains momentum and spreads through a social system. There are five main factors that influence adoption of an innovation: trialability, observability, compatibility, relative advantage, and complexity. These factors are defined in Table 3.1.02.

FIGURE 3.1.05

A conceptual framework synthesizing Social Capital Theory, Technology Acceptance Model, Experiential Learning Theory, and Diffusion of Innovation Theory.



SYNTHESIS

The intersection of the four frameworks presented above forms a model that guides my investigation. It asserts that the experiential learning process using innovative technology fulfills the criteria for the innovation to be adopted. This process feeds into itself through the compounding benefits of social capital (Parker et al., 2016). This feedback loop of compounded social capital aids the learning process as social capital "satisfies a necessary condition for knowledge exchange" (Tsai, 2014, p. 4910) and improves attitudes toward knowledge sharing (Chow & Chan, 2008).

The final conceptual framework does not include "complexity" with the other Diffusion of Innovation attributes because it is the only factor that has an inverse relationship with innovation adoption. Complexity is addressed earlier in the framework with the Technology Acceptance Model. See Figure 3.1.05.

TABLE 3.1.01

Defined stages of Kolb's Experiential Learning Cycle (2014).

Concrete Experience	The start of the cycle where the individual or group completes an assigned task through active involvement (versus reading or observation, for example).
Reflective Observation	Stepping back from the task and reviewing what has been experienced by the individual and/or others to learn how it can be applied in varying circumstances.
Abstract Conceptualization	The sense-making stage where the previous stages are interpreted, compared to the previous knowledge and values of the individual and/or group, and distilled into main concepts.

Active Experimentation	Translating new understandings into predictions of what will happen next or what actions should be taken to refine or revise the current situation— serving as a guide to create new experiences.

TABLE 3.1.02

Defined factors that influence adoption of an innovation (Rogers, 1962).

Trialability	The degree to which the innovation can be tested or experimented with before a commitment to adopt is made.
Observability	The degree to which the results of an innovation are visible to others— high visibility stimulates peer discussion.
Compatibility	The degree to which an innovation is perceived as being consistent with the existing values, past experiences, and needs of potential adopters.
Relative Advantage	The degree to which an innovation is perceived as better than the idea it supersedes.
Complexity	The degree to which an innovation is perceived as difficult to understand and use. The only factor with a negative correlation to the innovation's rate of adoption.

3.2 RESEARCH QUESTIONS

My investigation is directed by a primary research question with subquestions that frame narrow aspects of design inquiry.

PRIMARY RESEARCH QUESTION

How can a multimodal platform for experiential learning supplement existing civic engagement efforts by creating an informed citizen base who advocates for their values in the development of smart cities?

SUBQUESTIONS

Subquestion 01: How can an interactive digital playspace leverage metaphor to spark curiosity and heighten the perceived ease of use of smart technology?

Subquestion 02: How can individualized prompts guide experimentation with a physical toolkit to contextualize the usefulness of smart technology in the citizen's life?

Subquestion 03: How can community-wide prompts gamify discussion to enable group reflection and conceptualization of larger implications of smart technology?

Subquestion 04: How can a responsive, system-based organizer encourage the consideration and application of experiences to empower community advocates?

3.3 INVESTIGATION MODEL

This investigation model (Table 3.3.01) situates my studies, mapped one-to-one with my subquestions, and incites comparison between them. The four studies adhere to Kolb's Learning Cycle as a means to ensure effective and impactful experiential learning. In accordance with Kolb's theory, none of the stages can be truly divorced from one another, so each subquestion merely aims to prioritize one or more stages. The shading in model signifies which stage(s) are emphasized in each subquestion. The studies also guide citizens rightward on David Rose's Receptivity Gradient, which tracks compounding levels of receptivity to new information (Gehr, 2015).

	Concrete Experience	Reflective Observation	Abstract Conceptualization	Active Experimentation
SQ 1: Interactive Digital Playspace				
SQ 2: Contextualized Experimentation				
SQ 3: Gamified Group Discussion				
SQ 4: Preparing for Advocacy				
	Ready to Know	Ready to Hold an Opinion	Ready to Act	Ready to Advocate

TABLE 3.3.01 - *Investigation Model*

3.4 SCENARIO

Linda Wyatt is a 48-year-old mother of two who owns a small business. She was born in Portland, OR and continues to reside there. A few months back, she decided to talk with the city council about her concerns with the development of her city. She wants to ensure that the future of Portland is designed with her values in mind.

The city council meetings take place weekly on Wednesday mornings so Linda must take off work to attend. She has attended a few meetings but does not feel heard by the council. In one meeting, a city council member refers Linda to the PDX Smart City Steering Committee. She contacts the Community Outreach Coordinator of the committee, Don Lindelof, and is invited to their monthly meeting.

Don has worked with the steering committee since their inception in June 2017. This committee was created to set priorities, identify focus areas, and establish goals of smart city projects in Portland and facilitate community involvement in their development and implementation. As the Community Outreach Coordinator, Don has had trouble facilitating this community involvement, especially to underserved populations. These populations have a hard time expressing their needs and priorities because they are unfamiliar with the kind of development and technology behind smart cities.

This month, Don has organized a workshop and invited Linda and a group of twenty other Portland residents. In his meeting, Don introduces the group to a kit of technologies that sample the kind that are planned to be implemented into Portland within the next ten years. This kit includes sensors that test for data such as air quality, temperature, and movement, and light level and is accompanied by an interface that allows for easy control of the devices. Over the next few months, these citizens are encouraged to explore the potentials and limitations of this technology in their daily lives. Through mediated interactions on a paired virtual platform, citizens are incentivized to share their findings and discuss the implications of the technology in their city.

At the end of the workshop, Don has collected a record of public input and can better plan Portland smart city projects to align with the needs and wants of its citizens. At the same time, Linda feels more familiar with the technology and processes behind the development of Portland and is better equipped to advocate for her values.

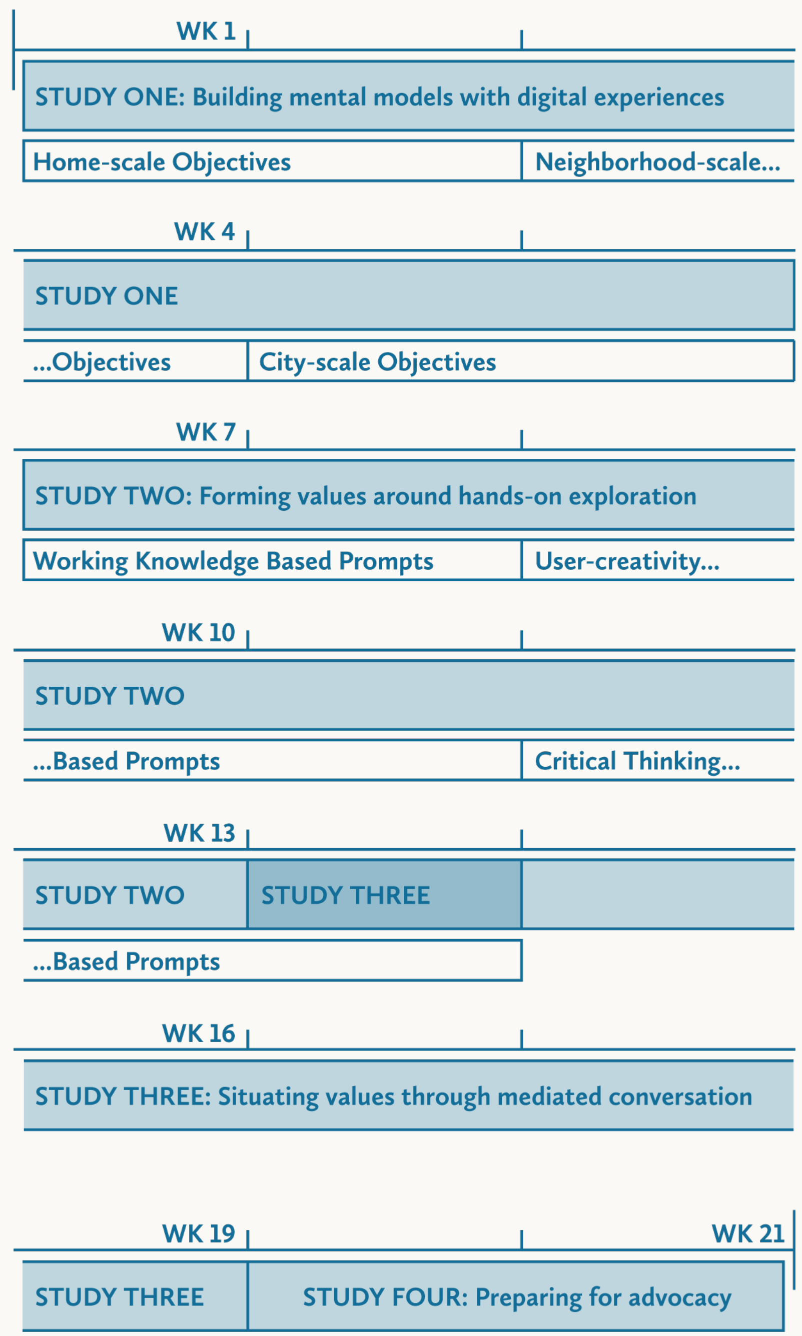


FIGURE 4.0.01

An approximate timeline of the four studies as a citizen would encounter them over the course of the roughly 21-week workshop

CHAPTER FOUR

STUDIES

4.1 BUILDING MENTAL MODELS WITH DIGITAL EXPERIENCES

How can an interactive digital playspace leverage metaphor to spark curiosity and heighten the perceived ease of use of smart technology?

SMART TECHNOLOGY

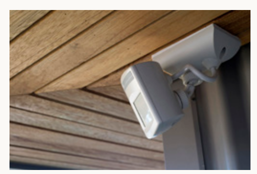
To create a properly informed citizen base who is ready to advocate for themselves in the development of smart cities, this development must be broken down into digestible pieces. The reasonably smallest and most foundational unit of smart cities is smart technology: electronic devices that use sensors, software, and wireless communication to collaboratively sense, adapt, and serve users within an environment (see Table 4.1.01). Unfortunately, this technology is by-design difficult to see and understand.

Smart technology is intended to operate invisibly in the background, only making itself known when it has anticipated a need to come out from behind the curtain. The most common pieces of smart technology are smartphones and computers but perhaps the simplest example is a smart thermostat. Constructed perfectly, the thermostat would never need to be touched by its user beyond setup. Instead, it would anticipate and adapt its environment to the user's preferred temperature seamlessly. While ideal for user ease and enjoyment, the opaque nature of smart technology makes it impossible to understand without a computer science background (Rabari & Storper, 2014). Open up the device and you will not find any moving parts intuitive in their function but instead circuit boards laminated with imperceptible gadgetry. The integration of these complex appliances into cities is what usually establishes them as "smart." So, the first step to understanding smart cities is to understand smart technology.

TABLE 4.1.01

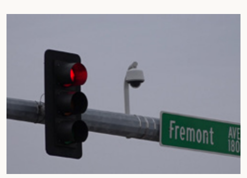
Examples of the smart technology used smart cities

Self-driving Cars



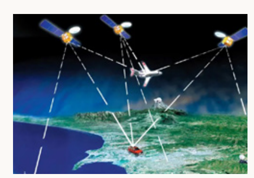
Motion Sensors

Crowd Detectors



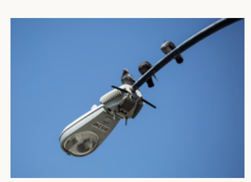
Smart Traffic Lights

Facial Recognition



GPS

City-Wide WiFi



Smart Street Lights

Weather Tracking

HEIGHTENING PERCEIVED EASE OF USE

According to the Technology Acceptance Model (Davis, 1985), a technology's perceived ease of use directly affects the user's likelihood of understanding and using it. Because it is the technology's *perceived* ease of use versus its *actual* ease of use that impacts the user, the scope of this study must be narrowed to the psychology of the user. According to Gefen et al. (2003), in addition to social and institutional trust, the user's self-efficacy impacts their perceived ease of use of technology. Self-efficacy is defined as "people's beliefs about their capabilities to produce effects" (Bandura, 1994, para. 1). There are four main sources of influence by which self-efficacy can form: experience, vicarious experience, social persuasion, and physiological factors (see Table 4.1.02). Incorporating these four factors in a design intervention will positively affect the perceived ease of use of smart technology.

TABLE 4.1.02

Defined factors that influence self-efficacy (Bandura, 1994).

Experience	The most effective way to build self-efficacy is through overcoming obstacles through mastery experiences, resulting in perseverance in the face of adversity and rebounding quickly from setbacks.
Vicarious Experiences	The user seeing people who are similar to themselves succeed by sustained effort raises their confidence that they have the same capabilities. The more similar the observed person is to the user, the more persuasive are their successes (and failures).
Social Persuasion	Verbal persuasion affirming the user has the capabilities to master their activities, such as positive appraisals, mobilize and sustain greater effort from the user.

Physiological Factors	"Reduc[ing] people's stress reactions and alter[ing] their negative emotional proclivities and misinterpretations of their physical states" (Bandura, 1994, p. 3).

LEVERAGING METAPHOR

Abstract challenges require abstract solutions. Smart technology is essentially an intangible network of signals (also called the Internet of Things) and cannot be simply dissected to determine its operation. An intervention to aid in its comprehension can and should exploit its disembodied nature as a blank canvas.

A metaphor is a device whereby the "attributes of a source entity or concept are selectively mapped onto a target entity or concept" to help explain the target (Peterson et al., 2015, p. 2). Because metaphors apply a skill, experience, or understanding that the user has already obtained to explain something unfamiliar, they can be used to familiarize someone with smart technology. This capability extends into visual metaphors: graphic structures that use the shape, form, or experience of familiar artifacts and activities to convey additional meaning to a target (Eppler, M. J., 2006).

Many types of visual metaphors have been used in the context of education and advertising, but I believe that skeuomorphic metaphors are the best form to introduce smart technology to the unfamiliar. In graphic design, skeuomorphism describes interfaces that mimic real-world counterparts in appearance, interaction, or experience. A simple example of skeuomorphic design would be the save button on a computer: the graphical representation of a floppy disc (the *source*) signifies the action of saving (the *target*) — introducing the foreign using visual attributes of the familiar. The representation lasting far beyond the use of real-world floppy discs speaks to the success of a well-implemented visual metaphor.

PRECEDENTS

I looked at existing design applications of smart technology and visual metaphor to inform my making and assessment.

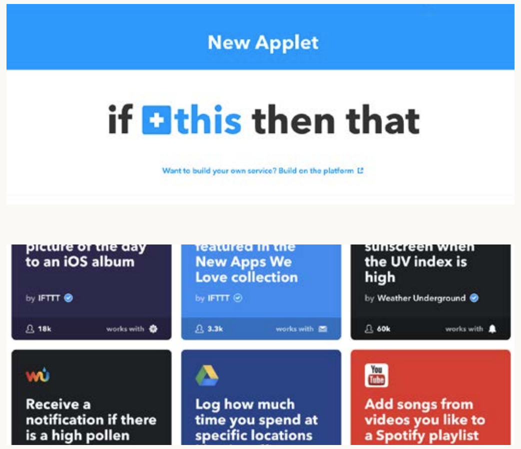


FIGURE 4.1.01

IFTTT interface and example applets

IFTTT is a website where users can create chains of conditional statements to connect various web services and smart technology. Users create programs called applets by customizing an if-this-then-that sentence. Examples of applets include: "send me a text if it is going to rain tomorrow" or "turn on my front porch light and close my curtains at sunset." The latter is an example of a user understanding and extending the affordances of smart home technology. In an effort to engage their citizens with smart technology, Louisville, KY has created applets on IFTTT that perform a multitude of actions based on data generated by the city.

FIGURE 4.1.02

The Scratch coding interface is reminiscent of building blocks

Scratch is a visual programming language and website designed by MIT targeted primarily at children as an educational tool for coding. Scratch is a superlative example of a visual metaphor used to explain a complex technological concept. The interface draws its modular form from building blocks like LEGOs. Strings of code that can be connected are represented by the well-known stud and tube design, even releasing a familiar plastic "click" sound when joined. Where raw code fails in approachability, Scratch succeeds in fun, easy design.

ASSESSMENT

Key results must be established to determine if the design in this study is successful and answers the respective subquestion. The following are outcomes by which to measure that success as a guide through the design process and in reflection.

- Does the design allow a user to complete an assigned task through active involvement as a part of Kolb's Experiential Learning Cycle (Kolb, 2014)?
- Does the design allow a user to test or experiment with smart technology as a part of Roger's Diffusion of Innovation Theory?
- Does the design give a user experience in overcoming obstacles through compounding, perseverant effort to build a robust belief in one's personal efficacy (Bandura, 1994)?

- Does the design allow a user to see people similar to themself succeed by sustained effort, boosting their self-efficacy (Bandura, 1994)?
- Does the design persuade a user verbally that they possess the capabilities to master their given activities, boosting their self-efficacy (Bandura, 1994)?
- Does the design teach the user to overcome negative physiological indicators, boosting their self-efficacy (Bandura, 1994)?
- Do these four contributions to the user's self-efficacy reasonably lead to higher perceived ease of use of smart technology?
- Does the design have a clear source and target, recognizable across an array of user cultures and backgrounds, where only the relevant attributes are mapped to the target making a complete and effective metaphor (Peterson et al., 2015)?

OBJECTIVE AND METHOD OF INTERACTION

The first step in designing the user experience of this digital playspace is to determine the objective and motivation behind their interaction. There are two pairs of categories into which all possible options can fit. The first category is virtual versus real outcomes. While the playspace will always be virtual because smart technology needs to be controlled digitally, the user could, for example, try to turn on a real lamp in their home as a goal versus a fake lamp on their computer. The second category is structured versus unstructured play. Unstructured play gives the user the ability to freely tinker with the smart technology while structured play is more like a game with clear rules and objectives. I analyzed the combination of these categories to determine the best method with which to move forward:

Unstructured play with real outcomes was the first option I dismissed. While this may be a good method for citizens with experience with smart technology, it is the least approachable for a new user.

Unstructured play with virtual outcomes has less stake than a scenario with real outcomes which makes it more approachable. However, unstructured play as a whole does not allow the intervention necessary for raising self-efficacy. Mediation is needed to give social persuasion, for example, which is not naturally present in unstructured play.

Structured play with real outcomes has natural moments for intervention but cannot account for outcomes that are hard to perceive. The earlier "turning on a lamp" example is very simple and has clear visual feedback. But exploring more complex smart technology may not afford the same rewarding outcome. For example, successfully changing ambient temperature in the user's real-world takes time and may be imperceptible.

Structured play with virtual outcomes averts the challenges presented by the other options. It has natural moments for intervention to raise self-efficacy while also being able to visually represent circumstances that would be too slow or subtle in real life. By introducing the rules and cumulative leveling system of a game, users can build their knowledge base from scratch at a steady pace.

ASSESSMENT OF OUTCOMES

Under the classification of structured play with virtual outcomes, I created a series of visual explorations exploring how smart technology could be introduced to a new user. All of the explorations satisfy the key results outlined or have space in which they may be satisfied.

As a part of building self-efficacy, a natural implementation in the game context to overcome obstacles through sustained effort were rounds and levels. Through levels of compounding difficulty, the user would be able to slowly understand increasingly complex smart technology interactions. This "leveling up" could be paralleled by the context-scale of the technology as well. The first series of levels would introduce the user to technology in the home (such as the objective in Figure 4.1.05) and once the highest level of difficulty was mastered there, the second series would expand to the technology found in a neighborhood. The scale of the challenge would increase until the final levels matched the complexity of technology in a smart city (such as the final objective in Figure 4.1.08).

An award and badge system seen in Figure 4.1.03 could also be implemented into the game environment to boost self-efficacy. This would verbally persuade the user of their ability and aid in overcoming negative physiological responses but could be best used as a way to allow the user to see people similar to themself succeed. Rather than introduce a public high score board that could instigate competition unproductive at such an early stage, a badge system would indicate the strengths and progress of other players and encourage play from the user. A badging system would necessitate a virtual lobby or player list to be visible and encourage play. The system of levels, badges, and the affordances of typical gameplay give many opportunities for bolstered self-efficacy with smart technology, leading to higher perceived ease of use.

PROCESS

Exploration A (Figure 4.1.04) is anchored in creating a basic understanding of how smart technology works. While it does build this understanding, it is essentially a multiple-choice test that may not be enjoyable for the user. In following explorations, I place a higher value on gameplay as means to explain smart technology to increase enjoyability.

Explorations B (Figure 4.1.05) and C (Figure 4.1.06) visualize the invisible mechanics of the technology. In exploration B, I compare the technology and its emitted signals to lily pads and water ripples—the level's objective only being completed when the proper pads are placed and pressed. Exploration C also visualizes the invisible, comparing waves of Bluetooth signals to that of a sunburst. Within a slingshot-style game, technology can be recontextualized using metaphors: "virtual assistants are cannons because of their XYZ shared attributes."

Explorations D (Figure 4.1.07), E, (Figure 4.1.08), and F (Figure 4.1.09) capture the relationship between smart technologies as a part of the Internet of Things through their form and interaction. Exploration D represents this relationship as building blocks— each device and their respective settings being a necessary piece to reach the goal. Exploration E reimagines this network as a solar system with device planets having and sharing conditional moons in harmonious orbit. And Exploration F portrays the network as a family tree where abilities are the child of two technology parents. The gameplay, method of interaction, and experiential qualities of these examples are based on their form. Each of these representations introduces a new way of thinking about smart technology using a familiar source.

Beyond the relationships of the technology, these explorations illustrate their defining characteristics as well. For example, the game shown in Exploration G (Figure 4.1.10) challenges the player to connect all the smart technology in their environment using augmented reality, spinning a virtual web around them. This exploration shows how this technology is real and ubiquitous— an important quality to convey to new users.

By mapping the relationships of smart technology onto understandable forms and communicating their essential qualities through gameplay, these explorations are a vital first step in acquainting new users with their complexities.

FIGURE 4.1.03

A selection of badges and their application as a part of an award system to boost self-efficacy

FIGURE 4.1.04

Exploration A is a game that builds a basic understanding of smart technology using a pick-and-choose style puzzle.

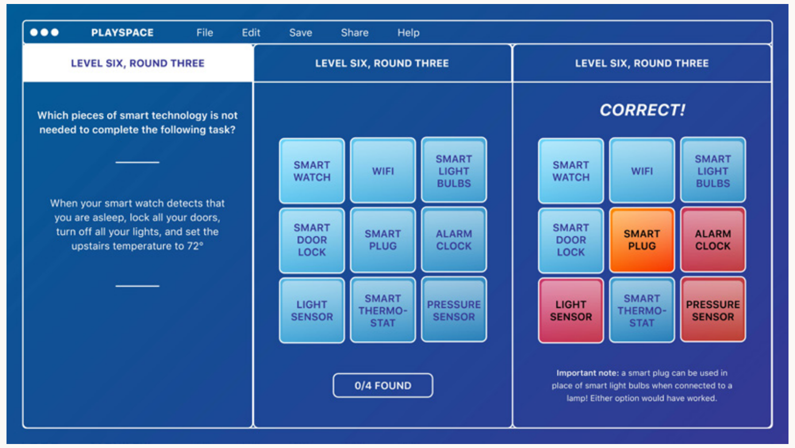
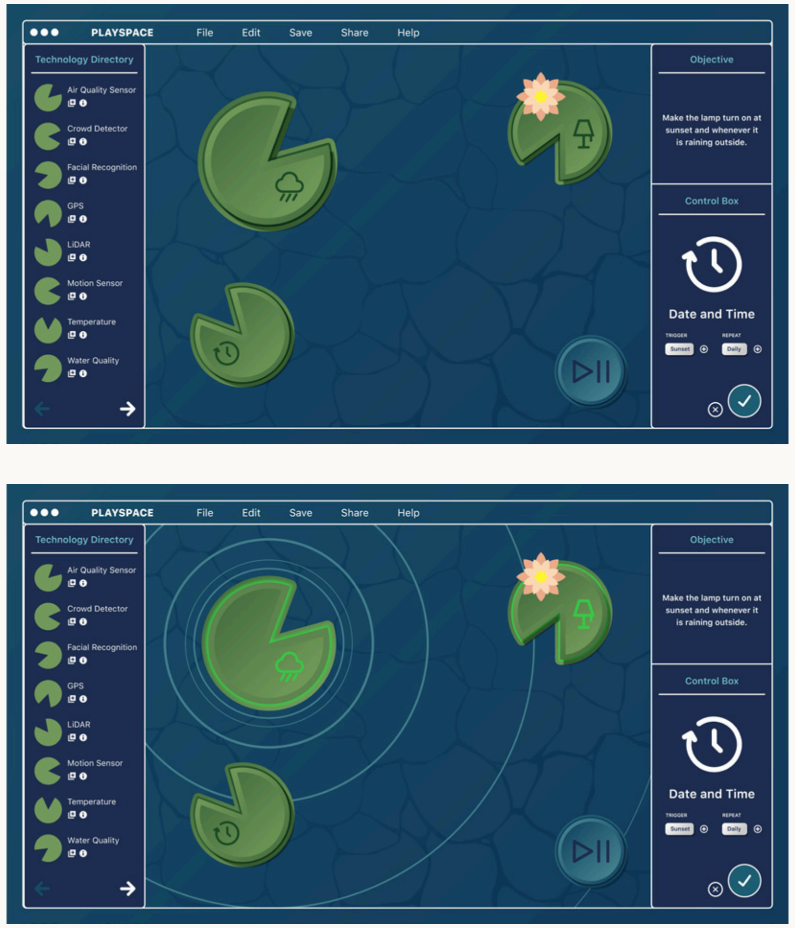


FIGURE 4.1.05

Exploration B compares the invisible signals sent out by smart technology to that of lily pads and water ripples. Objective is achieved when the ripples from the correct pads are received from the flowering goal lily pad.



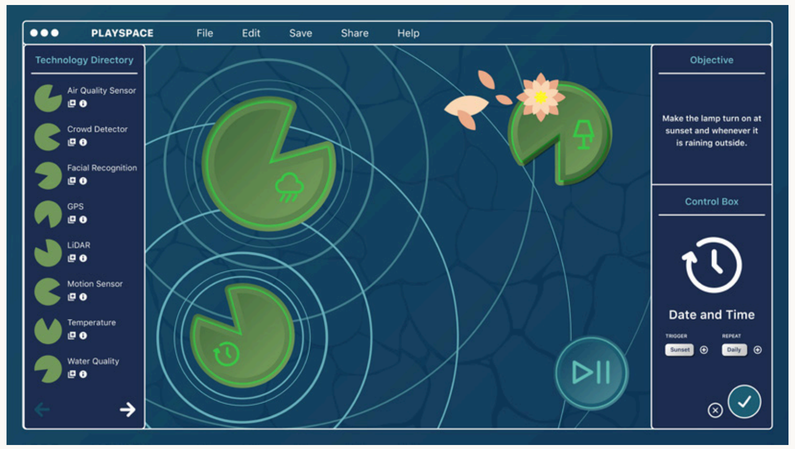


FIGURE 4.1.06

Exploration C is a slingshot-style game comparing the affordances of smart technologies to different projectile tools with the goal of feeding a fish.

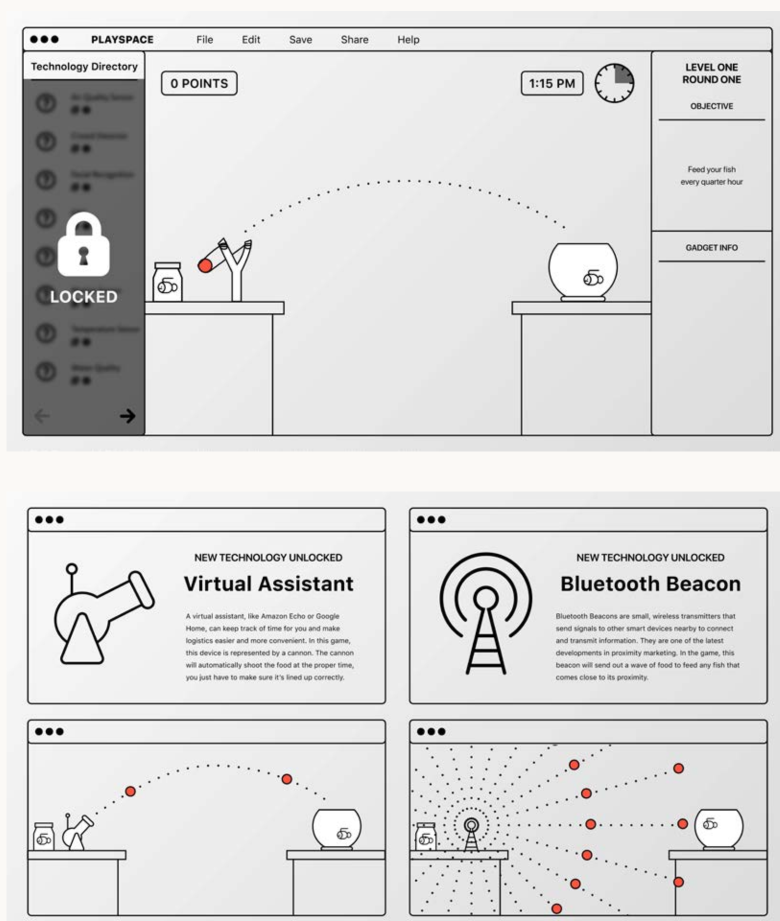


FIGURE 4.1.07

Exploration D is a visualization comparing smart technology to building blocks. The customizable blocks all depend on each other to reach their final goal, represented by a cloud.

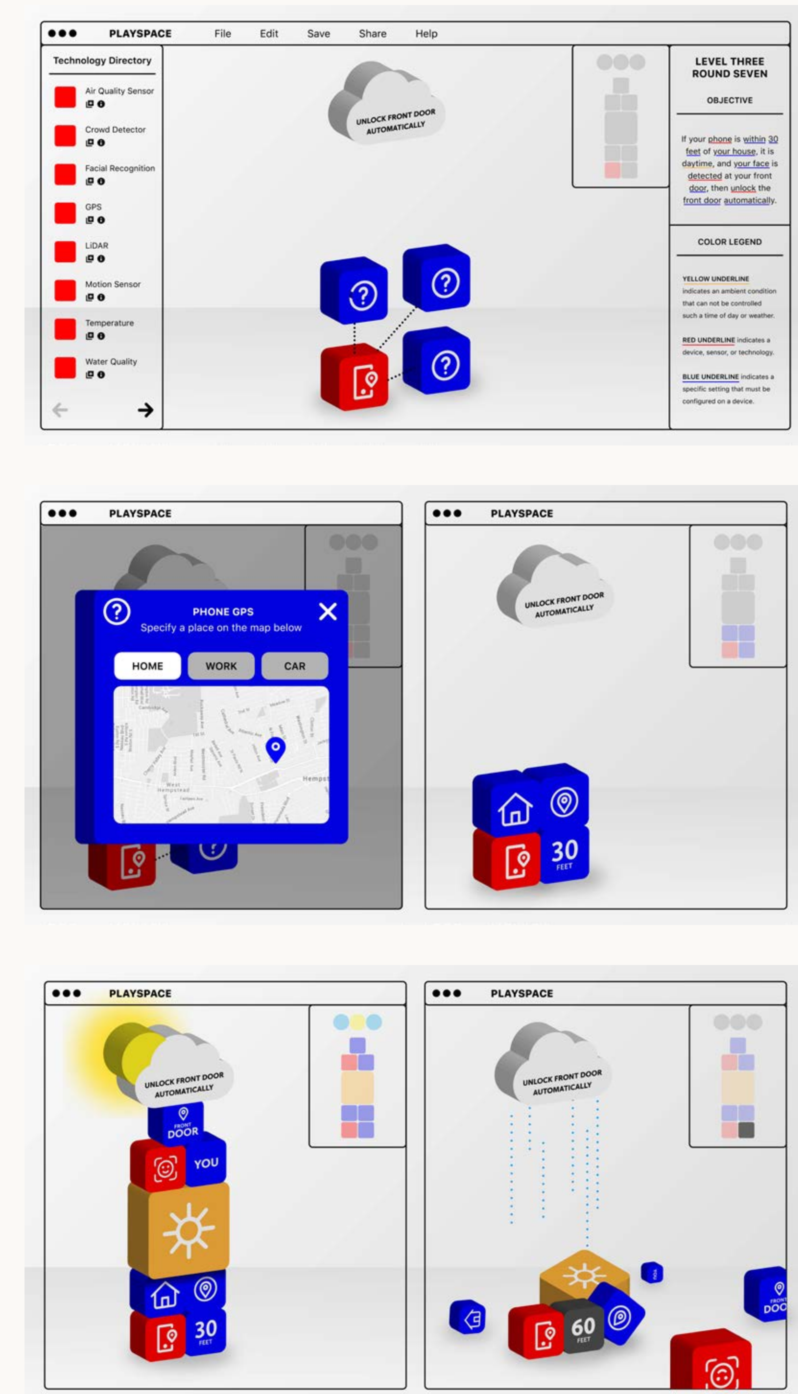
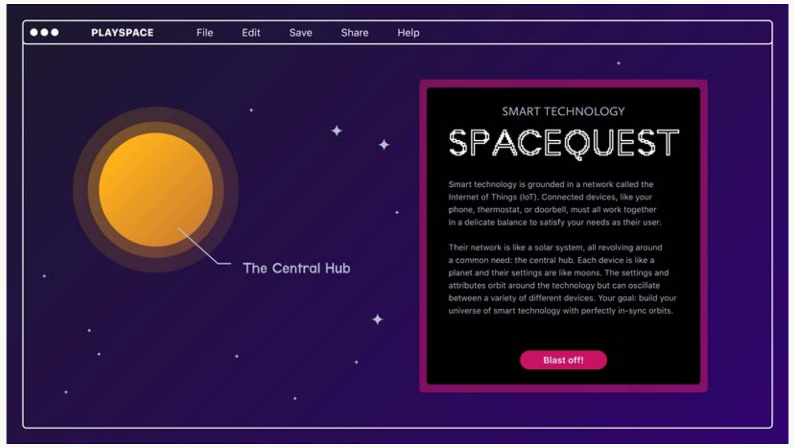
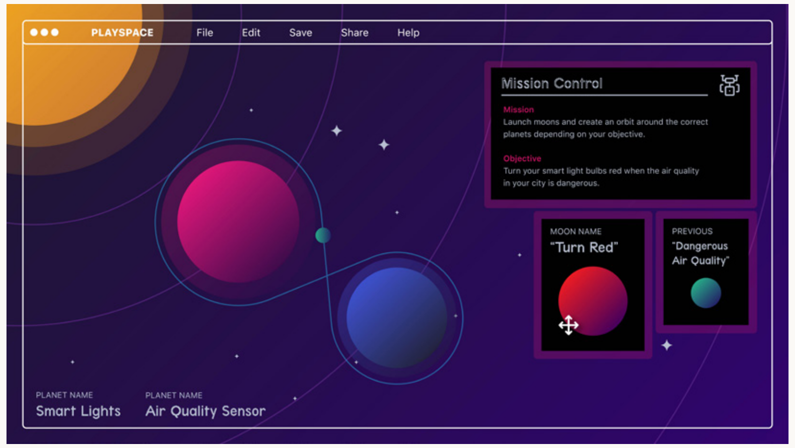
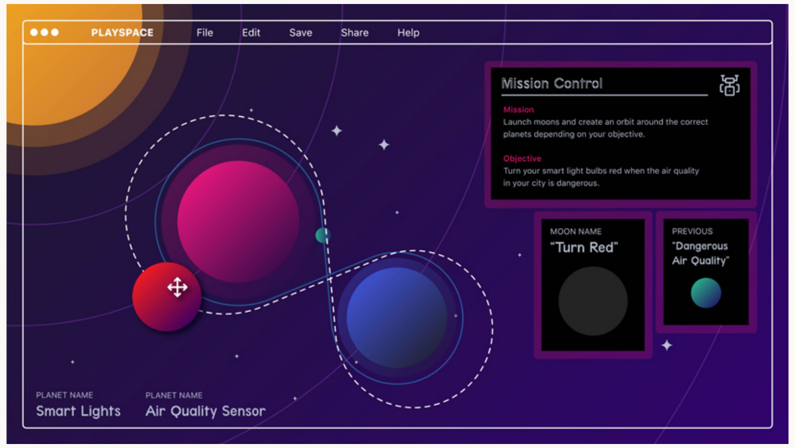


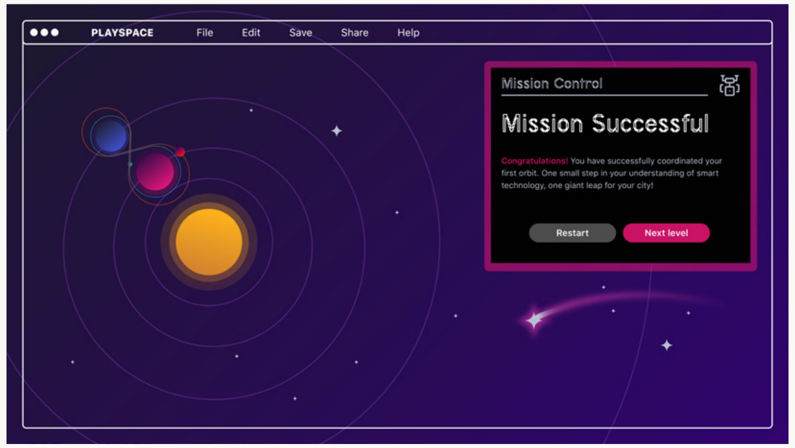
FIGURE 4.1.08

Exploration E represents the Internet of Things as a solar system with device planets and orbiting moons. The moons symbolize device settings — such as a smart light bulb turning red — that can be launched by the player to orbit other device planets, thus creating a system.









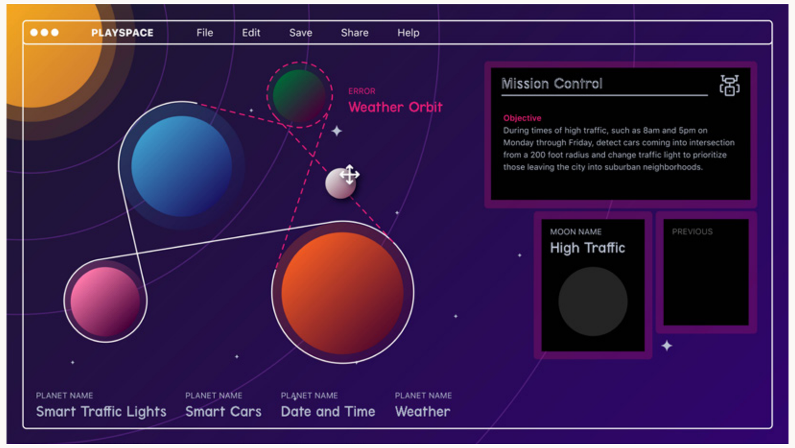


FIGURE 4.1.09

Exploration F depicts smart technology relationships as pieces of a family tree. The combination of two devices creates a "child" and eventually a branching network.

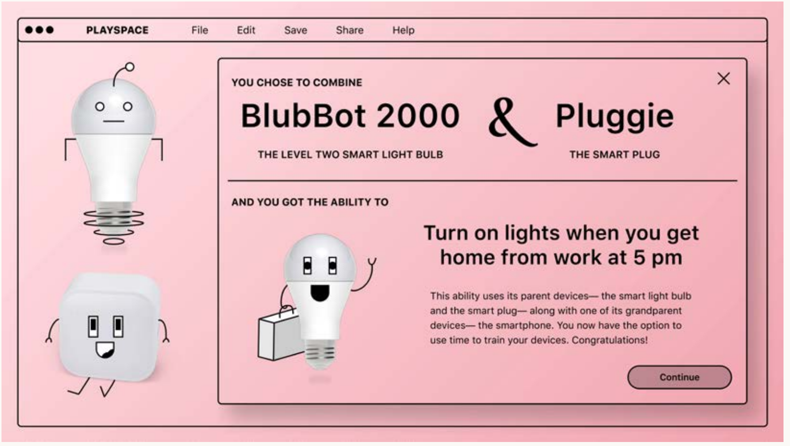


FIGURE 4.1.10

Exploration G uses augmented reality to challenge the player to find and connect smart technology in their environment and build a virtual web, showing that the technology is real and ubiquitous.

4.2 FORMING VALUES AROUND HANDS-ON EXPLORATION

How can individualized prompts guide experimentation with a physical toolkit to contextualize the usefulness of smart technology in the citizen's life?

PHYSICAL TOOLKIT

Once the group of citizens has a healthy foundational understanding of smart technology, it is important for them to use it hands-on to see that it is real and its effects are not theoretical. A physical toolkit would include a variety of smart technologies: sensors, receivers, ways to connect them, etc. The form of these devices ideally would reference their design in the first stage from study one. For example, if the digital playspace visualized in Figure 4.1.07 was used, the design of the tangible technology should resemble building blocks to continue that comparison. For the purposes of this investigation, the true form of the technology in the real world is inconsequential. I will be focusing on the digital interface paired with this toolkit rather than the details of its physical counterpart.

CONTEXTUALIZING USEFULNESS

Smart technology must be shown as being beneficial and impactful to its users and people similar to them. Challenging each participant to experiment with the technology in their daily lives will encourage them to think about its possibilities and wider implications. Similar to ease of use in the previous study, the objective is to situate the technology's *perceived* usefulness versus its *actual* usefulness, narrowing the scope to the user's mentality.

CITIZEN'S LIFE

Different participants will have different avenues in their daily lives in which they may experiment with smart technology. For this study, I will be focusing on the potential applications by the persona introduced in section 3.4: Linda Wyatt.

ASSESSMENT

- The following are questions by which to measure the success in answering this study's subquestion.
- Does the design allow a user to reflect on the knowledge and experience from the previous phase (study one) on a personal basis and learn how it can be applied in varying circumstances as a part of Kolb's Experiential Learning Cycle (Kolb, 2014)?
- Does the design allow a user to observe the results of smart technology as a part of Roger's Diffusion of Innovation Theory?
- Does the design heighten the perceived usefulness of the smart technology by contextualizing it in their daily lives?
- Is the design accessible to a reasonable variety of possible users in its content, interaction, and interface?

STUDY MATRIX

I constructed a matrix to guide and organize visual explorations in this study (see Figure 4.2.01). The x-axis of the matrix categorizes the citizen's daily life using terminology coined by Ray Oldenburg (Putnam, 2000). In addition to the home (the *first place*) and the workplace (the *second place*), there are third places. Third places are social surroundings beyond these two categories which I have divided into: *retail-based,* such as restaurants, grocery stores, and malls, and *public,* such as parks, churches, and community centers. *Places of mobility,* such as cars, buses, or subways, are not necessarily

destinations but they are spaces that are regularly occupied for a significant portion of most people's daily lives.

For the y-axis, I classified different types of prompts. Prompts activated by the user include *divergent prompts,* which motivate the user to meander and explore their surroundings, and *convergent prompts,* which motivate the user to overcome challenges without a focus on the environment. Prompts activated by the program include: *just-in-time prompts,* transient prompts fully dependent on the date, time, and/or user's location, and *ambient prompts,* which show themselves tacitly and motivate exploration or "figuring out." The latter two categories will present themselves actively but will still require the user's decision to act on the prompt to be completed.

	First Space	Second Space	Retail-Based Third Space	Public Third Space	Spaces of Mobility
Convergent Prompts	C	F	J	I	B
Divergent Prompts	A			H	G
Ambient Prompts	K		L		
Just-in-Time Prompts		E		D	

FIGURE 4.2.01 - *A matrix classifying the explorations of study two*

PROCESS

I began my explorations by creating an initial sequence of prompts that would introduce the user to the interface and acquaint them with the programming process. Exploration A (Figure 4.2.03) represents the first interaction the user would have with the interface. This exploration leads the user through setting up a simple program in their home: activating a smart light bulb which would be included in their physical toolkit. The walkthrough balances user agency and automation— enjoining the user to select the program location (within the home) and choose a triggering event (from a curated list of possibilities).

Once a working knowledge of the toolkit and interface is established, exploration B (Figure 4.2.04) would initiate the true application of the technology into the user's daily life. Using machine learning, a dashboard wizard would suggest smart technologies that could be integrated into the user's inputted routine. In the example visualized, sensors that detect air quality and ambient light are suggested to help the user decide if they should bike to work and can become a part of a customizable dashboard. These initial prompts are collaborative— making the possibilities of the technologies obtainable by involving the system in the brainstorming process.

Exploration C (Figure 4.2.05) begins to shift more of the creative load to the user. They are challenged to think of programs applicable to their daily lives using randomly paired smart devices. This quick, generative style of ideation has low stakes but great potential for imaginative technology applications.

Explorations D (Figure 4.2.06) and E (Figure 4.2.07) begin to consider the user's context and situation to prompt their exploration. They are both based on information the user has opted to share with the system so technological interventions can be discovered in situ. Exploration D recognizes the user's location, a sports field, to recommend potential programs that she may find helpful, such as a noise sensor to detect if the field is in use or a moisture sensor to measure the usability of the field. Exploration E recognizes frequent purchases by the user for her business and suggests how smart technology could assist her with low stock detection and automatic purchasing. Both explorations leverage user-generated data to prompt exploration opportunities unique to them.

Exploration F (Figure 4.2.08) uses information submitted in the user's profile to prompt more unique explorations. Knowing that the user is a small business owner, the system offers an exercise that challenges the user to consider the wants and needs of their patrons. The characteristics of their customers are randomly paired with devices to spark ideas and the system automatically suggests technology usages according to the input.

The latter half of my explorations incorporate prompts that stimulate critical thinking so users can begin to form an opinion on smart technology. Exploration G (Figure 4.2.09) introduces the user to the data they are already generating by living in a city with a smartphone. With clear opt-in preferences, the user chooses what data is tracked about them over a week just using their smartphone. This exercise helps the user understand on a deeper level the amount of trackable data they are producing and how it can be used and interpreted. It also prompts them to consider the privacy implications of a smart city.

Explorations H (Figure 4.2.11) and I (Figure 4.2.12) are prompts that demonstrate the limits of smart technology. These prompts would be activated much later in the timeframe of the study once the usefulness of the technology had been established. Exploration H asks the user to take certain sensors to places they consider “pleasant” and “unpleasant” and take data readings. In some cases, the readings would be nearly identical (e.g. a waterfall and a traffic jam are both objectively loud). This realization would highlight the limitations of what smart technology can capture using purely quantitative data. Exploration I highlights a similar limitation by asking the user to find an object, collect as much data as possible on it, and then challenge another person to interpret and identify that object, similar to an I Spy game. Both of these explorations underline the challenges and what could be lost in data interpretation.

Exploration J (Figure 4.2.13) is the most demanding in this study, requiring extensive critical thinking from the user. This prompt instructs the user to bring a color sensor to their next grocery store visit and only purchase foods deemed healthy. The challenge is that a food's healthiness is determined by its percentage of green detected. While technically achievable, this metric rejects the abundance of healthy food that is not green and accepts unhealthy food that is (e.g. sour apple candy). Users will see the fault in the system fairly quickly, challenging them to either use a broken method, try and trick the sensor, or reject the prompt altogether. Whatever their choice, the user must grapple with the understanding that even if the data is well-measured its assessment methods must also be appropriate for it to be usable.

Explorations K (Figure 4.2.15) and L (Figure 4.2.17) could be encountered by the user at any time after their introduction to the interface and do not require prerequisite knowledge. Exploration K is prompted not on the interface but automatically in a user's space using a system-generated program. The user encounters an unobtrusive but noticeable signal from a smart device whose triggering event they must "figure out." This reaction-based interaction preserves curiosity about the technology. Exploration L also sparks interest in the potentials of smart technology by creating a city-wide Easter egg hunt for Bluetooth beacon program suggestions. If the user happens to pass by a beacon, they get a smartphone notification to explore the nearby area and tap their phone on the device once found. Finding the device would be rewarded with a suggested program unique to their current space. System-directed prompts like these create intrigue around the possibilities of these technologies and tap into a deeper form of problem-solving and curiosity from the user.

OUTCOMES

These studies satisfy the outlined assessment requirements and establish the users as ready to hold an opinion. This segment of citizen engagement is similar to the methods seen in participant action research, participatory sensing, and citizen science. The defining difference is that the data the participant is collecting is eschewed in service of the learning opportunities available in the process of collecting.

While the explored prompts undoubtedly situate smart technology as useful for the citizen, it presents benefits for the city as well. The creative uses of the technology by the citizens (that they choose to share) can be used as inspiration for city-scale applications that may not have been previously imagined. Above all, this exercise reveals what is collectively important to a group of citizens. For example, the city can learn that its citizens care about air quality data more than expected— a piece of information that can be prioritized in their smart city development. The exercise creates use cases empirically informed by research that is grounded in the experiences of a diverse set of stakeholders— the very neighborhoods in which the smart technology will be employed.

The order of the prompts explored creates a knowledge base that compounds on itself— starting with building basic understanding and finishing with critical thinking skills and recognizing the limitations of the technology (see Figure 4.2.02). Being transparent with the capabilities and implications of the devices further accomplishes the goal of creating an informed citizen base who are ready to be transparent in return. This exercise engenders a headspace in the citizens who are ready to discuss encountered subject matters, make sense of their experiences, and form opinions.

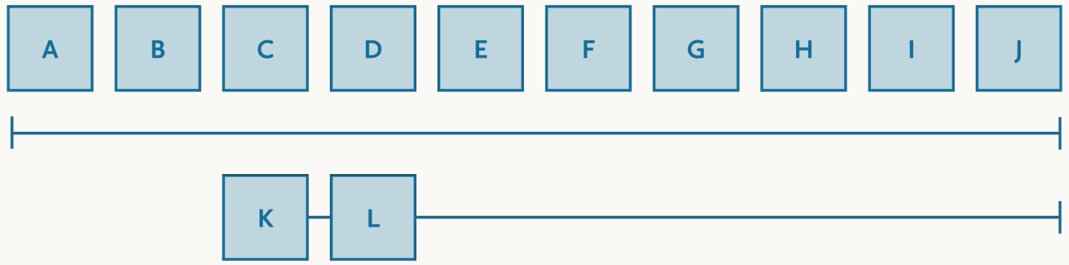
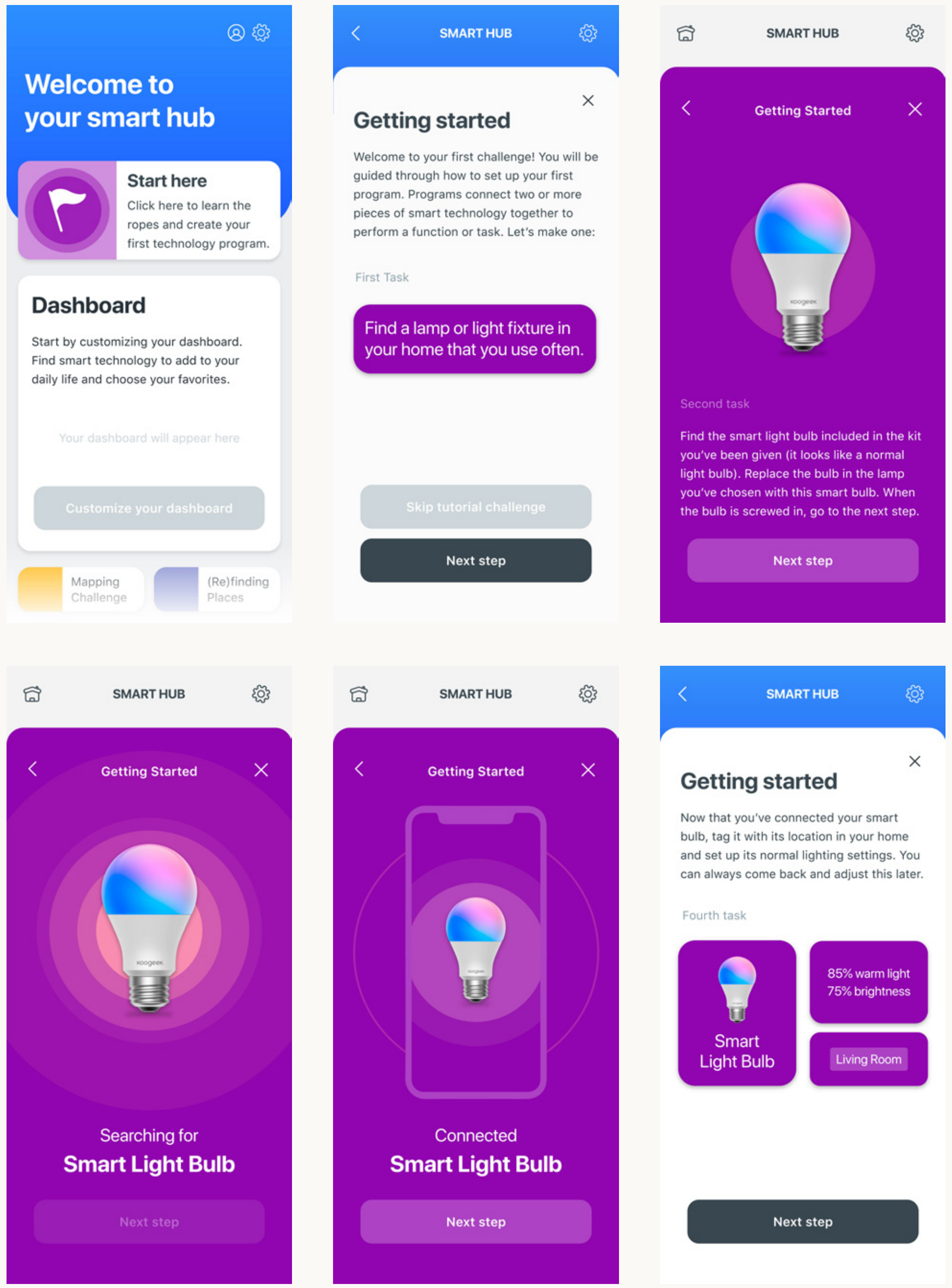


FIGURE 4.2.02 - *An approximate order of the prompts explored in study two beginning with basic technology understanding, transitioning to application, and ending with critical thinking challenges. Earlier prompts divide creative burden between the system and the user while later prompts allow more user agency. Explorations K and L could be encountered by the user at any time after their introduction to the interface and do not require prerequisite knowledge.*



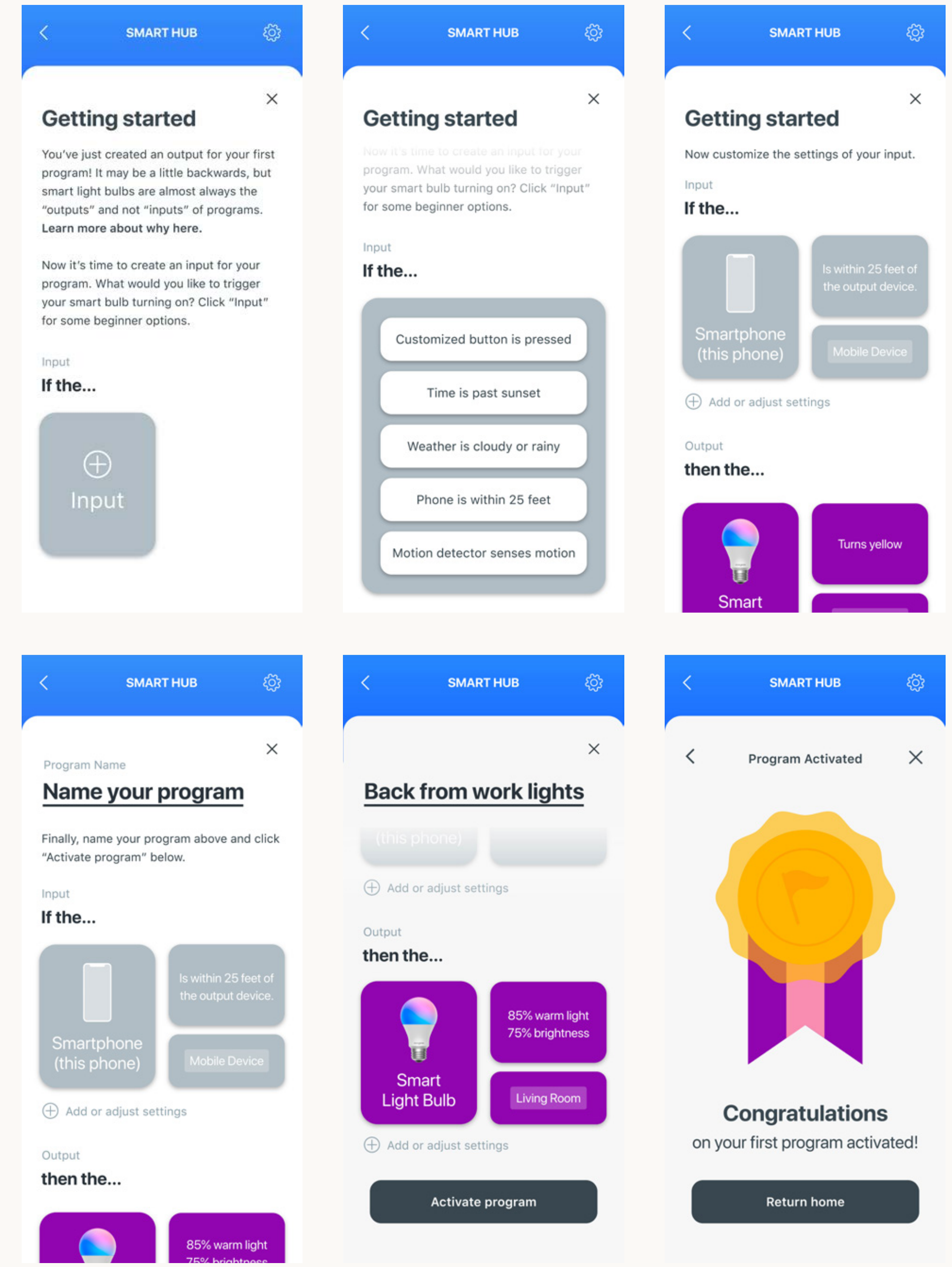
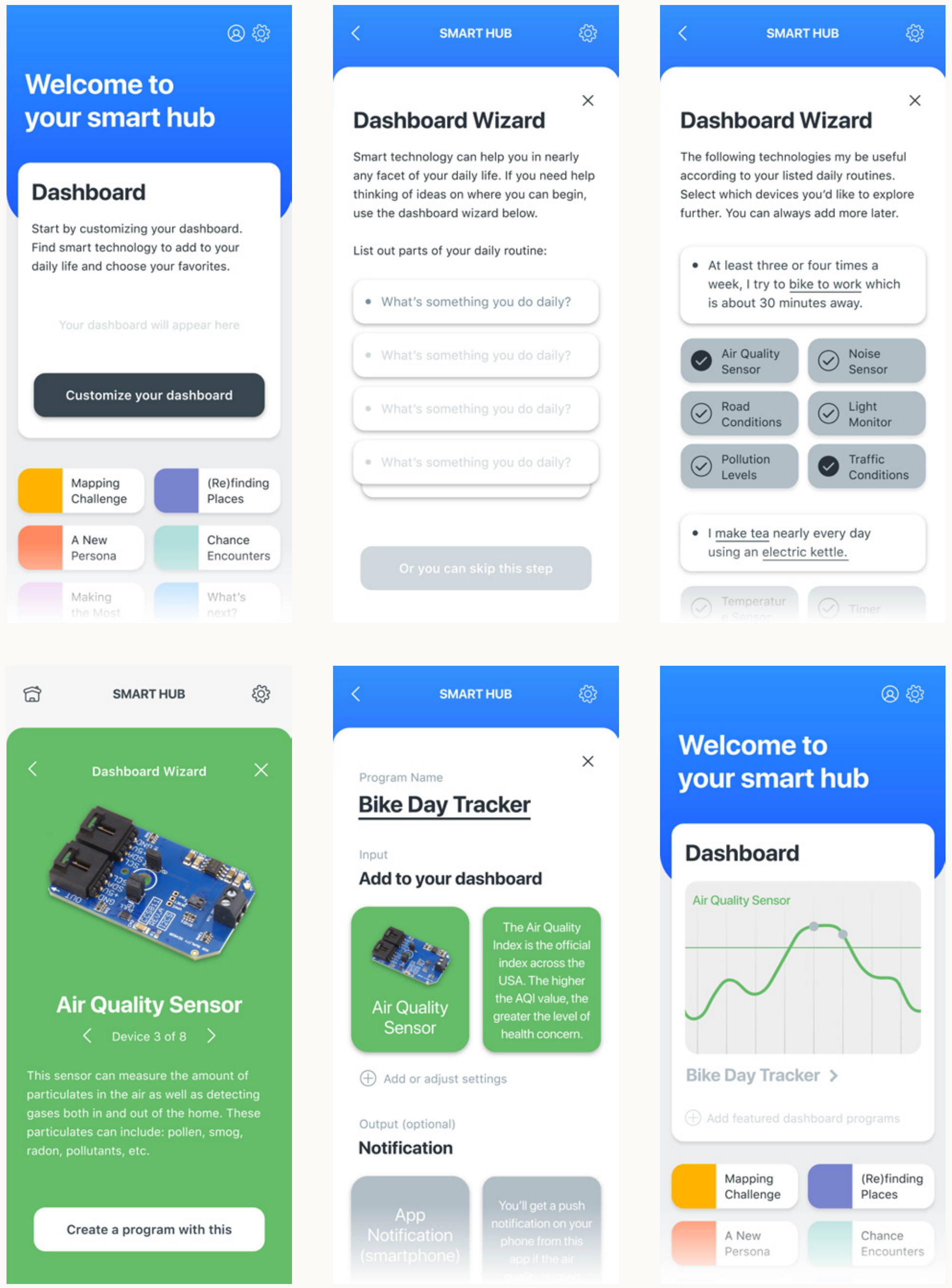


FIGURE 4.2.03 - *Exploration A runs through the first interaction the user has with the interface, establishing technology connections and the structure of programs*



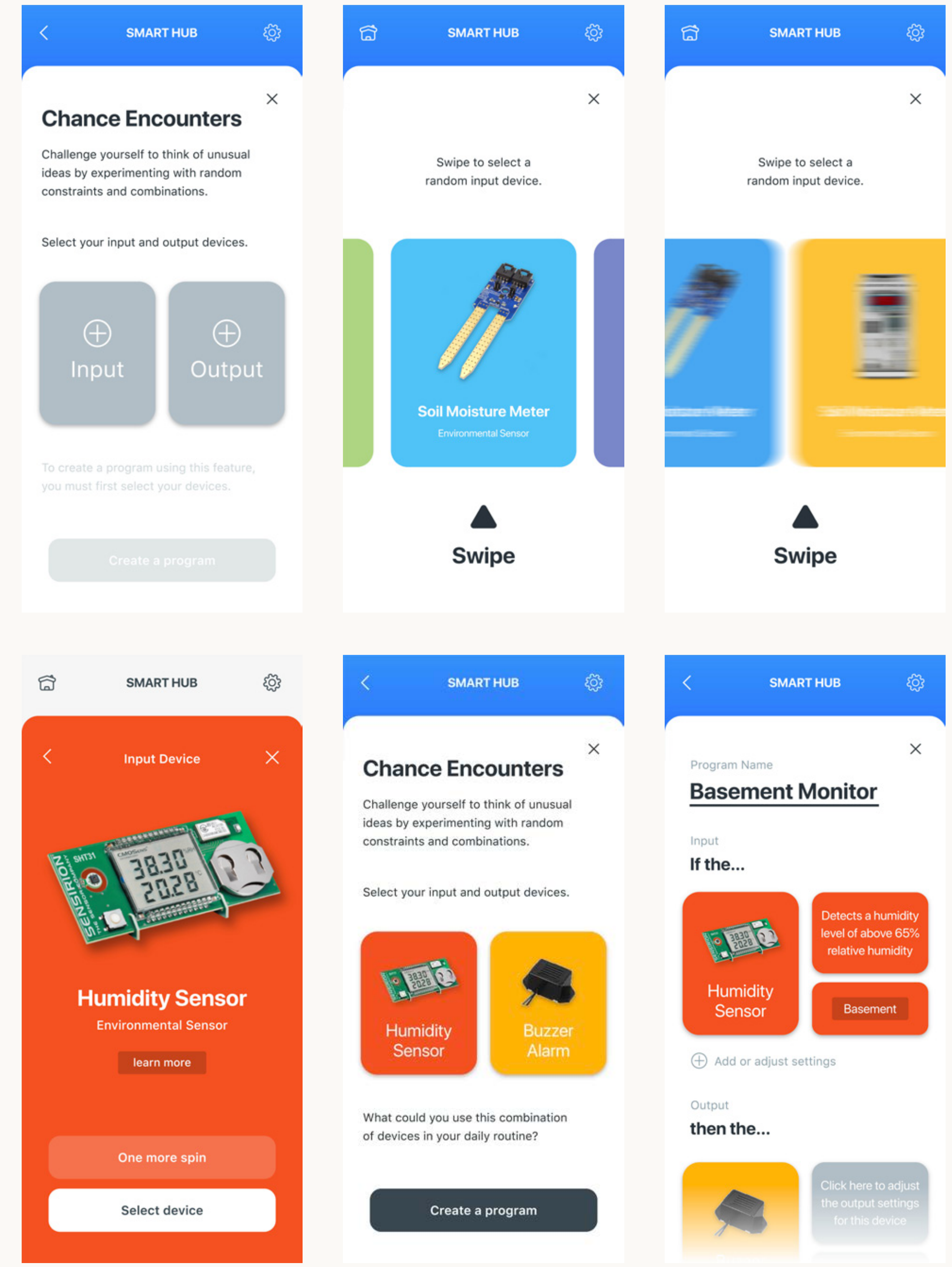


FIGURE 4.2.04 - Exploration B uses machine learning to suggest usages of smart technology predicated on user inputted routines to prompt technology application in their daily lives. The user can then add these suggestions to a custom dashboard.

FIGURE 4.2.05 - Exploration C prompts the user to take more creative liberty, asking them to think of programs using randomly paired smart devices.

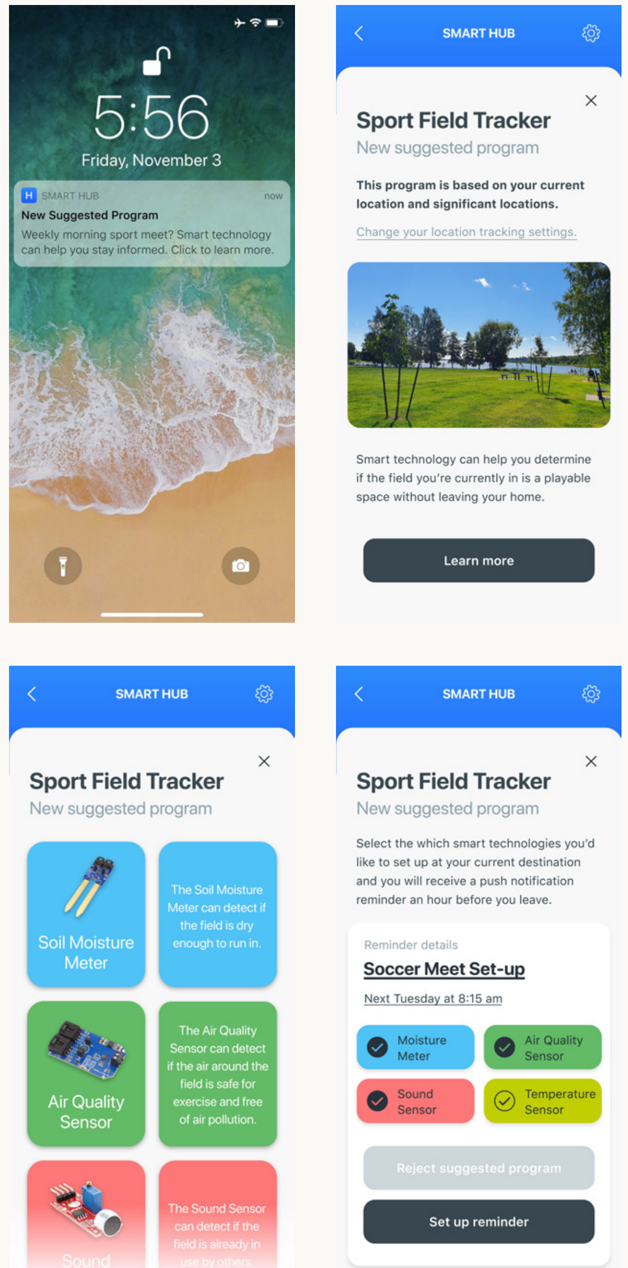


FIGURE 4.2.06 - *Exploration D uses the user's location to suggest potential programs just-in-time. In this example, a soil moisture sensor is recommended to detect the usability of the sports field the user is currently in. The user can choose to be reminded to bring such devices on their next visit.*

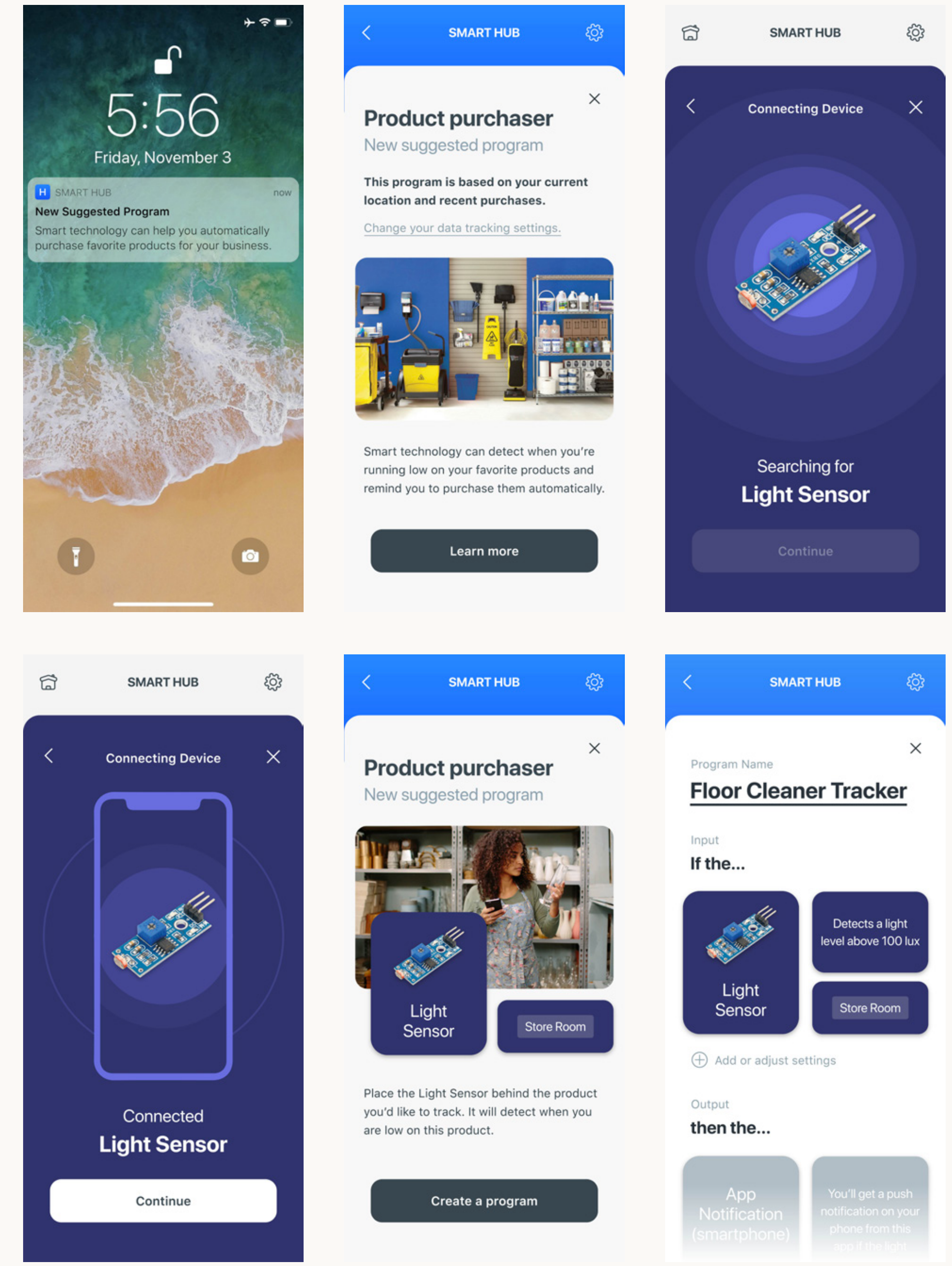


FIGURE 4.2.07 - *Exploration E uses data on repeat purchases from the user's small business to give a just-in-time suggestion on a smart technology implementation for low stock detection and automatic ordering.*

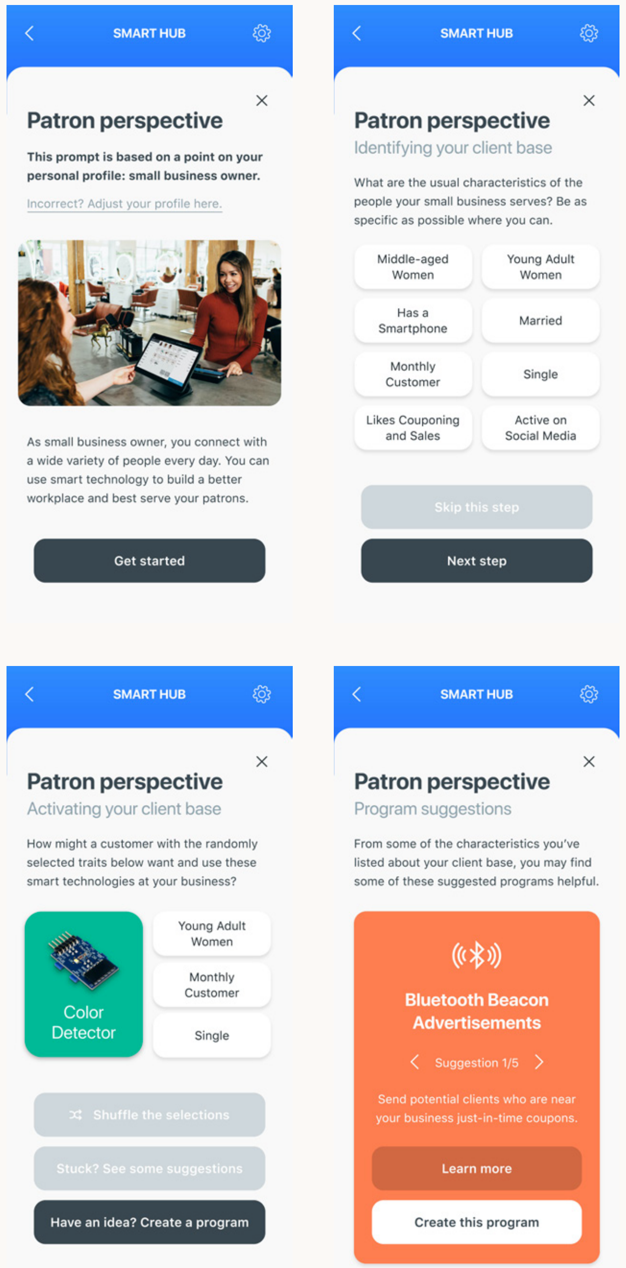


FIGURE 4.2.08 - *Exploration F is a prompt unique to users who are small business owners. The prompt asks users to consider the potentials of smart technology for the benefit of their patrons. Randomly pairing customer characteristics with smart devices sparks exploration with implementation.*

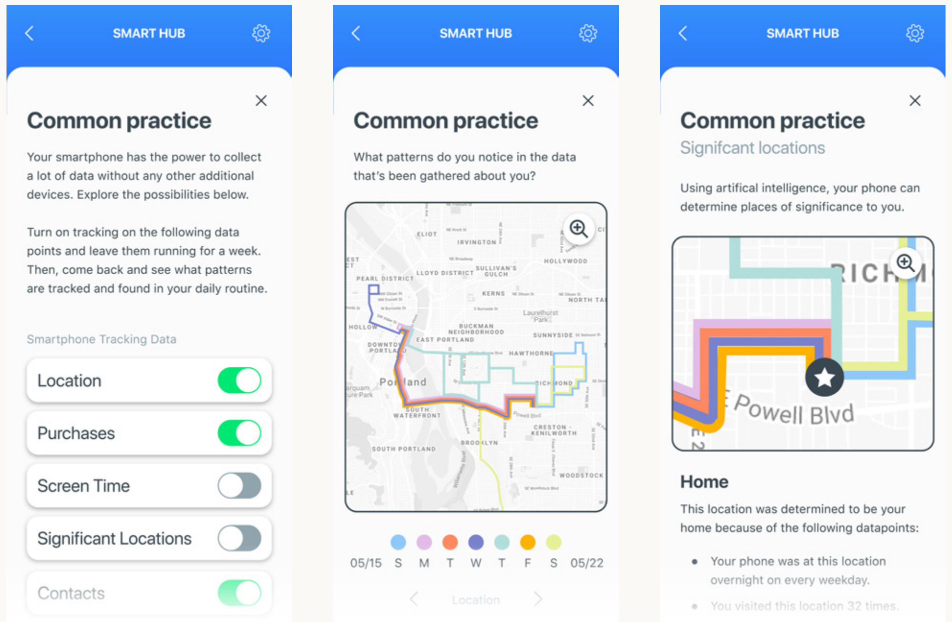


FIGURE 4.2.09 - *Exploration G tracks data already being generated by their smartphone over the course of a week and shows how it can be interpreted. This challenges the user to think about the larger implications of living in a smart city.*

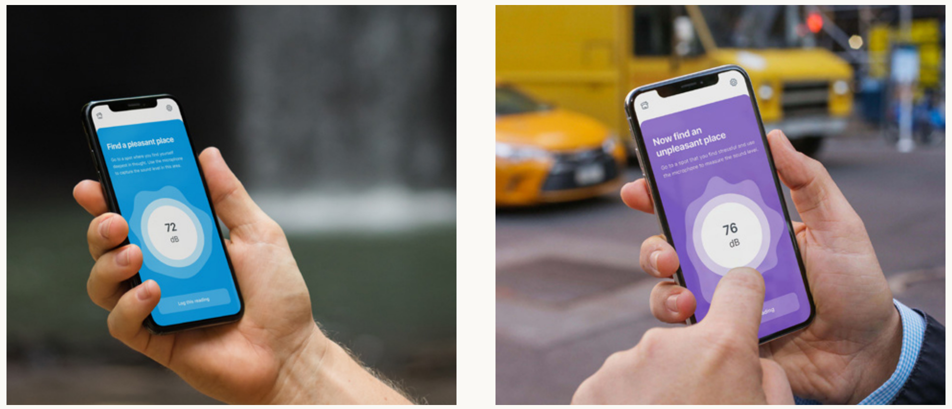


FIGURE 4.2.10 - *Mockups of Exploration H, Figure 4.2.11, in situ*

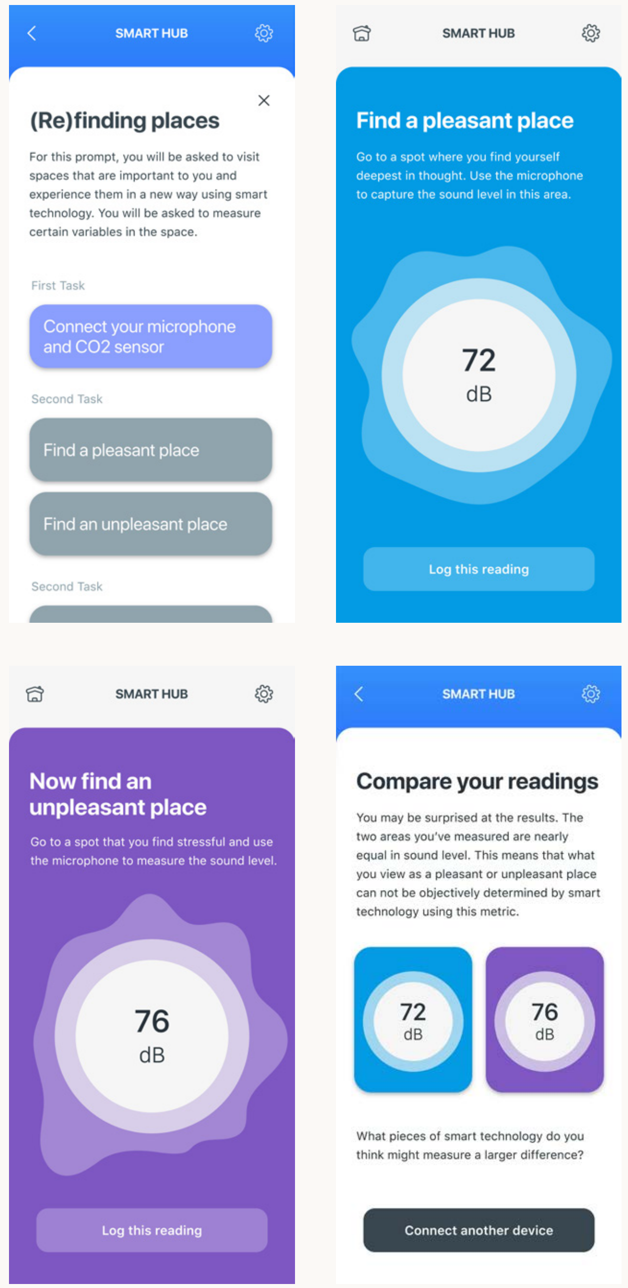


FIGURE 4.2.11 - Exploration H asks the user to log data using smart technology on places they consider "pleasant" and "unpleasant." In most cases, the results will be nearly identical (e.g. a waterfall and a traffic jam are both objectively loud). This highlights the limitations of what smart technology can capture using purely quantitative data.

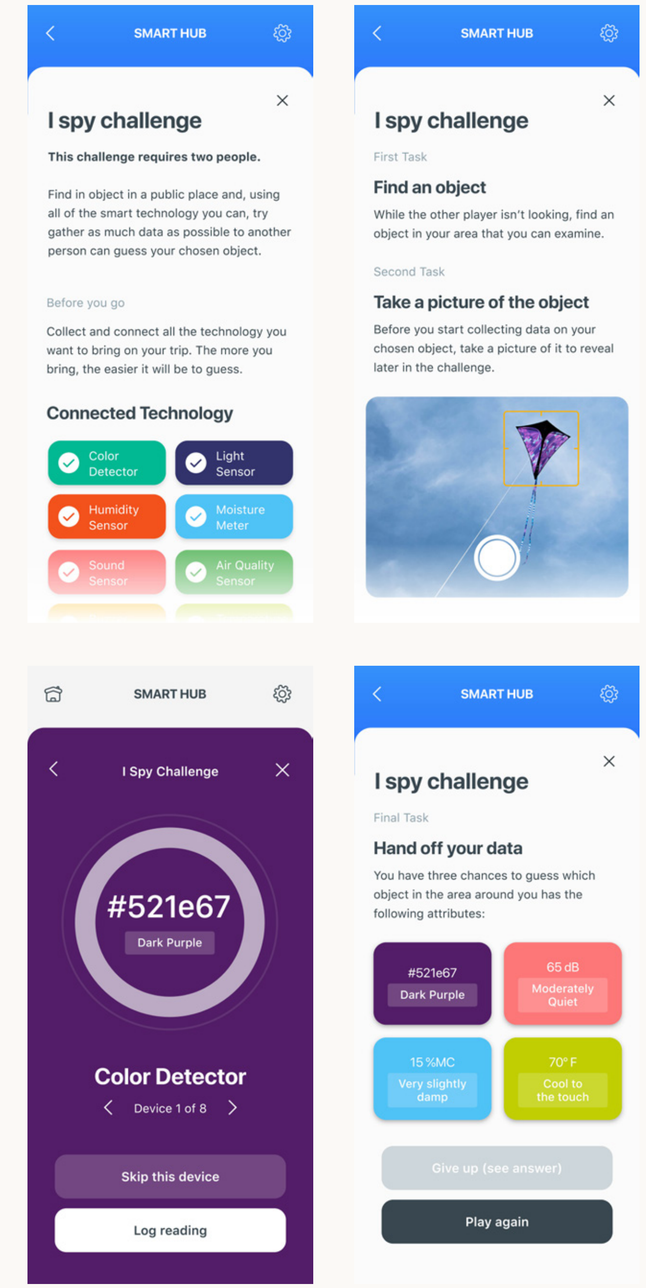


FIGURE 4.2.12 - Exploration I demonstrates the limitations of smart technology data collection using the familiar form of an I Spy game. One player captures multiple data points on a selected object and the other player must guess that object by interpreting the data.

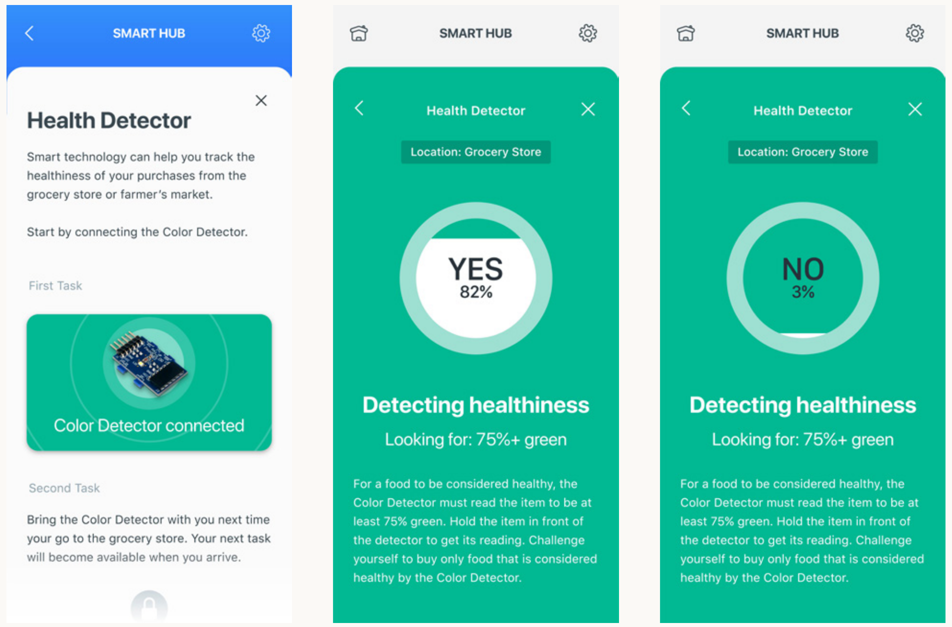


FIGURE 4.2.13 - *Exploration J challenges the user to complete a task using smart technology with an illogical measurement metric: only buying foods determined to be healthy by the amount of green it presents. This enjoins the user to consider the possibilities of broken data metrics.*

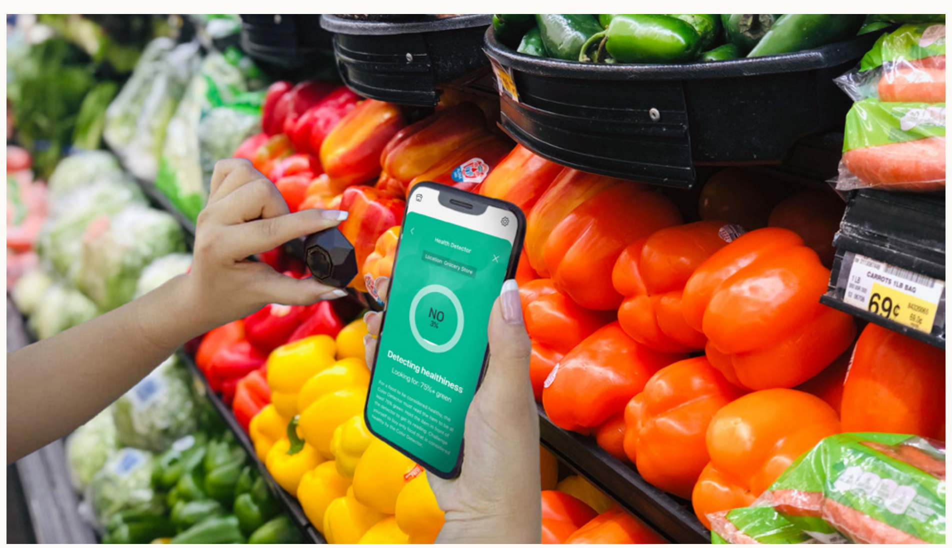


FIGURE 4.2.14 - *Mockup of Exploration J in situ*

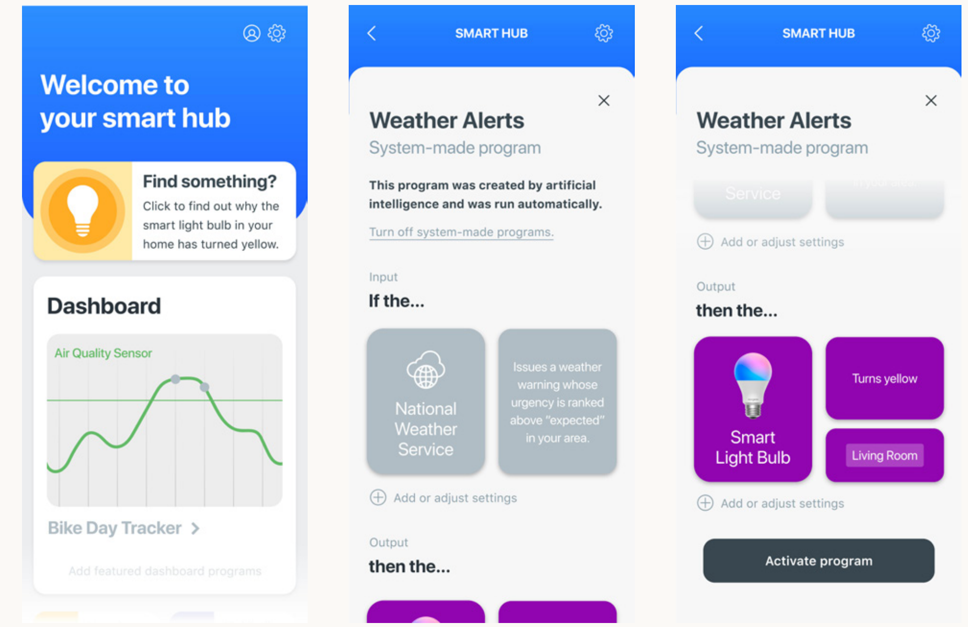


FIGURE 4.2.15 - *Exploration K is prompted not on the interface but automatically in a user's space using a system-generated program. The user encounters a smart light in their space that has turned yellow and they must use the interface to figure out why this change has occurred.*

FIGURE 4.2.16 - *Mockup of Exploration K in situ*

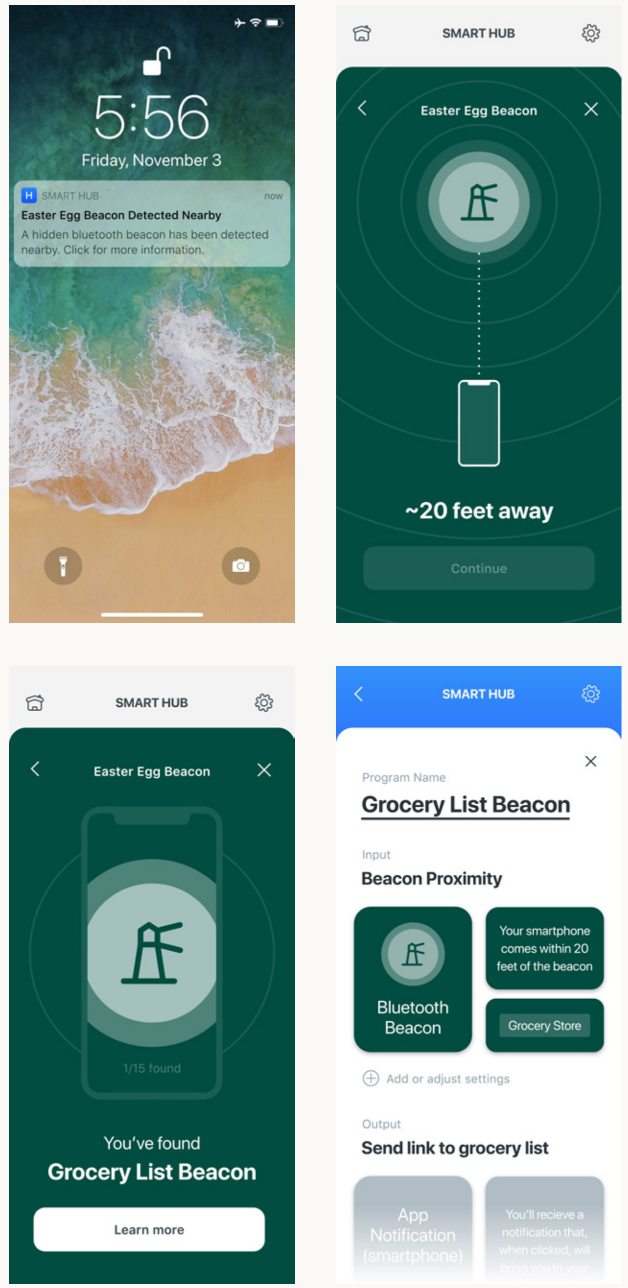


FIGURE 4.2.17 - *Exploration L is triggered when the user happens to walk by a Bluetooth beacon placed in their city. They are notified to search for the device and, once found, are rewarded by a location-specific program.*

4.3 SITUATING VALUES THROUGH MEDIATED CONVERSATION

How can community-wide prompts gamify discussion to enable group reflection and conceptualization of larger implications of smart technology?

REFLECTING AND CONCEPTUALIZING

In the previous studies, the participant has been primed for forming an opinion on smart technology. The intent of this study is to solidify that opinion so it can inform their wants and needs in smart city development. This study focuses on the third stage in Kolb's Learning Cycle: Abstract Conceptualization, which is a sense-making stage where the user's previous experiences are interpreted and distilled into main concepts.

COMMUNITY-WIDE PROMPTS

Introducing diverse viewpoints from the community that build off their individual experiences from the previous studies will give participants perspective and help them fully realize their opinions on smart technology. These community-based prompts can come in various styles which in turn influences its form (in this case, the kind of game).

GAMIFYING DISCUSSION

Up to this point, information has been delivered with a gradually increasing amount of creative responsibility on the user. For this study, the user must take the information they have accrued and apply it, through discussion with others, to form a well-rounded opinion. Because this result is subjective, the mental work required is more squarely on the user. In the same way gamification was used in study one to increase the accessibility of new information, it can be used in this study to ease the effort required to apply that information.

The end goal of this study is to create a base of properly informed citizens. What matters is that opinions are conceived and established, not whether those opinions are "correct" or "incorrect." For this reason, the form of these discussion prompts must resist the tendency of games to spark unhealthy competition and must instead stimulate collaboration and mutual respect, even when disagreements occur, to reach the common goal.

ASSESSMENT

The following are questions by which to measure the success in answering this study's subquestion.

- Does the design allow a user to interpret their experiences from the previous studies and compare them to their knowledge base and value systems in order to distill the information into main concepts as a part of Kolb's Experiential Learning Cycle (Kolb, 2014)?
- Does the design allow a user to perceive smart technology as being consistent with their existing values, past experiences, and needs as a part of Roger's Diffusion of Innovation Theory?
- Does the design encourage the critical thinking required of a user to form an opinion on smart technology without censuring diverse viewpoints?
- Does the design use gamification to encourage collaboration through discussion in the boundaries of healthy competition?
- Is the design accessible to a reasonable variety of possible users in its content, interaction, and interface?

PROCESS

In the ideal progression of these exercises, participants would have a period of overlap between working individually with their smart technology toolkit and working with a group. During this time, community-wide prompts could be slowly introduced to the participants in the format of the previous prompts. These transitional exercises would help participants prepare for discussion by breaking them out of their individualistic mindset, introducing them to alternative processes, and equipping them with the diction to articulate their thoughts.

Exploration A (Figure 4.3.01) is an example of a transitional exercise. This exploration exists in the mobile form and uses the toolkit like in the previous study, but instead of a user- or system-generated prompt, the user is acting on a request made by another participant. This exercise is doubly beneficial: it extends the affordances of smart technology beyond the limits of a single user and their toolkit (to a more realistic city-scale) and it requires the user to learn how to vocalize their ideas and understand others'. Exploration A is just a single example of what could be a whole host of exercises that transitions users between study two and three.

Exploration B (Figure 4.3.02) and Exploration C (Figure 4.3.03) show prompts that participants would encounter early in their work with the community. The former asks the user to guess the data being shown visually using a multiple-choice bank of options. This kind of exercise gives the group an explicit talking point and point of reference to ease them into discussion. Exploration C begins to put participant's opinions into perspective. In this exploration, users submit how much data they are comfortable with being tracked about them which is then directly compared to other participant's submissions. While there is no explicit discussion question, this exercise would still give users a visual to reference in their conversations.

Explorations D (Figure 4.3.04), E (Figure 4.3.05), and F (Figure 4.3.06) are examples of prompts that motivate deeper discussions with the group to aid in individual value conceptualization. Exploration D asks users to indicate on various images where smart technology could be implemented which are then ranked by the group on creativity and usefulness. This exercise introduces users to technology applications they may never have thought of, which in turn builds a more diverse knowledge base to form opinions around. Exploration E instructs participants to choose capabilities they want to see from their city and balance the collected data that would be required for them to function. This balancing by the group compels the user to determine which positions they are willing to compromise on and which are central to their value system. Exploration F uses information gathered from the previous study using machine learning to prompt discussion. In the exercise, a group of users are matched together based on a unique characteristic, practice, or opinion they all share. The group must then decipher how they are alike, verbalizing, voting on, and discussing viewpoints in the process.

Explorations G (Figure 4.3.07) and H (Figure 4.3.08) show how normal, user-directed discussion could be designed. Exploration G creates an open conversation space that mimics the information flow of web-based data collection. When someone grants information to be collected about them, they not only expose themselves but often all their close connections. This risk is recreated in a virtual discussion space where information about a user's conversation partner is given along with all their previous partners. This method encourages thought about trust in their community and trust in the technology system. Exploration H allows users to create and reply to community opinion posts. To stimulate discussion, users can respond to a post with supporting arguments *"because...,"* opposing arguments *"however...,"* or with inquiries *"what if..."* These responses can in turn be debated on, creating an outline of discussion that is easy to navigate and add to. These final explorations could be integrated into the previous as a method for discussion during exercises or kept independent to create a versatile forum.

OUTCOMES

While the explorations meet my assessment requirements, there are a few phrasing oversights worth addressing. First, I did not realize at the time of writing the assessment questions how difficult it would

be to gamify discussion without suppressing diverse opinions. Typical multiplayer game structures necessitate conflict where a player or group of players are the winners. In this scenario, I needed to motivate participation versus domination. To achieve this, I opted to focus on a few isolated gamification elements (e.g. social discovery, time pressure, various game mechanics, etc.,) rather than fully formed games as I did in study one. Because of this, there were very few opportunities for "healthy competition" as I had described. Second, I focused on building on experiences from my past studies in these explorations but there is a definite opportunity for leveraging existing value systems and experiences beyond this workshop as a part of Roger's Diffusion of Innovation Theory.

Through my ideation process, I discovered the potential for an additional study to transition between studies two and three. This study would feature community-wide prompts that heighten the perceived usefulness of smart technology, as seen in exploration A. Demonstrating how technology could be useful beyond individual limitations — physical, mental, and beneficial — at a scale closer to that of a city would be of great use to the participants.

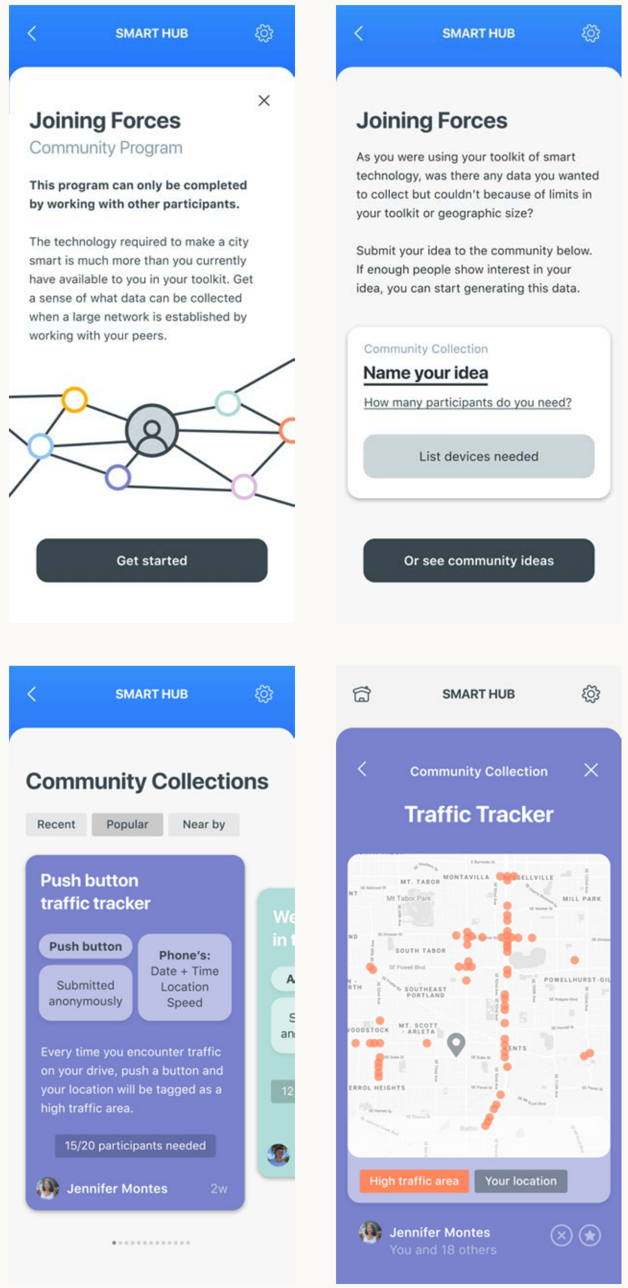


FIGURE 4.3.01 - *Exploration A transitions from individual to group exercises, using the mobile form and toolkit from the previous study to achieve programs suggested by other users.*

FIGURE 4.3.02

Exploration B is an early-stage community prompt. Through a multiple-choice guessing game, discussion is eased into through explicit questions and reference points.

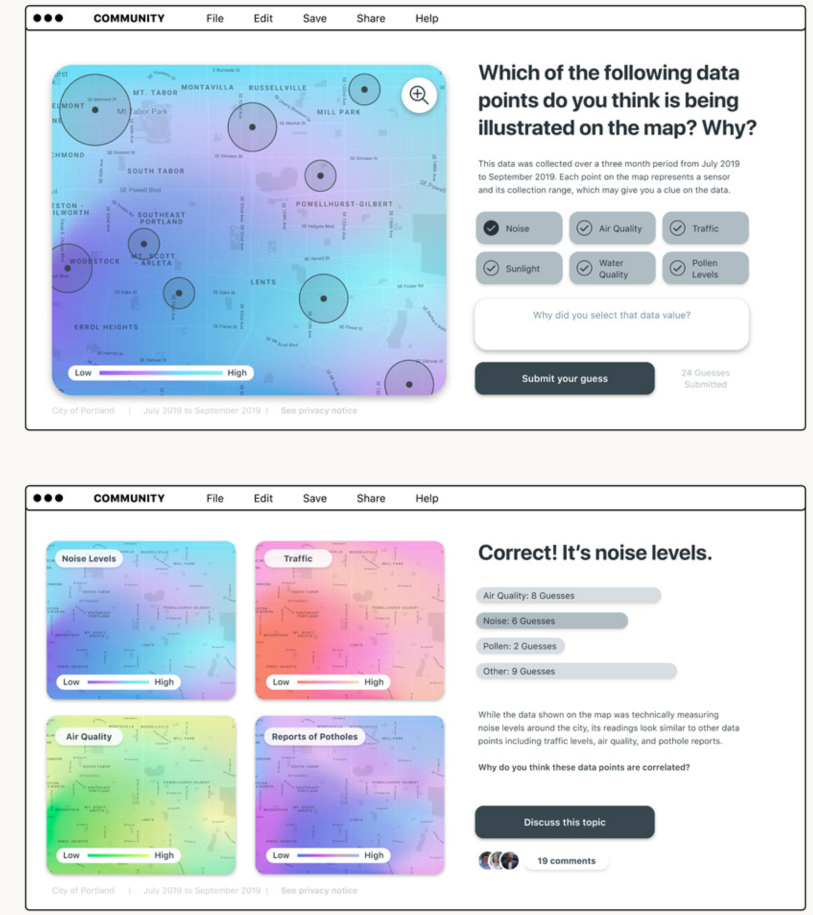
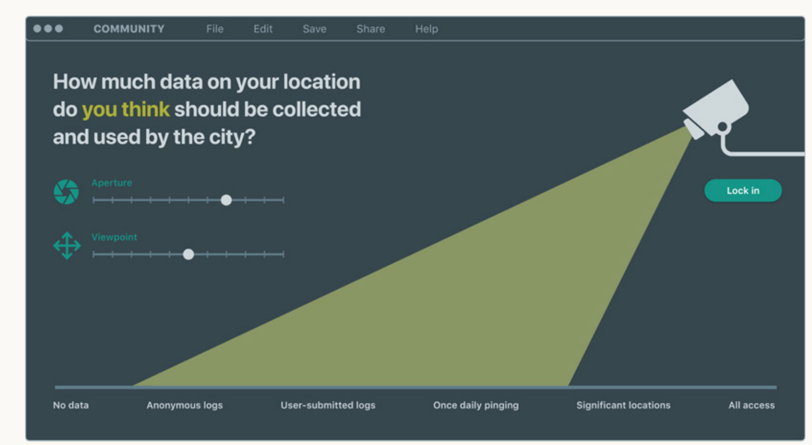
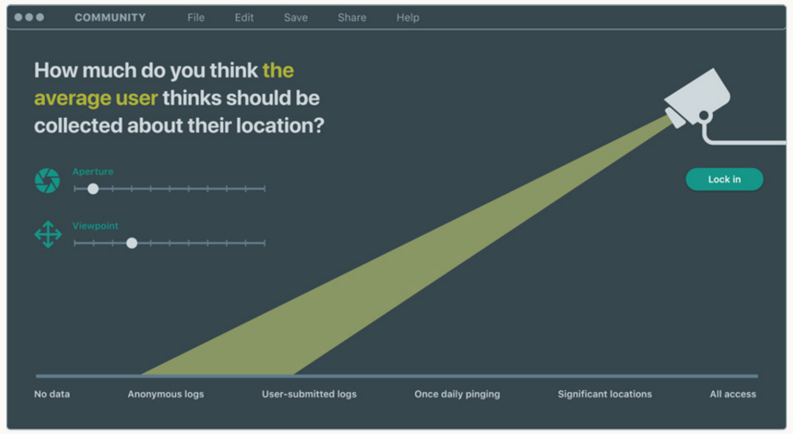


FIGURE 4.3.03

Exploration C asks the user to determine how much data they are comfortable being collected about them which, when compared to other's answers, puts their opinion into perspective.





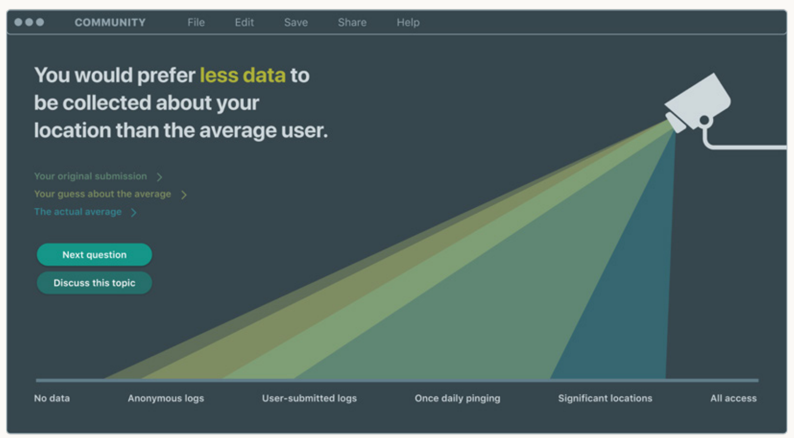
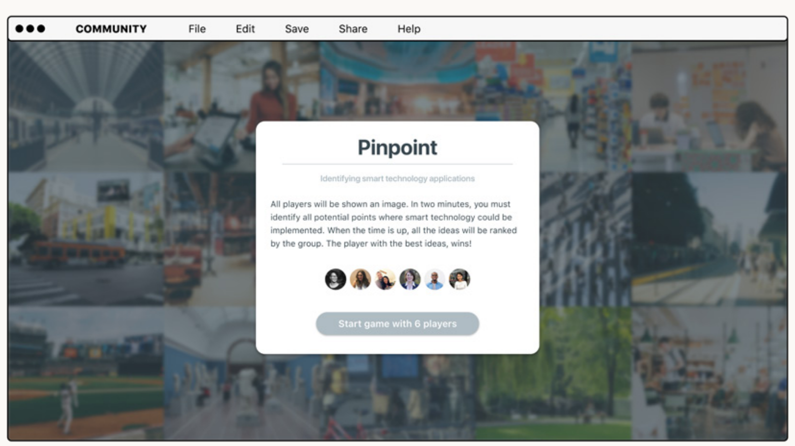
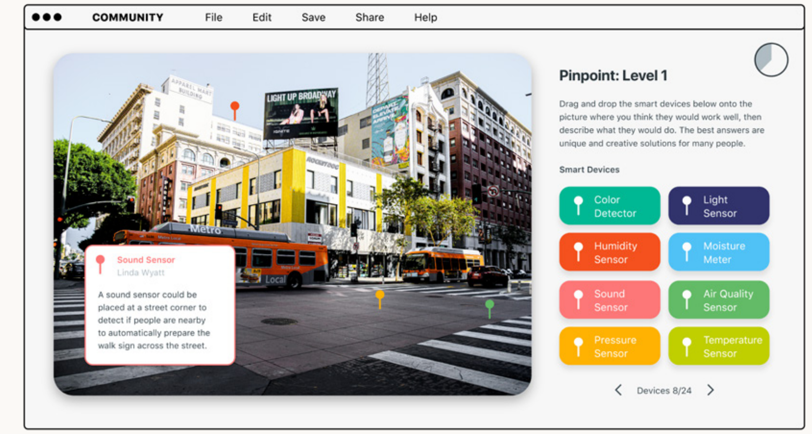
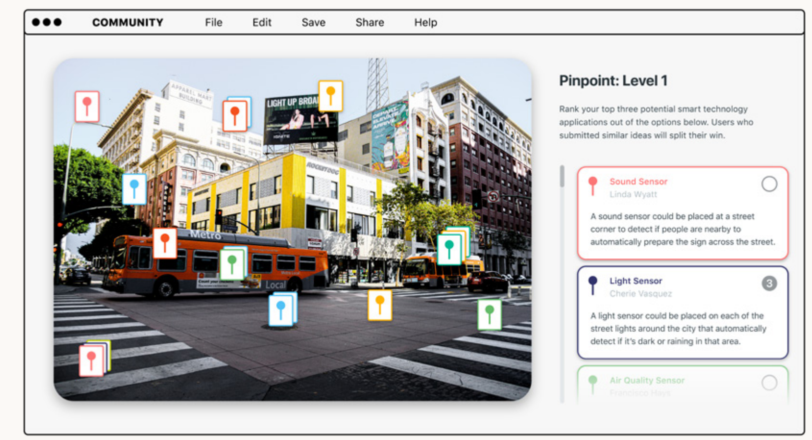


FIGURE 4.3.04

Exploration D asks users to indicate on various images where smart technology could be implemented. This exercise introduces users to unexpected technology applications, building a more diverse knowledge base to form opinions around.







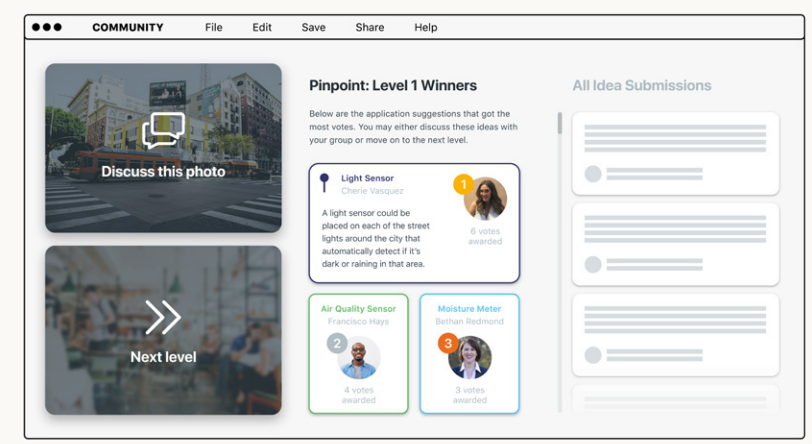


FIGURE 4.3.05

Exploration E instructs participants to collectively choose capabilities they want to see from their city and balance the collected data that would be required for them to function, requiring each user to decide what they are willing to compromise on.

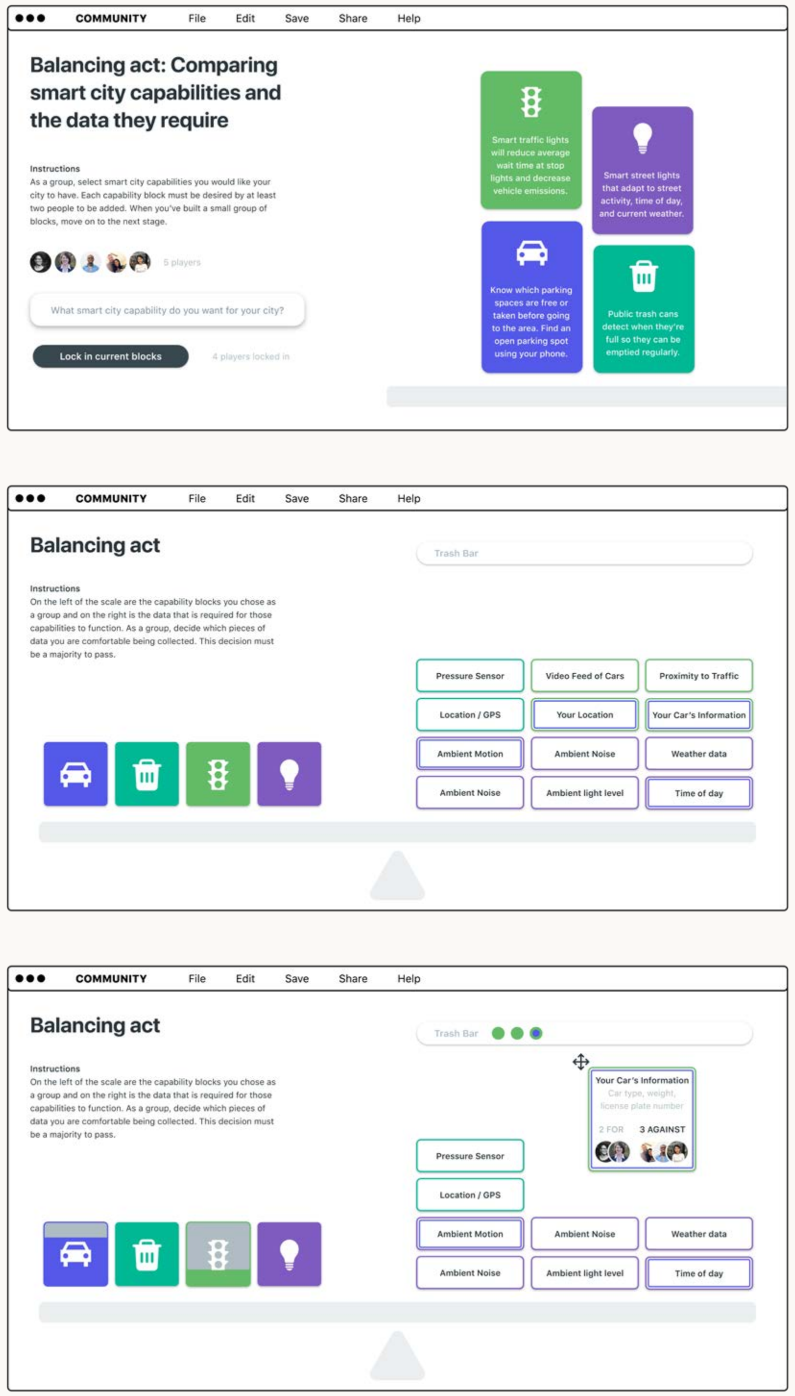
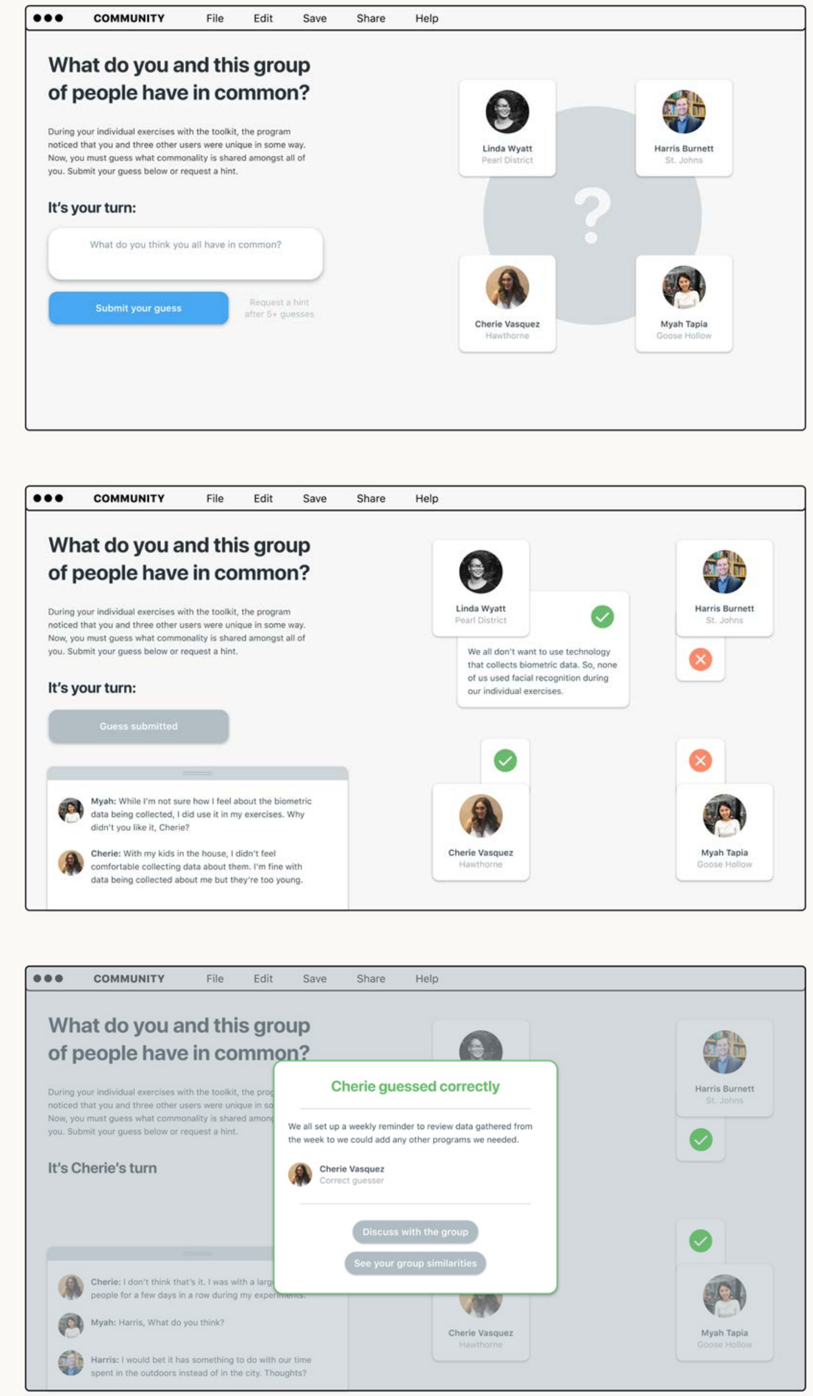


FIGURE 4.3.06

Exploration F matches a group of users based on a shared unique characteristic, practice, or opinion. The group must then decipher how they are alike, verbalizing, voting on, and discussing viewpoints in the process.



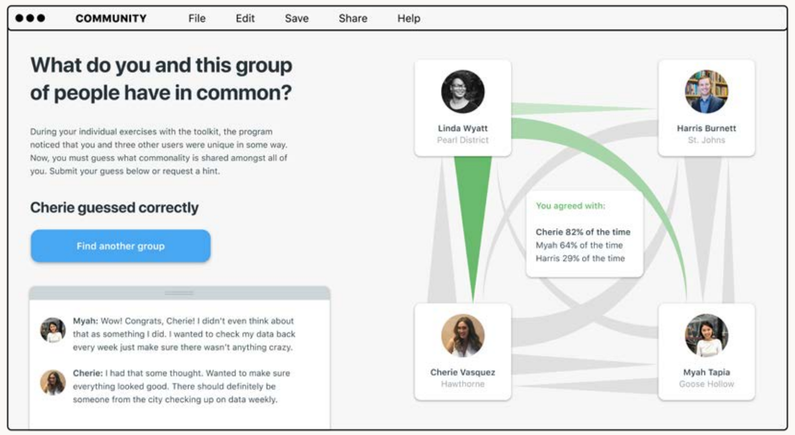
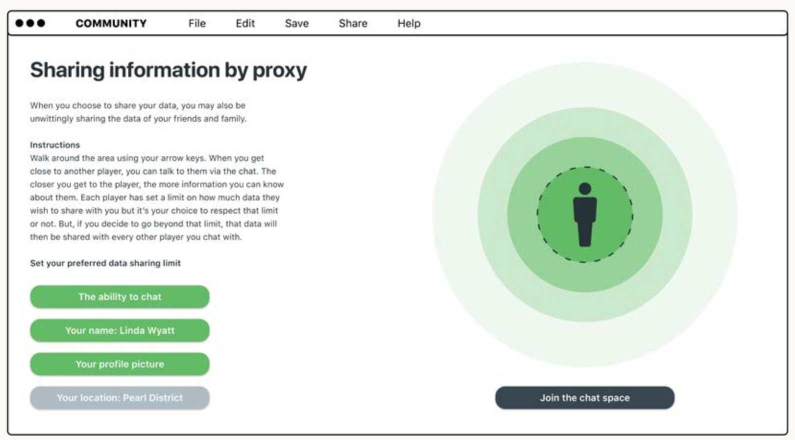


FIGURE 4.3.07

Exploration G creates an open conversation space that mimics the information flow of web-based data collection.



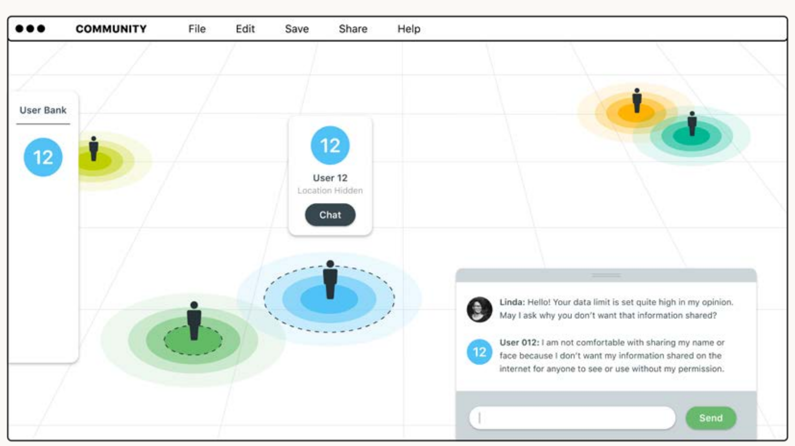
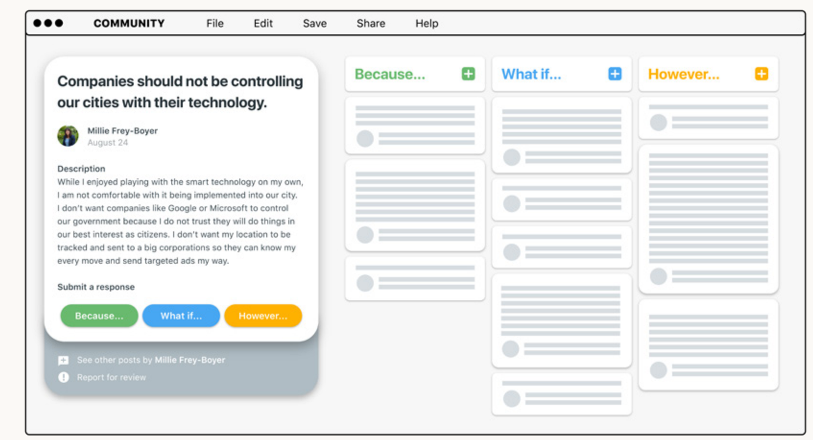
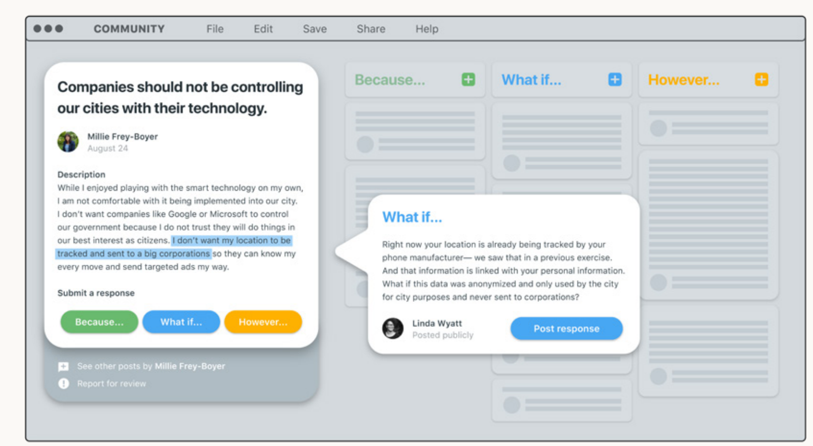
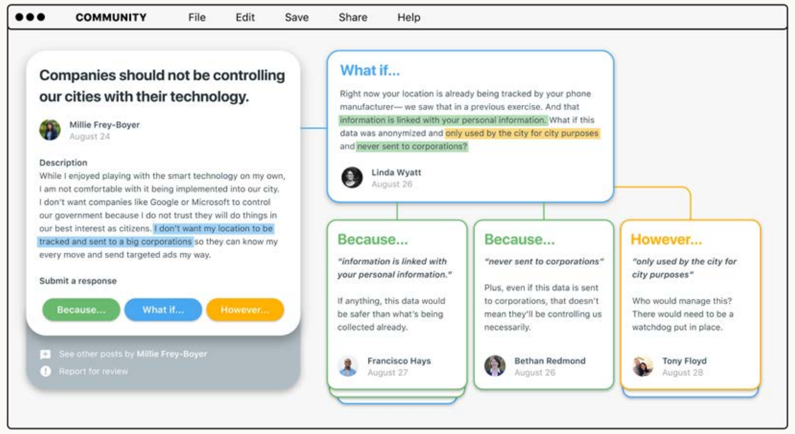


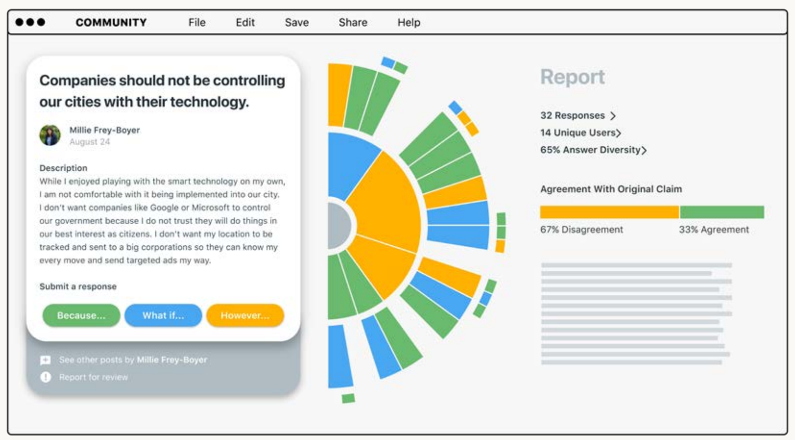
FIGURE 4.3.08

Exploration H creates a branching outline of discussion that encourages users to submit supporting, opposing, or inquiry-based comments on an opinion post.









4.4 PREPARING FOR SUSTAINABLE ADVOCACY

How can a responsive, system-based organizer encourage the consideration and application of experiences to empower community advocates?

EMPOWERING COMMUNITY ADVOCATES

The goal of this investigation as a whole is to establish a group of citizens who represent, support, and promote their informed wants, needs, and values. This goes beyond changing their mindset or daily routine and requires a public commitment to the opinions they have formed in the previous series of exercises. To achieve this, each participant must activate the social circles unique to their identity and impart their knowledge across a branching network of citizens. For this study, this advocacy won't be actively prompted as seen in previous studies. Instead, the exercises will be in preparation for unstructured work after the workshop.

CONSIDERING AND APPLYING EXPERIENCES

This study focuses on the final stage of Kolb's Experiential Learning Cycle: active experimentation. In this stage, the participant begins to think about how they will put what they have learned into practice. In previous studies, they have determined what an optimal future might look like, and now they must consider what actions must take place to achieve that goal (Kolb, 2014). In this way, the participants have been equipped with the knowledge they want to share and now must be provided tools to make the experience easy and effective.

RESPONSIVE, SYSTEM-BASED ORGANIZER

The tools to aid participants in post-experience advocacy will fit into two categories. The first category consists of features that will be built into the interfaces designed in the previous studies that help track and collect information throughout the workshop. The second category will be made up of new exercises that help the participants plan for their advocacy. Both of these kinds of features will culminate into a set of adaptable resources and tools the citizen can use in the field at their discretion.

ASSESSMENT

The following are questions by which to measure the success in answering this study's subquestion.

- Does the design allow a user to translate their new understandings into actions that should be taken to refine or revise their current situation as a part of Kolb's Experiential Learning Cycle (Kolb, 2014)?
- Does the design allow a user to consider how smart technology is compared to the idea it supersedes as a part of Roger's Diffusion of Innovation Theory?
- Does the design empower the user to publicly represent the values they have established in the previous studies?
- Does the design give the user an appropriate set of adaptable tools to prepare for and navigate their advocacy?
- Is the design accessible to a reasonable variety of possible users in its content, interaction, and interface?

PROCESS

Exploration A (Figure 4.4.01) is an example of a feature that would be implemented throughout the previous studies that would ultimately assemble into downloadable resources for the participant. In this exploration, users save pieces of information — forum questions, smart technology uses, participant responses, etc., — into an archive using a bookmark button. At the end of the workshop, the saved materials are consolidated into a report that analyses information like their main interests and most salient submissions. This versatile resource serves as a point of reference during the participant's advocacy to recall what they found important.

Exploration B (Figure 4.4.02) combines multiple support systems into one interface. At the end of the participant's experience, they will be categorized into one of four different styles of advocacy depending on how they overcame challenges and interacted with others. This archetypal distinction matches the user's behavior with corresponding expressions of advocacy, leadership qualities, and ways to improve potential weaknesses. The system also determines the user's self-identified archetype based on check-ins throughout their experience. By finding the type of advocate the user imagines themselves to be versus what they are, the system can recommend specialized advice on the key differences between the two and how they might overlap.

Exploration B continues by allowing the user to dig deeper into these advocacy styles— mapping them, and the user's unique position, onto Coffman and Beer's Advocacy Strategy Framework (2015). This visualization lets the participant see how the styles connect depending on their targeted audience and typical outcomes. Expanding this framework gives the participant the power to inspect their recommended expressions of advocacy within these domains and explore other strategies.

The goal of exploration C (Figure 4.4.03) is for the participant to recognize the elements of their social identity as they are connected to their newly realized opinions and activate the communities with which they share that identity. Pinpointing these commonalities allows the user to plan their advocacy strategies around values they are more likely to share. To achieve this, the user begins by categorizing the core, chosen, or given elements of their identity that they believe influenced their workshop participation. Then, they are prompted to list communities they are a part of that share these characteristics or can connect with other participants that listed similar items.

Along with exploration C, exploration D (Figure 4.4.04) aims to create communities of practice— groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly. However, in exploration D, this is achieved by connecting participants with regional partners and public services rather than with other citizens. These connections are suggested based on the participant's interest and their advocacy style.

Exploration E (Figure 4.4.05) guides the user through completing a Theory of Change model— filling in the "missing middle" between the activities the user can do and the impact they wish to see. This exercise starts with the participant identifying their desired impact and working backward through recursively determining the conditions that need to be in place. Throughout these steps, they are encouraged to specify and consider their assumptions. This exercise would ideally be one of the final ones completed, as it implements resources discovered in previous explorations (e.g. social networks and advocacy strategies) and builds out an explicit impact roadmap.

OUTCOMES

This study's explorations satisfy the respective assessment requirements. This phase of the participant's experience prepares them for real-world advocacy work unstructured by prompts and other designed interventions. Because of this, it cannot be *guaranteed* that participants will advocate for their values in smart city development but, considering their preexisting civic engagement, advocacy is highly likely. A continuation of the workshop prompting real-time advocacy work is possible but outside the scope of this investigation.

It is clear by the customizable nature of this study's explorations how personal advocacy work is. This versatility is responding to the previous study's effort to ensure differing opinions. However, there is room for more flexibility in this study. This study's exercises intend to make the wants, needs, and values formed during the workshop experience into actionable items. An unintended consequence of this is the little opportunity for *changing* those values during this stage. In effect, the exercises require the user to "double down" and solidify their opinions. Ideally, these final interactions would allow for, if not encourage, flexibility to ensure resilient advocacy work.

FIGURE 4.4.01

Exploration A, a bookmark button that saves pieces of information from the previous studies and adds them to a downloadable report for future reference by the user.

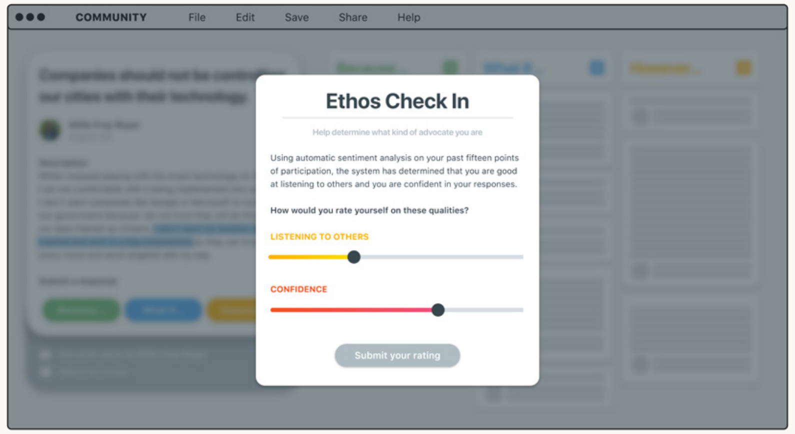
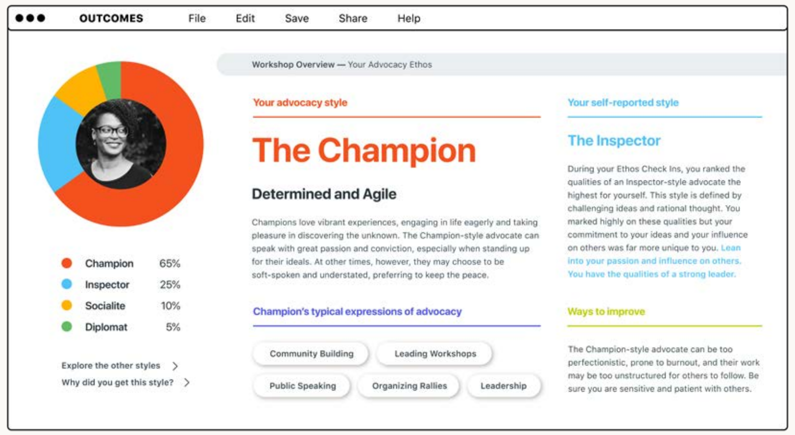
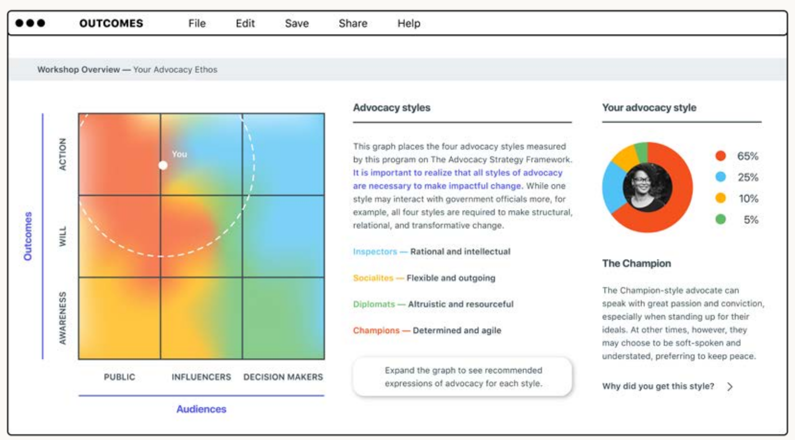


FIGURE 4.4.02

Exploration B categorizes participants into one of four archetypes that are matched with corresponding expressions of advocacy and other suggestions. This is also compared to the archetype with which they self-identify as determined by regular check-ins during the workshop.





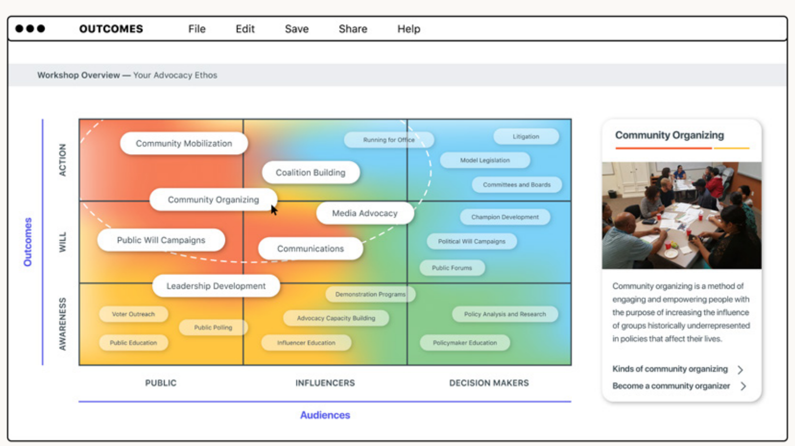
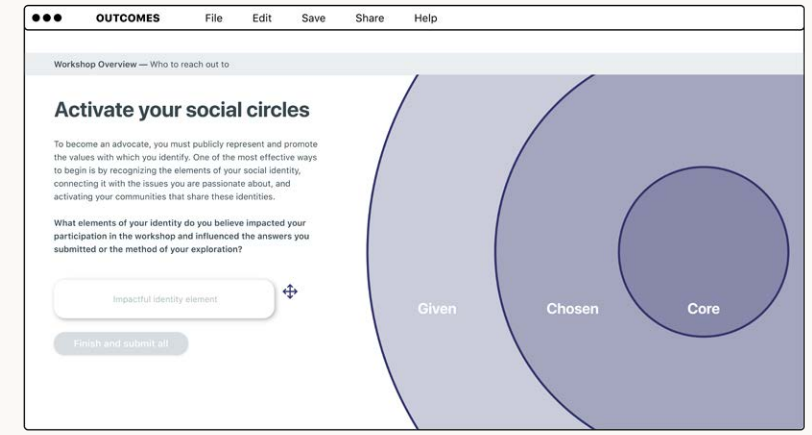
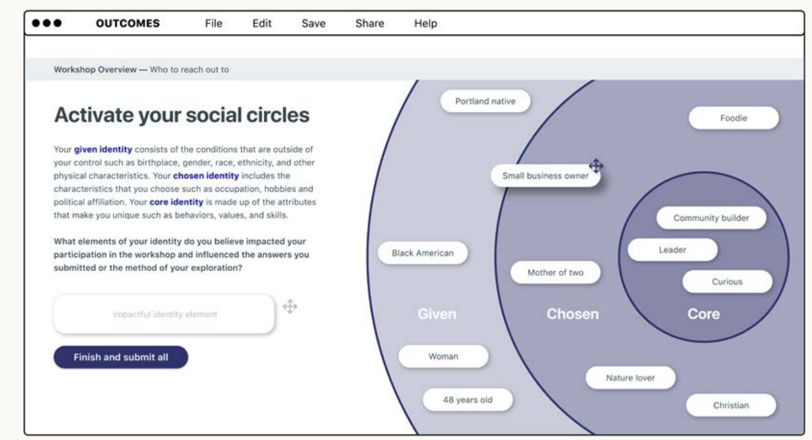
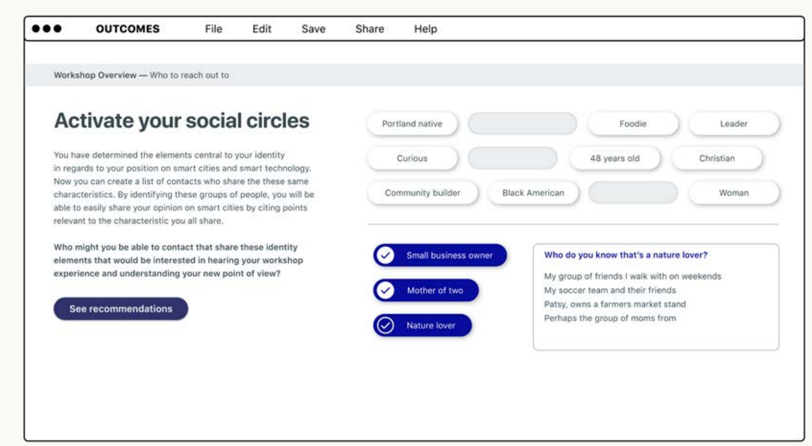


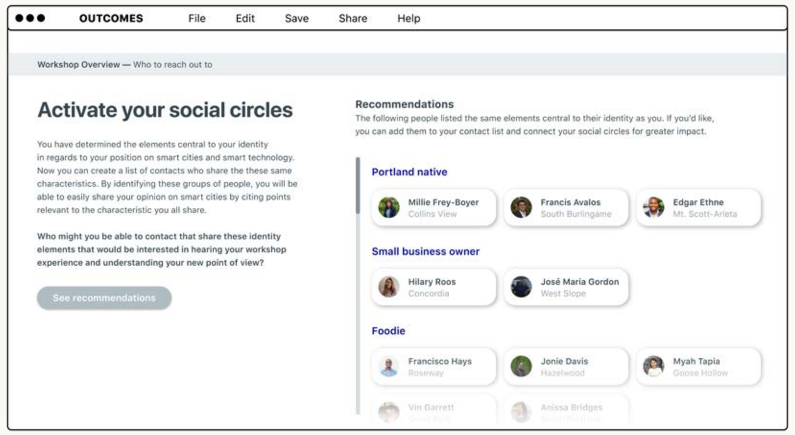
FIGURE 4.4.03

Exploration C asks the user to recognize the elements of their social identity as they are connected to their newly realized opinions and activate the communities with which they share that identity.









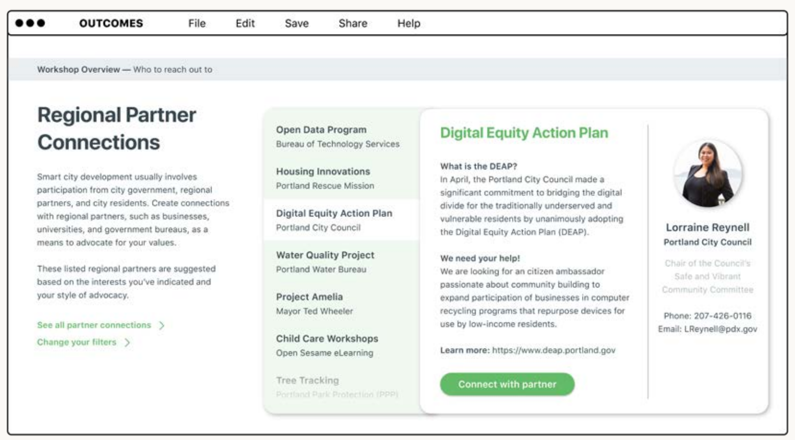


FIGURE 4.4.04

Exploration D connects participants with regional partners and public services through which they can advocate for their values.

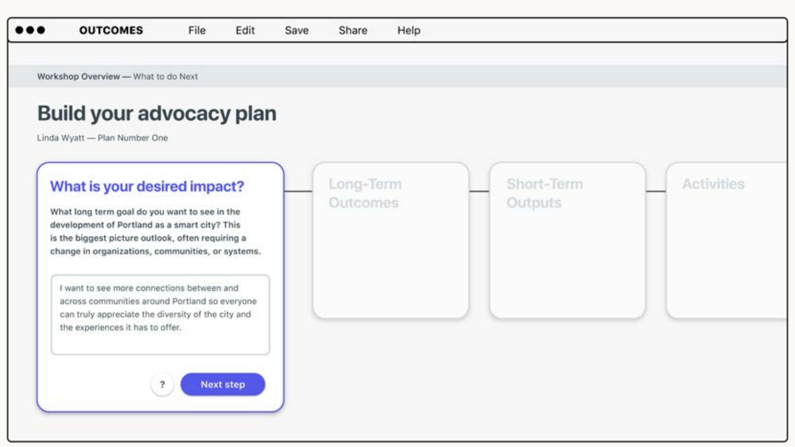
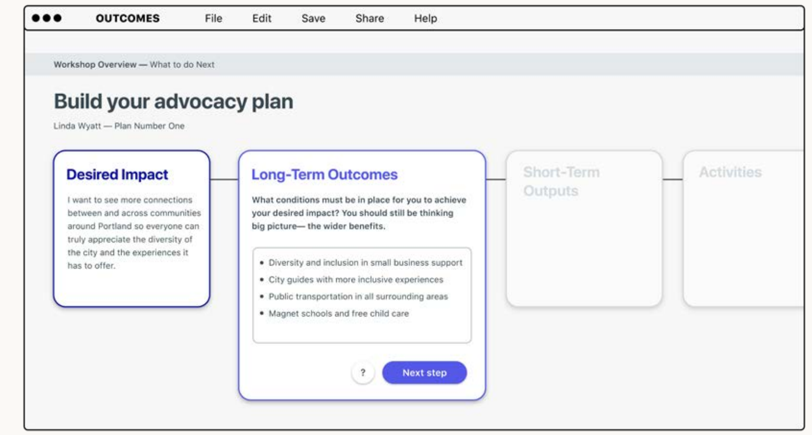
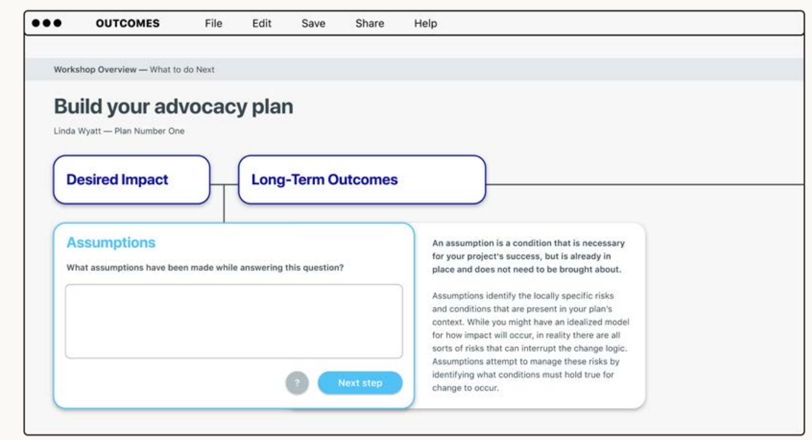
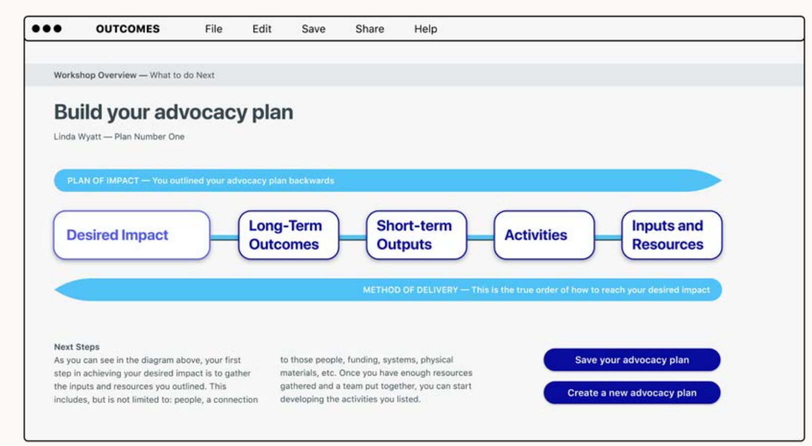


FIGURE 4.4.05

Exploration E is a Theory of Change model where the participant works backwards from their desired impact to the activities they can control with the resources available to them.







CHAPTER FIVE

DISCUSSION

5.1 DESIGN PRINCIPLES

The following are overarching principles revealed in my making and research that I believe are scalable, transferable, and applicable to situations within and beyond the design space.

EMBRACE COMPLEXITIES

Designers should embrace the complexity of cities, discussions, and opinions rather than trying to design for artificially simple versions. These systems are bound to change, get messy, and be seemingly redundant. While any attempt at their streamlining will only hinder growth, designing flexible processes that account for their unpredictability will result in easier, more sustainable development. Such flexibility can be seen in the customization of advocacy types in Figure 4.4.02 and the unbounded conversation flow in Figure 4.3.08.

To prime the user for this complexity, the designer can introduce them to smaller, familiar systems that build in scale over time until they reach a realistic form, as seen in the increasing game level difficulty in Figure 4.1.08.

INSTILL MENTAL MODELS FOR ABSTRACT CONCEPTS

When dealing with abstract, hypothetical, or invisible objects or systems, it is essential to first establish a flexible mental model in the user that embodies those objects or systems. If a framework already exists in the user's mind that mirrors the target concepts, a visual metaphor can be leveraged to catalyze understanding. For example, I used a lily pad's ripples on a pond as a scaffold to explain the pulsating radio waves emitted by smart technology (Figure 4.1.05). However, this comparison must be paired with experiences grounded in reality if possible so the user can get a sense of its actual nature, such as the experiences I designed with a physical toolkit in my second study.

ENCOURAGE NATURAL VALUE RECONTEXTUALIZATION

Experiences should be designed as a vessel for self-discovery with proper room for individual exploration. In most cases, my designed exercises encouraged matching values and qualities the participant already held to a new, smart city domain. For example, the opinions on privacy in Figure 4.3.03, the suspicion of big businesses seen in Figure 4.3.08, and the identity elements in Figure 4.4.03 all reasonably existed before the workshop but were applied and recontextualized within a new belief system. Users will gravitate to their established beliefs naturally. Since this particular investigation does not intend to change those beliefs but to reapply them, the designed system works smoother by providing space for the user to grow at their own pace.

That is not to say that a designed system should not challenge the user in service of a learning opportunity. There may be times when there is a dissonance between how the user views themselves and their values and how they actually behave. In this case, acknowledgment of that disconnect, the opportunity for introspection, and room to change must be provided, as seen in the misaligned advocacy styles in Figure 4.4.02.

DESIGN FOR PLAYFULNESS OVER GAMIFICATION

Games create order— "into an imperfect world and into the confusion of life it brings a temporary, a limited perfection" (Huizinga, 1949, p. 10). This order is helpful in some contexts, such as introducing complex, abstract concepts to users in my first study, but it can be harmful in others where complexity should be embraced. Where games establish structure and may incite competition, play creates adaptable, cooperative systems. When tied to specific learning objectives, designers should create experiences that value instilling a playful mindset over gamified challenges.

STIMULATE CRITICAL THINKING FOR IMPACTFUL INSIGHTS

If the objective of an experience is to reach an understanding of an object or system, designers should encourage critical thinking of its full range of possible implications and faults. Because positive affordances are usually more obvious and immediate (and thus easier to specifically mention), it is best to give the user "pieces" of information about the object or system's shortcomings and allow them to fit them together to create a lasting impression. For example, Figure 4.2.12 lays the groundwork for the user to realize the limitations of what smart technology cannot capture but gives them the room to come to that conclusion on their own. Figure 4.2.13 does the same with data metrics in a more extreme, straightforward fashion.

ESTABLISH PRACTICAL STEPS TO ACHIEVE GOALS

Designed experiences should help a user realize their desired impact *and* the steps it takes for them to achieve that goal. The exercise in Figure 4.4.05 creates an explicit roadmap to this effect but the studies preceding it deliberately equipped the user with the applicable information. Too often designs focus on the user's available resources and their big picture goal without mapping out the measures needed to connect the two, especially in political and innovation spaces. For real change to occur, a plan of action with a toolkit pertinent expertise and connections must be established.

5.2 FUTURE WORK

The following are threads of inquiry that I revealed in my designing process that can be picked up by other researchers for continuation beyond the limitations of this individual investigation.

SUBSTANTIATING AND SITUATING THE INVESTIGATION

The principles of this investigation and the outcomes of its studies are my informed assumptions and not supported by user or usability testing. The logical next step of this investigation would be to perform this testing to validate my assertions. Additionally, collaboration with public servants and smart city officials would inform the investigation beyond its design potentials. That is: additional expertise is needed to properly situate this designed experience in the political and municipal space.

ESTABLISHING IMPACT METRICS

This investigation aims to prepare citizens for advocacy but structured support after the workshop and establishing impact metrics for this advocacy fell outside of my scope. Confirming that my designed experience may actually lead to change in smart city development is the highest priority for continuation but is not within my skill set. Notably, impact metrics would ensure the citizen's work is empowering and not tokenistic (Arnstein, 1969), the main issue cited in my studied precedents. These metrics could also monitor any policy changes that would ideally be paired with this workshop.

CONSIDERING THE WORKSHOP EXPERIENCE

I intentionally designed the exercises in the workshop so they could be completed entirely online. The option to keep the workshop purely digital makes for a more adaptable experience (e.g. in the case of conflicting participant schedules or even a pandemic like the one at the time of writing). A virtual/in-person hybrid workshop, like the experience seen in my precedent Community PlanIt (Figure 2.6.01), may be a better fit for rural cities, for citizens with less technological experience, or for cities who have started participatory planning.

ALTERING THE STUDIES AS A SEQUENCE

I designed the exercises in the preceding studies to be completed in the order they appear in a workshop. There are multiple instances where previous activities directly affect the experience of the current study. Also, some exercises are designed to help the participant transition between studies, such as those seen in Figure 4.3.01. That being said, the studies could be separated and/or completed individually, requiring only a few adjustments to the issues above. This might be helpful in instances where the target audience is shifted (e.g. a more digitally literate group could skip the exercises seen in study one).

EXPANDING SOCIAL NETWORKS

Social capital both feeds into and is produced by the experiences in this investigation. The target participants of the workshop encompass a single type of network through which social capital is sustained: bond networks, or the links between people of common identities (Brian, 2007). A similar investigation could be conducted that expands this pool to social networks beyond a shared identity (bridges) or between those at different societal hierarchies (linkages). In the latter, power structures would need to be considered further, but both would result in better, more sustainable results in every aspect.

ACCOMMODATING OTHER CONTEXTS

This investigation was situated in a very particular context in regards to cities, temporally and ideologically. The following qualities, among others, could be changed about another target city which would considerably shift the designed process and product. How far into the future is the city implementing smart technology? Has it already been implemented? Will it ever be implemented? In this case, what other civic planning procedures could experiences be centered around? Is the city a small, rural municipality or a metropolis? How much do the city's citizens trust its government? While the workshop is fairly flexible, there are many factors worth considering if its context is changed.

5.3 CONCLUSION

"The 19th century was a century of empires, the 20th century was a century of nation states. The 21st century will be a century of cities."

— Wellington E. Webb, Former mayor of Denver, Colorado

In the next five years, the smart cities market size is expected to double to $820.7 billion worldwide (Associated Press, 2020). To ensure a strong and sustainable democracy in the exponentially rising number of smart cities, the voice of citizens must be heard, but the civic participation space is shifting beneath their feet. Soon, literacy in the latest technologies will be required to make an impact on even day-to-day governmental processes. This design investigation instills a lasting and contextualized understanding of smart technology in citizens, develops their critical thinking skills, and adequately prepares them for resilient advocacy for their wants, needs, and values. It transforms participants into community leaders equipped for the future of urban development. The outcomes of these studies speak to not only the prospect of design in governance but to the power embedded in a stimulated base of capable citizens.

CHAPTER SIX

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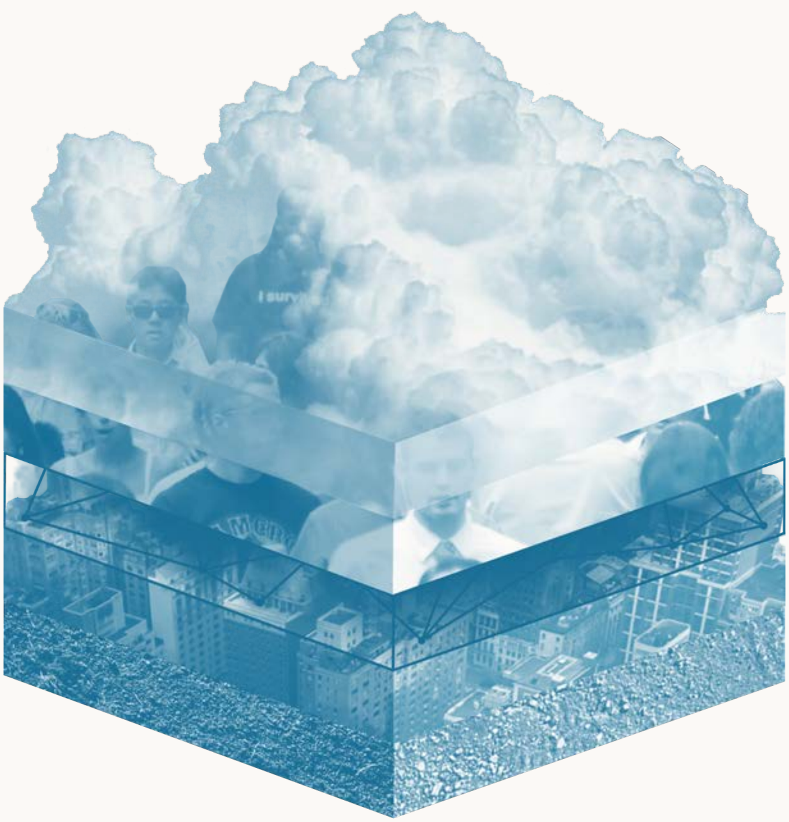

FIGURE 6.1.01

PLAYING SMART

Playful Civic Learning in Human-Centered Smart City Development