The Embodied Hybrid Space – Designing Social and Digital Interventions to Facilitate Connected Learning in Coworking Spaces

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Submitted in fulfilment of the requirements for the degree of
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Thesis in fulfilment of the requirements for the degree of

Doctor of Philosophy (PhD)

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Mami i tati, jer su najbolji na svitu.

[To mum and dad, for being the world's best.]

Abstract

Coworking spaces are shared spaces for people to pursue work and other interest-driven activities. The core challenge of coworking spaces is to facilitate their users' need for connected learning and networking opportunities to nourish creativity, inspiration and innovation. The objective of this thesis is to deliver design solutions for social and ubiquitous computing technology that achieve this.

The thesis reports research findings from a case study at The Edge – a bookless library space at the State Library of Queensland in Brisbane, Australia that is explicitly dedicated to connected learning, coworking, peer collaboration, and creativity around digital culture and technology. Based on a *participatory action design research (PADR)* approach, it delivers a greater understanding of the challenges and barriers for connected learning as perceived and experienced by everyday users at The Edge; it also informed the development of two design interventions that were deployed and evaluated at The Edge:

Hack The Evening (HTE) - a social intervention - was initiated as a weekly meetup group around hacking, making and Do-It-Yourself technology. Insights from 18 months of participation, ethnographic observations and in-depth interviews with HTE group members revealed hidden factors that are crucial for the organic growth of a community-driven, self-maintained and sustainable locale for self-directed, connected learning.

Gelatine - a custom-developed ambient media system - was aimed at supporting shared encounters between coworkers by allowing them to digitally 'check-in' at a workspace; the system displays skills, areas of interest, and needs of currently checked-in users on a set of public screens. Gelatine combines the affordances of the physical and the digital towards an *embodied hybrid space* – a space that is manifested in the physical world, but embodies digital information to make invisible social aspects of a coworking space visible. The outcomes of the evaluation show how Gelatine supports connected learning through amplifying users' awareness of fellow coworkers in ways that would not be possible in unmediated physical environments.

The research outcomes of this thesis illustrate the potential of combining affordances of social, spatial and digital space for connected learning. They propose a future research agenda on *hybrid placemaking* as a new way of thinking about the design of coworking and interactive learning spaces.

Keywords

Ambient Displays

Action Research

Coworking

Collaboration Spaces

Commons 2.0

Connected Learning

Embodied Interaction

Free-Choice Learning

Hackerspaces

Human-Computer Interaction

Hybrid Space

Informal Learning

Interaction Design

Locative Media

Participatory Action Design Research

Participatory Library

Public Screens

Shared Encounters

Smart Spaces

Social Computing

Social Learning

Ubiquitous Computing

Urban Informatics

List of Publications

Publications that form part of this thesis

1. **Bilandzic, M.**, & Foth, M. (2012). A Review of Locative Media, Mobile and Embodied Spatial Interaction. International Journal of Human-Computer Studies (IJHCS), 70(1), 66-71.

2. **Bilandzic, M.**, & Venable, J. (2011). Towards Participatory Action Design Research: Adapting Action Research and Design Science Research Methods for Urban Informatics. Journal of Community Informatics (JoCI). Special Issue: Research in Action: Linking Communities and Universities, 7(3).

3. **Bilandzic, M.**, & Foth, M. (2013). Libraries as Coworking Spaces: Understanding User Motivations and Perceived Barriers to Social Learning. Library Hi Tech, 31(2).

4. **Bilandzic, M.** (2013). Connected Learning in the Library as a Product of Hacking, Making, Social Diversity and Messiness. Interactive Learning Environments.

5. Caldwell, G., **Bilandzic, M.**, & Foth, M. (2012). Towards Visualising People's Ecology of Hybrid Personal Learning Environments. Paper presented at the 4th Media Architecture Biennale Conference: Participation.

6. **Bilandzic, M.**, & Foth, M. (2013, under review). Social, Spatial and Technological Aspects for Designing Effective Coworking Spaces. Learning, Culture and Social Interaction

7. **Bilandzic, M.**, & Foth, M. (2013). Learning Beyond Books – Strategies for Ambient Media to Improve Libraries and Collaboration Spaces as Interfaces for Social Learning. Multimedia Tools and Applications. Special Issue on Ambient Media Applications Linking the Digital Overlay with the Real Physical World, 65(1).

8. **Bilandzic, M.**, Schroeter, R., & Foth, M. (2013, forthcoming). Gelatine: Making Coworking Spaces Gel for Better Collaboration and Social Learning. Paper accepted for publication at OzCHI 2013 - Australian Conference on Computer-Human Interaction

Additional publications arising from this study

Journal Papers

- **Bilandzic, M.**, & Johnson, D. (2013, forthcoming) Hybrid Placemaking in the Library: Designing Digital Technology to Enhance Users' On-Site Experience. Australian Library Journal.

Conference Papers

- **Bilandzic, M.** (2013) Checking-in at the Library: Designing an Ambient Media System for Social Learning and Collaboration Opportunities. In Proceedings of ALIA Information Online 2013, Brisbane, QLD.

Doctoral Colloquia

- **Bilandzic, M.** (2010) The Embodied Hybrid Space: Designing Ubiquitous Computing Towards an Amplification of Situated Real World Experiences. In Proceedings of OzCHI 2010: Design – Interaction – Participation, Brisbane, QLD.
- **Bilandzic, M.** (2011, July 11-22) Designing for Digital Encounters in Physical Places. Invited presentation at the Oxford Internet Institute Summer Doctoral Programme 2011 (OII SDP 2011), Oxford, UK.

Workshop Proceedings

- **Bilandzic, M.**, Jones, M., & Foth, M. (2011) The Embodied Hybrid Space: Designing for Digital Encounters in Physical Environments. In Lugmayr, Artur (Ed.) Proceedings of the 4th International Workshop on Semantic Ambient Media Experience (SAME 2011), Ambient Media Association, Brisbane, QLD.
- **Bilandzic, M.** (2011, August 30) Designing the Internet of Things in Library Buildings. Invited presentation at the "Internet of Things marries Social Media" workshop at MobileHCI 2011 conference, Stockholm, Sweden.

Table of Contents

List of Figures

List of Tables

Statement of Original Authorship

The work contained in this thesis has not been previously submitted to meet requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

Mark Bilandzic

QUT Verified Signature

Signature

13 September 2013

Date

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In his autobiography, Andre Agassi describes tennis as the loneliest sport in the world. If writing a PhD thesis was considered as a sport, it would fit well into the same category. However, I was fortunate to have a magnificent team of people who supported me along my PhD journey – on as well as off the court. Without those people, this research and work would not have been possible; and the journey would not have transformed me personally, professionally and intellectually, as much as it did. First, I thank my principal supervisor Marcus Foth for being a brilliant mentor, coach, supporter and enabler. He stretched the horizon of my thinking from the first day I walked into his office, and, since then, tremendously supported all facets of my academic life. I owe him much. Thank you, Marcus. Second, I thank my associate supervisor Ronald Schroeter; for his friendship, pedantically critical feedback and endless sessions of discussion and advice on "cutting the salami." I am grateful you gave me confidence and made me laugh in times I actually felt like crying. Many thanks also to my other associate supervisor Daniel Johnson for his feedback and ongoing support. I thank the management team at The Edge and State Library of Queensland for their continuous support of my field research and design interventions; in particular, Matt Fallon, Kathy Hayter, Daniel Flood, Mick Bryne and the Visitor Service Operators. Thanks to all users and visitors at The Edge, and the Hack The Evening group. I learned a lot about *learning* from learning with and from you. Thanks to Hackerspace Brisbane for introducing me to and embracing me as part of the hacker and maker culture; and to all other Hackerspaces in Australia for sharing their insights and stories. You are, what the future of learning should be.

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Chapter 1:

Introduction

We live in a networked society. Mobile information and communication technology connect us to anybody, from anywhere, at anytime. This has changed people's socio-spatial relationships. Our person-to-person relationships have become more complex affording a seamless transitioning between being physically present at a particular place and being digitally connected at all times. Rather than being limited to only interact, work and socialise with people in the same neighbourhood, urban dwellers now traverse every day work and social environments beyond the physical boundaries of their local neighbourhood. People increasingly manage their everyday lives as 'networked individuals' (Wellman, 2001, 2002), having more freedom to choose where they work, play, live and learn, and with whom. This trend led to more spatial independence and flexibility, but at the same time weakened the prevalence of strongly tied door-to-door relationships from pre-industrial times when the radius of social interaction was usually limited to people within spatial proximity.

This is evident, for example, in the nature of workspaces. Today's teleworkers enjoy the flexibility of being able to decide when and where to work. However, this flexibility comes at a price: Rather than struggling with the constraints of traditional organisational settings, they struggle with issues such as isolation, lack of social contact and networking opportunities (de Jong & Mante-Meijer, 2008; Ellison, 2004). Nonetheless, traditional organisational settings have their challenges as well, e.g., social interactions tend to be isolated within organisational or disciplinary silos without much room for serendipitous encounters and inspiration from 'outside.'

In the knowledge economy of the 21st century, where disruptive innovation and creativity is increasingly based at the intersection of fields, disciplines and cultures (Johansson, 2004), locales for meeting and interacting with people from diverse backgrounds, cultures and areas of expertise become more and more significant. Human need and desire to interact, work and learn in socially diverse, real-world environments are illustrated by globally emerging trends of local, bottom-up, grassroots community initiatives such as 'Jelly' *coworking groups* (workatjelly.com, 2012), *hackerspaces* (Altman, 2012; Borland, 2007; Tweney, 2009) or *meetup groups* (Edgerly, 2010; Sander, 2005). These groups function as popular locales, where participants can engage in *intrinsically motivated* activities while being co-present in a shared space with other likeminded people

from different backgrounds, industry sectors, disciplines, fields, and organisations. A crucial by-product (Bennett, 2012; Schugurensky, 2000) of participation in such environments is *social learning*, a learning experience that Bingham and Conner (2010) define as *"…[the] result in people becoming more informed, gaining a wider perspective, and being able to make better decisions by engaging with others. [Social learning] acknowledges that learning happens with and through other people, as a matter of participating in a community, not just by acquiring knowledge."* (p.7).

Over the past decade, the need for local hubs that facilitate social learning through open spaces for people to mingle with likeminded other people from a variety of backgrounds, cultures and areas of expertise has triggered a number of trends across different spaces. *Public libraries* – as traditional facilitators of information, knowledge and life-long learning – have been decreasing the number of bookshelves in order to provide more floorspace for infrastructure and interior design elements that invite for coworking, peer-to-peer learning and collaboration (LaPointe, 2006; Martin & Kenney, 2004; McDonald, 2006; Shill & Tonner, 2003), as well as serendipitous encounters among people from different ages, classes, cultures, religions and ethnicities (Aabo & Audunson, 2012; Aabo, Audunson, & Varheim, 2010; Audunson, 2005; Leckie & Hopkins, 2002). Innovative *organisations* and *office space proprietors* experiment with different configurations of recreation, entertainment and hospitality facilities blended with professional office equipment and resources, aiming to not only make employees feel at ease, comfortable, and more productive, but also increase opportunities for networking and serendipitous cross-fertilisation of knowledge and ideas among colleagues. *Coworking spaces* started to gain global popularity and exponential growth since 2006 (Deskmag, 2011a) – providing similar, carefully curated shared workspaces that facilitate networking and interaction opportunities across organisational and disciplinary boundaries.

The common denominator of all these recent trends accords to what has most recently been promoted as *connected learning* (Ito et al., 2013) – a model that regards learning as an *interest-driven* and *socially embedded* experience. As such, connected learning, as a design approach, does not restrict learning to a particular space (school, organisation, university, etc.), but considers it to be an aggregation of individual experiences made through intrinsically motivated, active participation in and across various socio-cultural environments (school, university, cooking class, driving lessons, libraries, museums, community centres, sport clubs, home, etc.), including online spaces such as platforms

for content sharing (Youtube, Flickr), collaborative authoring (Wikipedia), open discussions (blogs, forums), or social networking (Facebook, Twitter, Google+). Hosts of innovative office, coworking, library and learning spaces have started to recognise the benefits around connected learning, and make use of digital channels to promote an engaging, participatory and open sharing culture in their communities (e.g., Library 2.0). However, initiatives to accommodate their physical spaces accordingly are primarily based on architectural design guidelines such as providing open, free, inspiring, comfortable and practical environments (B. Sinclair, 2007). Open architecture approaches such as no walls (or only glass) between different work spaces, for example, are aimed at facilitating serendipitous cross-disciplinary discoveries and interactions between people who work side-by-side. In general, however, those are limited to incidental and rather implicit cues.

With the rise of *ubiquitous computing* (Dourish & Bell, 2011; Weiser, 1991), the design of real-world spaces has become broader. Architectural elements and physical objects can be networked, embody sensors and ambient displays towards capturing and displaying situated, real-time information that would remain invisible otherwise.

The journey of this PhD study started with my interest in designing and developing ubiquitous computing technology that augments and complements the physical architecture of social spaces. As a computer scientist who specialised in human-computer interaction, I developed a research interest across people, place and technology. With the rise of Web 2.0 (O'Reilly, 2005) and social computing (T. Erickson, 2013), the Internet now provides an increasingly open, accessible, participatory and socially translucent medium that enables collaboration beyond the spatial, temporal and social barriers of the physical world. However, despite our increasingly networked society, place continues to matter (Gordon & de Souza e Silva, 2011). My point of departure was to inversely think about the design of digital technology: *not* to connect anybody, from anywhere, at anytime, but to augment social interactions in the 'here and now.' How can digital media be mashed up or layered on top of a physical space to amplify and facilitate its conceived purpose and activities?

My thinking followed a vision to combine the affordances of the *physical* and the *digital* towards an *embodied hybrid space* – a space that is manifested in the physical world, but embodies digital information to make visible the relevant but invisible social aspects of a space. Following this vision in the context of *connected learning, collaboration* and *coworking spaces*, my hypothesis was that digital augmentation of physical architecture can facilitate

a more social experience among coworkers, e.g., through supporting shared and serendipitous encounters, or increasing awareness of collaboration and connected learning opportunities. The thesis narrates my journey of *exploring, informing, designing and evaluating* social and technological interventions in the *embodied hybrid space* to facilitate *connected learning* in *collaboration* and *coworking spaces*.

Research Context and Definitions

Case Study: The Edge – Coworking and Collaboration Space at the State Library of Queensland

As a case study of this research, I selected The Edge (http://edgeqld.org.au/) – a novel library space at the State Library of Queensland in Brisbane, Australia, that is explicitly dedicated to coworking, collaboration, connected learning, and creativity around digital culture and technology. Launched in February 2010 as the Queensland Government's flagship 'Digital Culture Centre,' The Edge is one of the first library initiatives of its kind in Australia and world-wide. In its welcome brochure, The Edge is described as a *"hub for both planned and incidental collaboration – people stumble upon each other and create new possibilities that wouldn't have existed otherwise."* As a 'bookless' library space, it envisions to facilitate collaboration, connected learning and cross-fertilisation of knowledge, skills and ideas through an interactive, open sharing culture among users. The Edge is situated at the Queensland Cultural Precinct in Brisbane, vis-à-vis the Queensland Performing Arts Centre, the Queensland Museum, the State Library of Queensland, the Queensland Art Gallery, and the Gallery of Modern Art. As a cornerstone of the Queensland Government's *arts culture + me Children and Young People in Arts* Action Plan 2008 – 2011, The Edge is guided by an explicit focus on creativity, innovation and engagement with, for and by young people.

With this focus, The Edge served as a cutting-edge case study to investigate contemporary challenges of connected learning within place-based social environments (libraries, organisations, coworking spaces, etc.), and explore opportunities for innovative technology artefacts in the embodied hybrid space. The findings of this case study are relevant beyond The Edge and the library space context. Through the analysis of my initial user observations and interviews at The Edge (Chapter 6), *coworking* emerged as a focal theme and overarching construct which I then embraced to guide my further investigations and design interventions in the research process. In general, the

research on this case study is relevant to any space that aims to facilitate connected learning and collaboration among people who share the space to pursue work or other interest-driven activities.

Social Learning

Social learning is a broad concept with various definitions and interpretations (cf. Reed et al., 2010). Social learning, as understood and conceptualised in this thesis, is based on Bandura's (1977) early understanding of *individual learning* as facilitated through the socio-cultural context of the learner, in particular individual learning that occurs as a result of observation, imitation, and modelling of other people. Reed et al. (2010) narrow this definition down further to *learning that occurs through social interactions* between actors within a social network; such interactions can take place either directly, for example, in conversations, or in mediated spaces, such as online social media platforms. This concept aligns with the ideas behind Vygotsky's (1978) *zone of proximal development* and *collaborative learning* (Kaye, 1992), which describe the phenomenon of individuals acquiring knowledge and skills through interactions with (optimally more knowledgeable) peers. Peers in the group function as facilitators who *scaffold* (D. Wood, Bruner, & Ross, 1976) each other's learning experience and help acquire knowledge that the individual learner would not be able to tap independently.

As a working definition that summarises the abovementioned concepts, I adopt Bingham and Connor's (2010) definition, i.e., social learning as

> "…[the] result in people becoming more informed, gaining a wider perspective, and being able to make better decisions by engaging with others. It acknowledges that learning happens with and through other people, as a matter of participating in a community, not just by acquiring knowledge." (p.7)

This understanding of social learning is different from some concepts that regard social learning as learning that is situated in the wider social units or communities of practice which individuals belong to, e.g., organisations, local communities or society in general (Reed et al., 2010). Crucial to the definition further above and the use of the term *social learning* in this thesis, is that it is focused on *individual* learning as a result of *participation* and *interaction* in a socio-cultural environment.

In the literature, *social learning* is mostly discussed and referred to as a learning *theory*, e.g., Social Learning Theory (Bandura, 1977) or Social Constructivism (Vygotsky, 1978; Wertsch, 1997). As such, the term *social learning* is predominantly associated with a body

of research that investigates cognitive and psychological aspects of how learning is facilitated through the socio-cultural environment of the learner. The focus of this thesis, however, is less on social learning theory per se, but rather on both *spatial* and *technological* design aspects that facilitate social learning. In that context, the focus and goals of this thesis are rather situated in the context of connected learning.

Connected Learning

Rather than representing a theory per se, connected learning, as recently formulated by Ito et al. (2013), represents a *design and research agenda* for education and learning spaces. It focuses on design aspects and spaces that, in particular, build upon two main factors that contribute to the most effective learning experiences, i.e., *individual interest* and *social support*. For example,

> "…connected learning is realized when a young person is able to pursue a personal interest or passion with the support of friends and caring adults, and is in turn able to link this learning and interest to academic achievement, career success or civic engagement" (p. 6).

As such, connected learning *"focuses attention on the spaces of integration and translation between divergent domains of knowledge, culture, and social practice."* Similarly, in the context of online environments, Thomas and Brown (2011) describe a 'new culture of learning' through what they define as *collectives*, i.e., people with shared interests (surfing, skateboarding, gaming, etc.) forming world-wide networks through social media in order to interact, learn from each other, help each other, and grow the collective knowledge in their subculture. *Connectivism* (Siemens, 2005) describes how such networked interactions amplify four key principles relevant for learning, i.e. autonomy, connectedness, diversity, and openness (Downes, 2010; Tschofen & Mackness, 2012), thus providing new learning opportunities that would not necessarily be possible in unmediated environments.

In the remainder of this thesis, I use *connected learning* as a term to refer to individual learning that happens as a result of intrinsically motivated participation and interactions within a supportive socio-cultural environment of likeminded peers.

The Edge served as a case study to explore innovative design strategies in the *embodied hybrid space* (physical environments blended with ubiquitous computing technology) that facilitate connected learning through digital encounters and connections among

collocated people in a physical environment. As Ito et al. state (2013), connected learning *"…is a work in progress and an invitation to participate in researching, articulating, and building this movement."* (p. 87). The findings and contributions of this thesis contribute to the connected learning movement through a user-centred design, development and evaluation process of innovative ubiquitous computing technology.

Research Questions and Aims

The aim of this PhD study is summarised in the following overarching research question:

RQ **How can ubiquitous computing technology be designed to facilitate connected learning among users in coworking environments?**

My approach to provide answers to this research question was to explore and evaluate opportunities through user-centred design, development and evaluation of both technological and social interventions at The Edge. The Edge served as a case study and 'living lab' environment throughout all stages of the research. The study followed a Participatory Action Design Research process (Chapter 5) and aimed at the following four research aims towards understanding relevant aspects and finding answers to the RQ stated above:

1. **Understand** user attitudes and challenges of connected learning in coworking environments;
2. **Inform** design strategies for social and ubiquitous computing interventions that enhance connected learning among users;
3. **Design, develop and deploy** a relevant ubiquitous computing artefact;
4. **Evaluate** the target artefact and its implications in 'the wild,' real-world context as encountered by people during their everyday visits.

As the research progressed, a number of secondary questions were iteratively formulated and added for each of the aims:

Aim 1: Understand User Attitudes and Challenges of Connected Learning

The initial step was to gather a base understanding of issues and challenges that contemporary public coworking spaces – such as The Edge – face in relation to

facilitating connected learning and collaboration among their users. It was guided by the following two secondary research questions:

RQ1 **a) How do users make use of The Edge as a library space that is dedicatedly designed for coworking and connected learning purposes?**

b) What are the barriers and challenges for connected learning among users at The Edge?

RQ1a was specifically targeted at investigating different use patterns and user attitudes at The Edge; RQ1b aimed at revealing barriers and challenges for connected learning as perceived or encountered by users in their everyday visits at The Edge. The emerged base understanding of the user would then direct further investigations in relation to the overarching research question above (RQ).

Aim 2: Inform Design Strategies to Enhance Connected Learning

In order to inform the construction of a design concept that enhances connected learning, further investigations aimed at revealing particular socio-spatial aspects that facilitate connected learning in general.

The following RQ2 and its sub questions were targeted at learning communities such as meetup groups and hackerspaces, i.e., groups of people that meet in particular for the purpose of learning with and from each other. The aim was to investigate the natural motivations, interactions and selected environments of such learning communities.

RQ2 **In relation to the group interactions of people that engage in connected learning activities:**

a) What do people do when they meet for connected learning purposes? What structures and formats do their interactions follow?

b) Where do people meet for connected learning purposes, and why do they meet where they meet?

c) What (social, spatial, technological) interventions do these groups apply already in order to facilitate connected learning?

The insights gathered from RQ1 and RQ2 lead to RQ3 and RQ4 towards explorations on the actual design of specific ubiquitous computing artefacts and interfaces for connected learning in coworking environments. A particular focus was set on ambient media, i.e., media that materialise digital information as observable and sometimes interactive parts of the physical environment.

RQ3 **What are adequate design strategies for ambient media to address some of the identified challenges for connected learning among users in coworking environments?**

RQ4 **How do ambient media interfaces for connected learning look like? In particular, what content and information should they provide, and, how should they be represented?**

Aims 3 and 4: Design, Develop, Deploy, and Evaluate

The findings from RQ1 to RQ4 shaped the creation of two main design interventions; a social intervention and a technology intervention. The social intervention consisted of the launch of a weekly meetup group / learning community at The Edge. The aim of this intervention was to explore potential cross-fertilisation of goals between The Edge as a coworking space and learning communities as self-driven, grassroots environments for connected learning.

RQ5 **How can coworking environments better host, nourish and support connected learning within their user communities?**

The technological intervention was an ambient media system named *Gelatine* that allows users to 'check-in' at The Edge, and then display their skills, interests and questions on public screens inside the building. In order to evaluate the proposed design strategies as elaborated through RQ3 to RQ4, *Gelatine* was developed as a custom designed functioning prototype application, and deployed in a pilot user study at The Edge. The evaluation of the system was aimed at investigating how it affected people's connected learning experience in 'the wild' and in the real-world context of their visits at The Edge.

RQ6 **How does the target ambient media system affect the connected learning experience of users at The Edge?**

Thesis Structure

This thesis is presented by published papers, as per the PhD regulations of QUT in the following paragraphs:

14.1.1 *The Queensland University of Technology permits the presentation of theses for the degree of Doctor of Philosophy in the format of published and/ or submitted papers, where such papers have been published, accepted or submitted during the period of candidature.*

14.1.2 *Papers submitted as a PhD thesis must be closely related in terms of subject matter and form a cohesive research narrative.*

The core of the thesis consists of eight papers that have been published or submitted for publication during the period of my PhD candidature. Each of these papers is presented as one chapter of this thesis. The chapters stand as individual writings on their own, but also form a cohesive narrative iteratively targeting the four research aims and research questions described further above.

The studies presented in the individual publications cohesively follow a *Participatory Action Design Research (PADR)* process (Chapter 5). They iteratively contribute towards understanding user attitudes and challenges (Aim 1) and informing relevant design strategies (Aim 2) from different angles at the intersection of *people, place and technology.* These iterative cycles of understanding and informing were fed into the design, development and deployment (Aim 3) as well as evaluation (Aim 4) of two target design interventions – a social intervention ("Hack The Evening," Chapter 7), and a technology intervention ("Gelatine," Chapter 11).

The way the individual chapters are related to the research process and aims is depicted in Figure 1. The order of the chapters was set to construct a coherent research narrative from *understanding and informing* towards *designing, developing and evaluating* the subject matter in relation to *people, place* and *technology* related aspects.

Introduction 1

A Review of Locative Media, Mobile and Embodied Spatial Interaction 2

Library as a Hybrid Space 3

Technology and "Sense of Place" 4

Literature Review

Towards Participatory Action Design Research: Adapting Action Research and Design Science Research Methods for Urban Informatics

Methodology 5

**PADR Cycle 1 –
Aims 1 & 2: Understand & Inform**

**PADR Cycle 2 –
Aims 3 & 4: Design, Dev. & Evaluate**

Libraries as Coworking Spaces: Understanding User Motivations and Perceived Barriers to Social Learning

People 6

Towards Visualising People's Ecology of Hybrid Personal Learning Environments

Place 8

Social, Spatial and Technological Aspects for Designing Effective Coworking Spaces 9

Connected Learning in the Library as a Product of Hacking, Making, Social Diversity and Messiness 7

Gelatine: Making Coworking Spaces Gel for Better Collaboration and Social Learning

Learning Beyond Books - Strategies for Ambient Media to Improve Libraries and Collaboration Spaces as Interfaces for Social Learning

Technology 10

11

Conclusion 12

Figure 1: Thesis structure

The following eight chapters were published in below listed publication outlets, targeting specific audiences across the domains of people, place and technology.

Chapter 2:   Bilandzic, M., & Foth, M. (2012). A Review of Locative Media, Mobile and Embodied Spatial Interaction. **International Journal of Human-Computer Studies (IJHCS)**, 70(1), 66-71.

Chapter 5:   Bilandzic, M., & Venable, J. (2011). Towards Participatory Action Design Research: Adapting Action Research and Design Science Research Methods for Urban Informatics. **Journal of Community Informatics (JoCI).** Special Issue: Research in Action: Linking Communities and Universities, 7(3).

Chapter 6:   Bilandzic, M., & Foth, M. (2013). Libraries as Coworking Spaces: Understanding User Motivations and Perceived Barriers to Social Learning. **Library Hi Tech**, 31(2).

Chapter 7:   Bilandzic, M. (2013). Connected Learning in the Library as a Product of Hacking, Making, Social Diversity and Messiness. **Interactive Learning Environments**.

Chapter 8:   Caldwell, G., Bilandzic, M., & Foth, M. (2012). Towards Visualising People's Ecology of Hybrid Personal Learning Environments. Paper presented at the **4th Media Architecture Biennale Conference**: Participation.

Chapter 9:   Bilandzic, M., & Foth, M. (2013, under review). Social, Spatial and Technological Aspects for Designing Effective Coworking Spaces. **Learning, Culture and Social Interaction**

Chapter 10:   Bilandzic, M., & Foth, M. (2013). Learning Beyond Books – Strategies for Ambient Media to Improve Libraries and Collaboration Spaces as Interfaces for Social Learning. **Multimedia Tools and Applications.** Special Issue on Ambient Media Applications Linking the Digital Overlay with the Real Physical World, 65(1).

Chapter 11:   Bilandzic, M., Schroeter, R., & Foth, M. (2013, forthcoming). Gelatine: Making Coworking Spaces Gel for Better Collaboration and Social Learning. Paper accepted for publication at **OzCHI 2013 - Australian Conference on Computer-Human Interaction**.

Significance and Contributions

The significance and contributions of this study are situated at the intersection of people, place and technology (see Literature Review – Figure 2). With the rise of the Internet over the past two decades, there have been major reconfigurations in terms of work and learning spaces. However, despite our increasingly networked society, opportunities for people to mingle, connect, collaborate, socialise and learn from each other, still matter. In fact, spaces that provide such opportunities might be more important than ever before. This is illustrated by the exponential rise of the number of coworking spaces across the globe over the past seven years (Deskmag, 2011a), as well as global grassroots community initiatives such as *Jelly coworking groups* (workatjelly.com, 2012), *hackerspaces* (Altman, 2012; Borland, 2007; Tweney, 2009) or local *meetup groups* (Edgerly, 2010; Sander, 2005). Innovative corporations, office building proprietors, libraries and coworking spaces have recognised the significance of providing spaces that encourage such interactions. From a design perspective, the focus is mostly on physical arrangements of such space (e.g., Joint Information Systems Committee (JISC), 2006; Oblinger, 2006; B. Sinclair, 2007). However, little is known about design approaches that combine physical and digital affordances to facilitate connected learning in such spaces. This thesis fills that gap by exploring design factors for digitally augmented physical spaces that facilitate connected learning.

Ubiquitous computing – a research area that explicitly studies the embodiment (Dourish, 2001) of computing into physical space and facets of everyday life – was only born just over two decades ago (Weiser, 1991). As Humphreys notes, *"despite a 25-year history of computer-mediated communication research, the role of physical and social spatial practice has been relatively neglected in the field"* (Humphreys, 2010, p. 775). This work contributes to the efforts of an emerging body of research into *urban informatics* that recognises the significance of studying the interplay between people's spatial practices and the embodiment and ubiquitous integration of computing devices in everyday environments (Dourish, 2006b; Dourish & Bell, 2007, 2011; Foth, 2009b; Foth, Choi, & Satchell, 2011; Galloway & Matthew, 2006; Gordon & de Souza e Silva, 2011; Willis, 2010). The outcomes of this thesis contribute to the existing body of knowledge with innovations on three levels:

Methodological Innovation

Participatory Action Design Research (PADR) is presented as an innovative methodological approach to tackle the cross-disciplinary requirements of the individual disciplines (see Literature Review) through which the subject matter of this study is investigated, as well as to feed back the findings towards disciplinary as well as trans-disciplinary impacts. PADR is designed with an aim to combine the strengths of Design Research (Hevner, 2007; Hevner, March, Park, & Ram, 2004; March & Smith, 1995) and Action Research (Baskerville & Wood-Harper, 1996; Davison, Martinsons, & Kock, 2004; Tacchi, Foth, & Hearn, 2009) in order to inform and guide the *design*, *development* and *impact evaluation* of *innovative* technology. It builds on previous discussions in the field about the challenges of combining ethnographic approaches to understand socio-cultural settings with design and development oriented methods in the field of ubiquitous computing (Dourish, 2006a, 2007; Hughes, King, Rodden, & Andersen, 1995).

Theoretical Innovation

This thesis presents an innovative approach towards combining the affordances of digital as well as physical space to enhance opportunities for connected learning. It introduces the concept of an *ambient media architecture* (Chapter 8), i.e. digitally augmented physical spaces that are designed to increase awareness of and connections between likeminded other people in the same space. It provides a set of *design strategies* for such ambient media architecture (Chapter 10) towards visualising the current in-situ collective intelligence and available social capital of a place-based community. These strategies not only recognise *learning* as a phenomenon that is fertilised through both physical face-to-face interactions, as well as social interactions in digital spaces, but actually suggest a design approach for *hybrid* learning environments that provide opportunities for both. This is relevant for a growing audience of researchers and practitioners of spaces that strive to nourish connected learning and collaboration among their user community.

Empirical Innovation

The analysis of empirical data in this thesis provides insights into socio-spatial barriers (Chapter 6) as well as opportunities (Chapter 8, Chapter 9, Chapter 10) in relation to connected learning. I used these insights to design and develop a social (Chapter 7) as well as a technological (Chapter 11) intervention at my case study at The Edge. The

evaluation provides empirical evidence for the potential of the mechanisms that I used in these interventions. In particular, Chapter 7 provides insights how the socio-cultural context of an interest-driven meetup group enriched The Edge as a physical destination for connected learning, incidental learning, and learning through socialisation. Chapter 11 provides empirical evidence for how a custom-designed ambient media artefact *amplified users' awareness* of connected learning opportunities, as well as brokered serendipitous conversations and collaborations among coworkers that were unlikely to happen otherwise.

Literature Review

The following chapters provide an overview of relevant literature at the intersection of people, place and technology. The scope of the literature review is depicted in Figure 2. **Chapter 2** is situated at the intersection of **people and technology**. It discusses previous work on locative, mobile and embodied media, in particular in relation to how such media affect people's socio-spatial interactions and their transitioning between being physically present at a particular place and being digitally connected beyond the physical barriers of that place.

Chapter 3 is situated at the intersection of **place and technology**. According to the nature of the selected case study environment at The Edge – a space motivated and initiated in the context of a public library, it discusses the *library as a place* and how it has been affected and challenged by the emergence of ICT over the past couple of decades. I discuss literature on contemporary strategies for libraries to respond to such challenges, and relate the research questions of this thesis (as outlined in the Introduction) to a research gap that has been mostly neglected so far in the current literature.

Chapter 4 is situated at the intersection of **people and place**. I discuss concepts of space, place and *placemaking* from literature in the urban context, and provide examples of how digital amplification of urban architecture (e.g., through LED signs, animated building lightning, public displays) has had positive and negative effects on people's *sense of place*. I discuss the insights from these studies in relation to the challenges, issues and goals of this thesis, and outline relevant research areas from the ubiquitous computing domain as a design space that informed and inspired the concept and development of the technology intervention presented later, in Chapters 9 and 10.
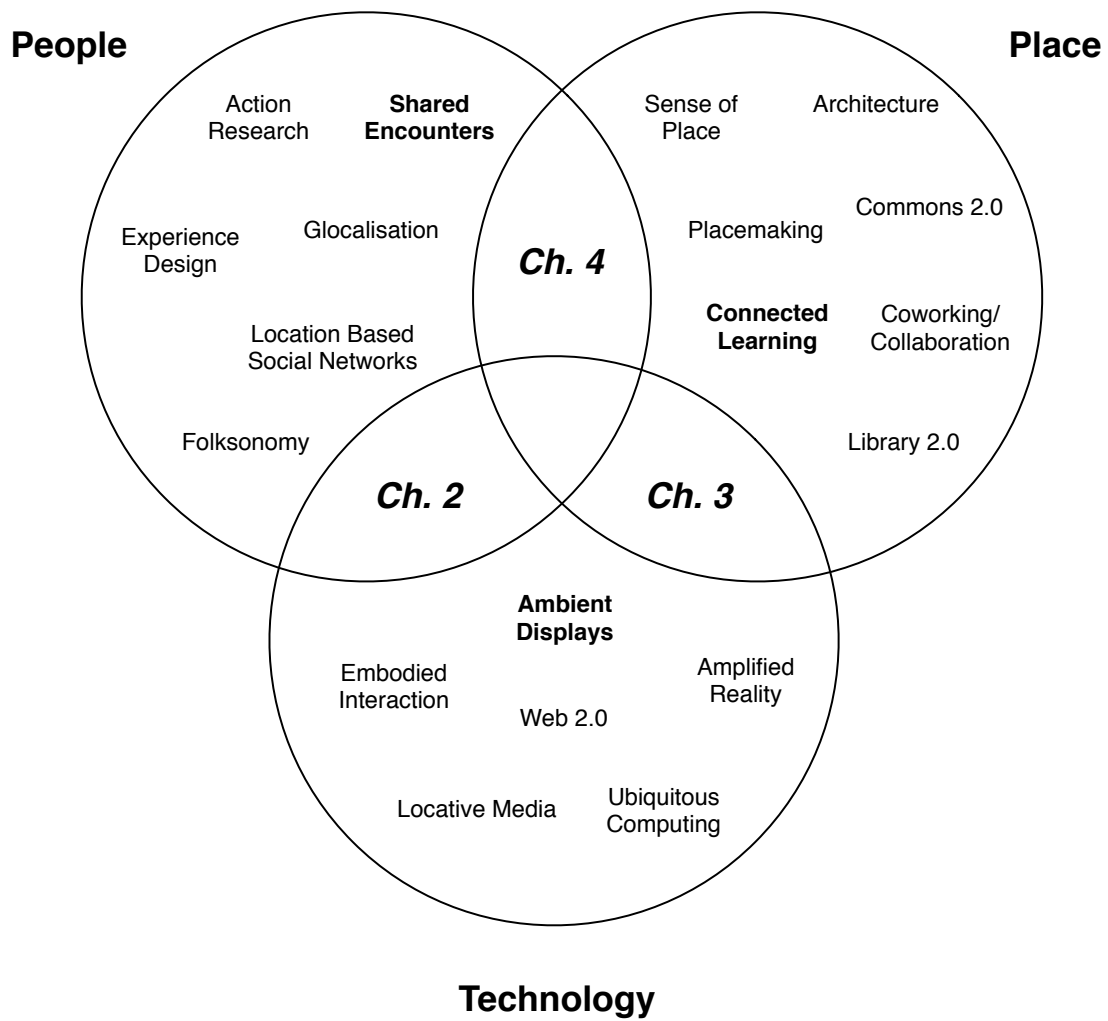
Figure 2: The research focus of this thesis is situated at the intersection of a number of research areas across people, place and technology.

Chapter 2:

A Review of Locative Media, Mobile and Embodied Spatial Interaction

Statement of Contribution

This paper has been co-authored with my principal supervisor Assoc. Prof. Marcus Foth. Marcus' contributions are limited to editorial comments, which helped me revise and improve earlier drafts of the paper.

Preamble

This chapter was specifically written and published as an invited review paper for the special issue on "locative media and communities" in the International Journal for Human-Computer Studies. As such, it provides an overview of the field of locative media, discussing its origins and current state of the art, as well as findings from empirical research that emerged from key projects in the field. A particular focus is set on how locative media affect communication and interaction patterns among collocated people. The insights from the literature review provide a base understanding of opportunities as well as methodological challenges in relation to the design of future locative media. These insights informed the conceptualisation and early design stages of the technology intervention discussed in Chapters 8, 10 and 11. The paper was double blind peer reviewed.

Mobile phones have become a mundane and well-established communication device in the everyday lives of many people. Their promise is to connect us to anybody, from anywhere at anytime. Mobile communication has contributed to a shift of people's role towards 'networked individuals' in urban environments (Wellman, 2001, 2002); our person-to-person relationships have become more complex affording a seamless transitioning between being physically present at a particular place and being digitally connected at all times. Mobile media support people not only to connect to distant others, but also to coordinate and initiate social interactions in their physical proximity, e.g. spontaneously organising collective actions (Rheingold, 2002).

The advent of GPS enabled phones has given rise to what today is referred to as 'locative media'. The first use of the term is traced back to Kalnins and Tuters in 2003 (de Waal, 2012, in press; Galloway & Matthew, 2006), who selected 'Locative Media' as a title for an international workshop of artists and researchers (International Workshop 'Locative Media', 2003), aiming to explore how wireless and location-based networking affects people's notions of space and social organisation within space. Later, the term became a synonym for media that blurred the barrier between the physical and the virtual world, in particular mobile media that augment people's experiences in real places through relevant geo-tagged information from the Internet (Espinoza et al., 2001; Kjeldskov & Paay, 2005; Lancaster University, 1999; Proboscis, 2003).

Locative media applications have opened up new opportunities for mediated interactions with and within physical spaces (Bilandzic & Foth, 2009a). A workshop at CHI 2007 focused on 'mobile spatial interaction' (MSI) and classified relevant applications in four categories (Fröhlich et al., 2007): applications that (1) facilitate navigation and wayfinding; (2) mobile augmented reality applications; and applications to (3) create; or (4) access information attached to physical places or objects. Since 2007, smart phones with touch-screen displays, QWERTY-keyboards, multimedia recording capabilities, as well as mobile high-speed Internet connectivity through 3G and WiFi networks enable users to continuously capture, create, upload and share geo-referenced content. Design principles that have shaped the Web 2.0 as a 'Social Web' (O'Reilly, 2005), in particular user participation, folksonomy and geo-tagging, have been translated for mobile interactions (Jaokar & Fish, 2006). Mobile users collectively tag, rate and recommend restaurants, cafés and other public places, crafting and nourishing a digital information layer that augments the urban physical infrastructure in real-time. The ubiquitous connectivity through mobile devices has transformed our urban

environments into 'hybrid spaces,' where social interaction and communication patterns traverse through physical, digital, and a mix of both spaces (De Souza e Silva, 2006). In particular, applications that subscribe to the latter two MSI categories have triggered new socio-spatial practices and interaction patterns in urban environments, also referred to as 'net localities' (cf. Gordon & de Souza e Silva, 2011).

In contrary to Putnam's (1995) claim of declining social capital in urban environments through ICT, such community driven social services empower people to harness the collective intelligence (C. Anderson, 2006; Scharl & Tochtermann, 2007; Douglas Schuler, 2009; Shirky, 2008; Surowiecki, 2004) of their global and local community in-situ as they are traversing everyday life and activities. The probably most prominent example of this phenomenon is location-based social networking (LBSN) through mobile applications such as Dodgeball, Loopt, Foursquare or Facebook Places. They enable users to 'check-in,' i.e. digitally confirm their physical presence at a particular place. Aggregated with social network information, users can see where their friends have checked-in as well as background information of current and previous check-ins of people in their immediate proximity. Knowing where our friends hang out might reveal places that we might enjoy as well, and looking through ratings and comments from many previous navigators tells us how the majority of people perceive a specific place. People naturally navigate space by looking at what others do. Such social navigation affordances have been successfully transferred to virtual spaces (Dieberger, 1997; Dourish & Chalmers, 1994; Höök, Benyon, & Munro, 2003), and eventually to MSI applications (Bilandzic, Foth, & De Luca, 2008; Höök, 2003) enabling people to socially navigate real world environments in a way that exceeds traditional, physical barriers of space. This trend can be observed on a more general level. In early 2000, before the emergence of the Web 2.0, Erickson and Kellogg (2000) argued that visibility, awareness, and accountability, as important building blocks of our everyday social interaction in the physical space, should be transferred to support interaction in virtual spaces. They suggest that augmenting virtual spaces with such simple characteristics of the physical world would create 'social translucent systems' which would "eventually support the same sort of social innovation and diversity that can be observed in physically based cultures" (2000, p. 80). Looking back at the evolution and success of Web 2.0, we can confirm that they were right. In fact, the social translucence that we today find in Web 2.0 goes beyond what is afforded by the physical world – it bridges spatial, temporal and social barriers. The convergence of Web 2.0 as a 'social translucent

system' with locative media creates a digital layer on top of the physical world affording new practices for social interaction that would not be possible otherwise; these affordances have caused a social translucence of physical space, hence transformed it into a *translucent hybrid space*.

With ideas and developments in "context-aware computing," first introduced by (Schilit, Adams, & Want, 1994), space becomes even more translucent. Sensor equipped devices not only detect and respond to location, but also other contextually relevant variables, such as the user's current activity, emotional state, focus of attention, identity and presence of nearby people or objects, time, temperature and so forth (Anind K. Dey et al., 1999). Information gathered through ubiquitous context-sensing often overcomes the limited abilities of human perception. Such as the telescope and microscope enabled us to see things normally invisible to the naked eye, Schmidt et al. (2011) envision that sensor-equipped computing devices will ultimately reveal new insights about us and our environments – "by the middle of this century, the boundaries between direct and remote perception will become blurred" (p. 87). While it is technically possible to measure a huge variety of contextual parameters (Schmidt, 2002), and there are toolkits (Anind K. Dey, 2000; Anind K. Dey & Abowd, 2000a) to help with the application development of such, Dourish (2004) reminds us that context is a rather relative construct, which is not stable and cannot be defined in general (e.g. Anind K. Dey & Abowd, 2000b). Context is "continually renegotiated and defined in the course of action" (Dourish, 2004, p.29), hence the scope and set of features that describe the context of a situation is a dynamic product of the social settings, actions of and interactions between people. Therefore it is impossible for a system to fully capture a situational context and relevant context parameters in advance.

While many mobile social software applications have been explicitly designed to facilitate a specific type of social encounters in particular user context scenarios, e.g. with application areas in enterprises (Eagle, 2004), dating (Wired, 1998), group finding (Kjeldskov & Paay, 2005), conferences (Eagle & Pentland, 2005) or carpooling (Hartwig, 2006)), recent LBSN as outlined above do not follow such explicit goals. They augment the physicality of a place for the matter of making its invisible social properties visible. As they change our perceived physical boundaries and notions of space, they also affect our social interactions and practices within these boundaries.

Pervasive connectivity of location based people networks and accessibility to the collective intelligence that is embedded in a place brings not only the trend of

'glocalisation' (Robertson, 1995; Wellman, 2001) to a new level, but also issues around privacy and publicness, triggering tactical practices (Certeau & Rendall, 1984) that were not anticipated by the designers of such media. In her study of users of Dodgeball, one of the first commercial LBSNs, Humphreys found that the application is not only used to facilitate, but also to avoid sociality in urban public spaces (2010, p. 774). Furthermore, while users have met new people through Dodgeball, these people tended to be demographically similar to themselves hence facilitating 'social molecularisation' (p. 776). Similarly, Crawford argues that mobile social software "takes the chance out of chance encounters" (2008, p.91) by filtering and pre-selecting demographically compatible people for face-to-face encounters. As a consequence users tend to flock into mobile cocoons of similar people, missing the qualities and benefits of the social diversity and heterogeneity in urban environments (P. Wood & Landry, 2007). Looking at the development and yet early findings about people's use and practices of locative media that have become mundane, the question is how do we go about the design and shaping of future locative media? How do we realise opportunities afforded by new technology, yet consider issues and risks that come with its use?

In order to support spatial interaction and experiences in a meaningful way (Lentini & Decortis, 2010), two things need to be considered. First, *methods* to investigate and understand the social and cultural context of people's spatial practices, and second, *design principles* that guide the form and function for new media and technologies according to their potential to support such practices and rich experiences in everyday life.

Over the last 20 years, mobile and ubiquitous computing has been shaped by many technology-oriented innovations. However, as Bell and Dourish state, "perhaps dealing with the messiness of everyday life should be a central element of ubicomp's research agenda" (Bell & Dourish, 2007, p.134). In fact, as computer technology spreads from the desktop to people's everyday environments, the traditional focus in Human-Computer Interaction on interfaces and interaction between humans and computers has perpetually shifted to accommodate a broader perspective that seeks to understand the dynamics between people and the spatiality where such interactions are situated in (e.g. Galloway & Matthew, 2006). Hassenzahl's (2011) description of the difference between 'user experience' and 'experience design' illustrates this shift of foci. While the study of user experience implies a focus on the relationship between the user and a particular artefact, experience design focuses on the needs, emotions and meanings of people's

everyday experiences. Focusing on such situated experiential aspects of the user rather than materialistic aspects of a specific artefact, experience design does not presuppose the use of technology or creation of a particular artefact. In fact, the design outcome often fuses with the spatial infrastructure, hence affords embodied interaction (Dourish, 2001) through direct use and manipulation of everyday infrastructure or objects (cf. Millard & Soylu, 2009). While the mobile phone tends to shift its user's attention from the immediate spatial environment to the mobile display (which people sometimes intentionally apply as a cocooning method when traversing urban environments (Mainwaring, Anderson, & Chang, 2005)), embodied artefacts are part of the physical infrastructure of space; they are visible and accessible to everyone (Falk, Redstroem, & Bjoerk, 1999), thus have the potential to enrich the *collective* situated experience of people in a place (e.g. Veerasawmy & Ludvigsen, 2010). In terms of mediating situated experiences and interaction between people and (hybrid) places, and among people within a (hybrid) place, perhaps an 'embodied spatial interaction' approach is more suitable than mediation through a dedicated device such as in MSI. In the context of mediating 'shared encounters' (Willis, 2010), some studies have shown the applicability and benefits of different embodied interaction approaches in urban settings (e.g. through multi-user, multi-touch displays (Jacucci et al., 2010, p.26) and digital carpets (Fatah gen. Schieck, Kostakos, & Penn, 2010, p.183)) or have identified gaps where embodied interaction is suggested as a promising approach (Konomi, Sezaki, & Kitsuregawa, 2010).

The other question is how to approach investigations of the messy everydayness, and spatial experience methodologically? Coyne notes, "the move to the everyday promotes methods of research that engage with narrative and socially situated ethnographic study, rather than the transportation of phenomena to the laboratory, or isolation into the calculative world of variables and quantities" (Coyne, 2010b, p.74). Foth calls for, "research approaches that can differentiate (and break apart) a universally applicable model of 'The City' by being sensitive to individual circumstances, local characteristics and socio-cultural contexts." (Foth, 2009a, p. xxviii-xxix).

Methodologically, ethnography provides powerful tools to help understand the facets of a socio-cultural setting in a detailed and fine-grained manner. However, having its roots in social sciences, traditional ethnographic research does not necessarily imply or propose specific implications for the design of an artefact (Hughes et al., 1995) and is often regarded as a "prolonged activity" (Hughes et al., 1995, p.59) causing time

pressure if particularly dedicated to inform system design. A trade-off, which has been established to bridge the dichotomy between understanding social aspects of a setting and technology design goals, are methods that follow a "quick and dirty" principle of ethnographic research, such as cultural probes or quick user interviews. However, such ethnographic techniques that are explicitly applied to inform design-aspects of a specific artefact might 'marginalise' theory (Dourish, 2006a), i.e. miss important social contexts and human factors of the targeted environment that are crucial to understand what role design and technology can or should have at the targeted site in the first place. The role and significance of ethnography in the context of ubiquitous computing and human-computer interaction has caused some earlier confusion (Dourish, 2007). Ethnography might not outline obvious implications for design, but serves as a powerful tool for understanding, describing and capturing social and cultural phenomena and contextual settings, hence informing the overall role which technology might or should play at the site of interest.

Designing technologies that are embedded in peoples everyday lives, and locative media appears to evolve more and more into such a technology, requires a methodology that recognises the significance of ethnography in its traditional sense, yet bridges the gap between ethnographic research and deriving implications for design. This is what Taylor refers to as design-oriented ethnography (Taylor, 2009).

The ultimate goal is to inform the role of technology in a way that it evolves from people's natural practices, tasks and activities and, in particular, from the context and meaning that they attach to those everyday activities. Therefore, evaluation of a technology artefact cannot be practised in laboratory environments only, but through iterative cycles of analysis, design and re-design while it is used within people's everyday activities and context (Ackerman, 2000). In accordance, Willis calls for an approach where "computer scientists team with professionals such as ethnographers and partners in the community to take a long-term view of how changes can be made to the way in which shared experiences are facilitated in these social scenes" (Willis, 2010, p.13).

In fact, such cooperation between researchers and participants or other 'partners in the community' over a longer period of time is a significant principle of Action Research (Blum, 1955; Susman & Evered, 1978). Action Research is a research approach that has its roots in the social sciences. Its aims to find practical solutions to issues in a social setting by taking action; the researcher provokes social change and observes the outcomes. Baskerville and Wood-Harper (1996) refer to Action Research as an

"interventionist approach to the acquisition of scientific knowledge". Hereby, the collaboration between researchers and participants is a crucial factor to achieve this goal, as the participants' problem-oriented point of view, and the researcher's strong methodological knowledge and solution-orientation (Hearn and Foth, 2005) cross-fertilise each other.

If approaches, such as Action Research, are canonically designed to create and evaluate solutions in and for social settings, a logical question that arises is how can such approaches be combined with engineering-oriented goals towards designing, developing and evaluating new technology, or in this case, locative media artefacts that will shape people's actions, interactions and shared encounters in the future? Even though traditional Action Research does not aim to solve problems through the development of technological artefacts per se, its methodological approach can be applied as a tool to understand the underlying problems in a socio-cultural setting, inform the design and requirements of technological solutions, implement (act) and evaluate (reflect) its impact in real-world settings.

Situated in a similar dichotomy between design-oriented thinking and investigation of relevant socio-cultural aspects in organisational settings, methodology literature in information systems research has started a discussion about the convergence between Action Research and Design Science Research (Baskerville, Pries-Heje, & Venable, 2007; R. Cole, S. Purao, M. Rossi, & M. Sein, 2005; Figueiredo & Cunha, 2006; Iivari & Venable, 2009; Jarvinen, 2007). This is a first step towards treating technology designed for use in socio-technical settings not as isolated IT solutions, but rather as "ensembles emerging from design, use and ongoing refinement in context" (Sein, Henfridsson, Purao, Rossi, & Lindgren, 2011, p.6). As artefacts are not only technologically, but also socially constructed, they have to evolve, grow and be shaped by and within the organisational context (Iivari, 2003a), rather then introduced over night. It will bring the design of locative media closer to what has been earlier discussed as 'social construction' (Bijker, Hughes, & Pinch, 1987) or an 'ensemble view of technology' (Orlikowski & Iacono, 2001, p.26).

Chapter 3:
Library as a Hybrid Place

> "My fear is that the virtual library will render the philosophy of library service invisible and that such invisibility will insulate the library from impassioned public debate about who has access to its resources. That loss, I would argue, is more than we should be willing to bear." (Van Slyck, 2001, p.523).

This chapter discusses the evolution of library spaces, in particular in regards to the library as a physical place with the rise of ICT. This literature review will help the reader contextualise and better understand the main case study environment of this research – The Edge – as an innovative space that represents a cutting edge experiment as part of the contemporary evolution of library spaces.

The Library as a Physical Place in the Digital Information Age

Over the last couple of decades, libraries as social spaces have been highly affected by the emergence of information and communication technology (ICT). Weise states, *"Technology during the last twenty years has had more impact on libraries than it had in the previous two hundred, and it is forcing us to examine this place we call a library"* (2004, p.6). The emergence of ICT initially triggered a trend of designing towards a 'library without walls' – research has been primarily concerned with electronic library services (e.g. digital archives, digital catalogues, e-books, digital loan systems, etc.) that provide access to library services to anyone at anytime, independent of a user's location and the library's opening hours. This trend, however, has challenged the relevance and significance of the library building as a physical destination. Designing towards a library without walls, libraries have done their "*best to provide [users] with services so they won't have to come to the library*" (Weise, 2004, p.10). Further, experts in a delphi study predict that by 2025 only a small fraction of print collections will remain in the library building, and that, *"mostly for their artifactual and historical, as opposed to clinical or educational, value."* (Ludwig & Starr, 2005, p.317). If all knowledge and information is perpetually being archived and made accessible online, what is left for the library as a physical place?

Carlson (2001) provocatively raised the point that libraries might soon become deserted – a notion that was proven wrong. In a survey across 390 libraries on the usage of

library facilities, Shill and Tonner provide empirical evidence that library buildings as physical places, even with online access to library services and a plethora of information resources available online, are still heavily used and continue to matter (Shill & Tonner, 2004). Other scholars stress the library's significance as a place for socialisation, relaxation and rejuvenation (Waxman, Clemons, Banning, & McKelfresh, 2007), community gathering and meeting place (Aabo & Audunson, 2012; Aabo et al., 2010; Audunson, 2005; Audunson, Essmat, & Aabo, 2011). Leckie and Hopkins warn that the tendency towards privatised and controlled public places in modern society *"diminishes social interaction and diversity, if only because strangers of differing ages, classes, ethnicities, genders, and religions have less opportunity to mingle in the same physical space."* (Leckie & Hopkins, 2002, p.331). They acknowledge public libraries in their role as one of the few remaining non-commercial, not-privatised, and *truly* public urban places that provide an open and free place for everyone to access and participate, regardless of their cultural and educational background or socio-economic status. As such, libraries serve as vital locales for democratic active citizenship, social capital, social inclusion and trust within a community, and need to be preserved as such (Audunson, 2005; R. Audunson, A. Varheim, S. Aabo, & E. D. Holm, 2007a; Cox, 2000; Johnson, 2010; Varheim, 2007). Whilst these facts underline the significance of libraries for society and local communities in general, the question remains how the penetration of ICT has reconfigured the perceptions and use of library space from the users' point of view. Empirical studies underscore the relevance of libraries in particular for marginalised groups such as immigrants (Audunson et al., 2011; Varheim, 2011), as well as young children and old retired people (Cox, 2000). However, in a review of Abo et al. (2010) Hunsucker (2012) points out that the local public library as a meeting place *"appears to be something that appeals more to younger than to older adults, more to those in the lower than to those in the higher income categories, and more to those with an immigrant than to those with an indigenous background"* (p. 97). It seems, that the library as a place embodies a different significance for different people across the socio-cultural spectrum. For non-marginalised members of the general public, as Varheim et al. suggest, the library as a place to meet others and build social capital, appears to be no more significant than other public places such as shopping malls or bus stops (2008, p.889).

The library's traditional function as a physical place for public access to information and knowledge has become less significant – at least for those who do not depend on the library as their only access point to information. As Lawson (2008) notes, *"in terms of*

connectedness, there may not be much to divide the library from the Starbucks or even from the local park (in some places)" (p. 2). Broadband mobile Internet via mobile networks and increasing numbers of WiFi hotspots afford connected study and access to information from any other 'third place' (R. Oldenburg, 2001). Building upon Castells' (2004) theoretical concept of 'space of flows,' Lawson (2008) warns that ICT, as it transcends the physical boundaries of the library, provides a challenge for libraries as a physical place; *"…in an environment where boundaries dissolve, place is threatened"* (p. 2). Pomerantz and Marchionini sense a similar notion of libraries moving towards losing their unique position as a public place for work:

> "…given a choice between different physical places in which similar tasks may be accomplished –, e.g. a library or a bookstore in which to get access to printed materials, or the local coffee shop as a place to sit and work – is it any wonder that users choose the more inviting physical environment?" (Pomerantz & Marchionini, 2007, p.518)

From a library and space designer's point of view, this gives rise to the following questions: *In today's connected world, how does or should the library still attract users as a physical destination? What benefits does it provide to the user in contrast to other urban 'third' places?* In particular, for people who are not marginalised by places of commercialisation and can afford to buy a muffin, cappuccino and mobile data plan to work, study, dwell or meet in the local coffee shop, what is the benefit of pursuing these activities at the library anyway? In a quest to find answers to such challenges, libraries have been making continuous efforts to reinvent their physical spaces to adapt to people's evolving needs in the digital information age. The next section provides an overview of those efforts.

Towards Library 2.0: A Place for Participation, Conversation and Coworking

Libraries, despite being hubs and archives for information and knowledge, have always served some higher level roles, in particular through their qualities as a place that facilitates sustained, uninterrupted intellectual work, as well as a sense of creativity, inspiration and scholarship. *Library buildings* represent a manifestation of such aspirations. They provide a particular *'sense of place'* through their architectural setup, as well as huge diversity of co-present people that engage in scholarly activities (Freeman, 2005, p.6). Fisher et al. (2007) find that scholars choose the library as a popular

workplace partly because of its *"conduciveness to scholarship […] and the life of the mind to flourish"* (p. 175). Aabo and Audunson (2012) as well as Björneborn (2010) find it to be a place for chance encounters with acquainted people such as neighbours, and serendipitous discoveries of, e.g., community information, local events and books. Goulding (2005) reports that "*although a user may actually not talk to anybody during their visit to the library, the feeling of community can still be strong, encouraging a sense of belonging and solidarity*" (p. 357). Such experienced qualities of the *library as a place* are not replaceable by digital libraries. In fact, with the increasing amount of time that people spend online, the physical space becomes an increasingly important complement. As Talve states, "*the great paradox of our time is that the more virtual we become, the more we seek tactile, earthy, soft nesting spaces in which to rest our bodies and soothe our overactive minds*" (Talve, 2011, p.500). The general notion among scholars (Goulding, 2004; K. Lawson, 2008; Leckie & Hopkins, 2002; Martin & Kenney, 2004; McDonald, 2006; Pomerantz & Marchionini, 2007; Weise, 2004) is that the digital library has not, cannot and will not cannibalise the physical library, but libraries evolve into a *hybrid place*, a place where its digital and physical space equally contribute to its perceived values. Weise (2004), for example, speaks of *convergent architecture* (p.11) between the digital and physical library space, and McDonald (2006) of "*a blended service where the virtual and the actual spaces are complementary, influenced by the number and diversity of new technologies*" (p.112).

However, how do such visions of the library as a hybrid space translate into current practice? What are the current design trends towards hybrid library space?

Commons 2.0 (B. Sinclair, 2007) is a widely pursued trend towards accommodating collaboration, peer-to-peer learning, informal social hangouts, meetings or comfortable work in library spaces. We see more and more libraries removing bookshelves in order to provide more floorspace for infrastructure and interior design elements that invite social activities (LaPointe, 2006; Martin & Kenney, 2004; McDonald, 2006; Shill & Tonner, 2003), e.g., lounge areas, couches, meeting rooms, whiteboards, projectors, video consoles, café and food bars, etc. Open architecture approaches such as no walls or only glass between different work spaces are used to facilitate serendipitous cross-disciplinary discoveries from people who work side-by-side; reconfigurable furnishing and continuous connectivity through free WiFi allow flexible formations that suit different modes of interaction and learning, such as individual study, group work, or presentations (McDonald, 2006; Niegaard, Lauridsen, & Schulz, 2009). The purpose behind such Commons 2.0 spaces is to better facilitate open sharing, collaboration, and

human interaction in general, thus fostering the learning principles of social constructivism (cf. Vygotsky, 1978; Wertsch, 1997).

In parallel, with the rise of *Web 2.0*, libraries have recognised the value and significance of engaging in the culture of participation and co-creation of knowledge through social media. Scholars in *Library and Information Science (LIS)* have discussed such concepts as the *Participatory Library* (Nguyen, Partridge, & Edwards, 2012), *Libraries as Conversation* (Lankes, Silverstein, Nicholson, & Marshall, 2007) or *Library 2.0* (Holmberg, Huvila, Kronqvist-Berg, & Widen-Wulff, 2009; Stephens & Collins, 2007). The discourse around such new library models foster the evolution of the library role away from being a 'gatekeeper' of books, more and more towards being a facilitator for learning and knowledge. Learning and the acquisition of knowledge is recognised as a social phenomenon which – according to the principles of *social constructivism* (Vygotsky, 1978; Wertsch, 1997) – is created through social interaction, conversation and collaboration. Literature concerned with digital strategies around such new library models primarily discusses how libraries can engage in digital spaces, e.g. what tools and social media they can or should engage in (Courtney, 2007; Maness, 2006; Stephens & Collins, 2007), or what digital skills librarians need as part of such new library models (Casey & Savastinuk, 2007).

Over the past two years, practitioners have started transferring and promoting a culture of connected learning, collaboration, participation and co-creation among the user community *in the physical library space* as well. Recent discussions in blogs, forums and workshops, for example, embrace the idea of integrating *hackerspaces* (Britton, 2012; E. Fisher, 2012; Mack, 2012; Torrone, 2011), *start-up incubators* (Badger, 2013) and *coworking spaces* (Knodl, 2012; Sistare, 2013) as part of the library space to promote such a culture. This trend is illustrated through *Fayetteville Free Library* (http://www.fayettevillefreelibrary.org) or *Allen County Public Library* (http://www.acpl.lib.in.us) that have pioneered such developments by integrating *hackerspaces* with tools such as 3D printers for users to play and experiment with (Kalish, 2011), or *The Edge at State Library of Queensland* (http://edgeqld.org.au/) by providing dedicated spaces for collaboration, coworking and peer-to-peer learning (Bilandzic & Foth, 2013b).

Reseach Gap: Using Digital Technology as a Tool for Placemaking in Library Buildings

In summary, the current trends in relation to the *library as a hybrid place* are twofold. First, physical space is adapted to better cater for social activities and interactions that involve the use of technology that users have adopted as part of their everyday life, study and work (power points and pervasive WiFi access for laptops, tablets and smartphones, projectors and flatscreens for presentations and collaborative work, etc.). Second, new library models such as Library 2.0 foster conversations and participation with, for and by the user community *in* the *digital space.*

However, there is little practice or research on interventions that harness the affordances of digital technology as an actual *tool for placemaking* in *physical* library spaces. Research in this context was pioneered in 2003 with the "Future Hybrid Library" project at the Center for Interactive Spaces at Aarhus University. The project was aimed at augmenting people's experiences when visiting physical libraries through interactive displays and projections in various setups, e.g., InfoGallery (Groenbaek, Rohde, Sundararajah, & Bech-Petersen, 2006), iFloor (Krogh, Ludvigsen, & Lykke-Olesen, 2004) and BibPhone (Lykke-Olesen & Nielsen, 2007). Such innovative library installations provided an alternative access point to the library's archives, e.g. by visualising the circulation of checked out books (Legrady, 2005), or providing flexible, artistic, animated and playful interfaces (Groenbaek et al., 2006; Thudt, Hinrichs, & Carpendale, 2012) that help serendipitously identify and explore library collections in new ways. iFloor (Krogh et al., 2004) seemed particularly innovative as it did not seek to augment connections between visitors and library archives, but rather social interaction among library visitors themselves.

Similarly, this projects presented in this thesis aimed at enhancing the library as a social place, in particular reinforcing the vision of contemporary libraries as places for *social learning, participation, interaction and collaboration.* Inspired by Commons 2.0 principles (B. Sinclair, 2007) that inform architecture and interior design to facilitate collaboration, social learning and serendipitous encounters among library users, the overarching research question of this thesis (see Introduction) focuses on how *digital technology* can be designed and applied to *facilitate connected learning* among *coworking* users**?**

Coworking as a term and concept is not common in library and information science literature. However, I selected it as an overarching term to describe the focus of this

research on innovative library spaces (and related environments) that aim to facilitate connected learning among their user community. Further, using *coworking* as a term, I intended to divert from the stereotypical (mis-) conception of libraries being spaces strictly for quiet self-study only.

Chapter 4:

Technology and "Sense of Place"

This chapter discusses concepts around *space*, *place*, and *placemaking*. In particular, it discusses how notions on *sense of place* have been affected by the introduction of ICT. Literature and recent work on this matter is presented from an urban context, and *ubiquitous computing* and *ambient displays* are introduced as promising design spaces for amplifying physical architecture towards enhancing people's perceived *sense of place*.

Sense of Place

Scholars distinguish between the concepts of *space* and *place* (Dourish, 2006b; Harrison & Dourish, 1996; Tuan, 1977). While *space* refers to geometrical and physical configurations of the environment, *place* embraces a social layer of attributes that people attach to a space, such as meanings, memories and experiences through their everyday practices, activities and interactions with and in a space. Such social attributes render *space* into *place*. In accordance, Coyne describes places as *"inhabited spaces, particularly as populated by people, their concerns, memories, stories, conversations, encounters and architects"* (Coyne, 2010b, p.xvi).

While space is designed and built by architects and spatial designers, place is a social construct that is continuously shaped by the way people attach meaning and make use of it. The subjectivity of people's relationships to a place explains why different people can perceive the same location as different *places* – a house is not necessarily a home (Tuan, 1977, p.140). The personal meanings and relationships to a particular place shape a 'sense of place.' *Placemaking* as a discipline practiced for example by urban designers and architects, is an attempt to design spaces that accommodate and invite particular activities, experiences and meanings being associated with the place. Architecture, from this point of view, can be regarded as a placemaking tool to communicate a message or to provide "*an impression of the psychological and moral attitudes it supports*" (De Botton, 2006, p. 76). De Button wondered, "*why are we so vulnerable, so inconveniently vulnerable, to what the spaces we inhabit are saying?*" (De Botton, 2006, p.106), and found some answers in human psychology – people have different selves, and access to these selves is "*to a humbling extent, determined by the places we happen to be in, by the colour of the bricks, the height of the ceilings and the layout of the streets*" (p.106). The manifestation and characteristics of the

surrounding physical environment influence people's feelings, behaviour and mood. From an architectural point of view, a holistic answer to design questions of physical infrastructure cannot be found in engineering only, but needs to take into account social and cultural aspects that are lived and valued in a particular place (Francisco, 2007). Places are *"meanings that arise from the experience of living, working or visiting somewhere, appreciating its architecture, being familiar with its routines, knowing its people and having responsibilities towards it"* (Relph, 2007, p.2).

Junkspaces and Non-Places: Negative Impacts on "Sense of Place"

With the rise of electronics, the design space of architecture has become broader. Spatial infrastructure does not only consist of physical material such as bricks or concrete, but has more and more digital components embedded. In cities we find more and more public displays, flashing LED signs and animated building lighting. Such electronic components affect people's sense of space: Scherr (2006) criticises that the emerging use of electronic visualisations in urban environments blurs the 'authentic' and real city marks, i.e. 'real,' physical buildings as traditional icons of the city are increasingly hidden behind or augmented with screens, LEDs and other 'artificial' lightings. He describes this phenomenon as *"real-not real"* (p. 10), where we can no longer clearly differentiate between the real, authentic elements of a city, and the fictive, artificial ones. His concern is that synthetic elements such as electronic advertising billboards or public screens create a ubiquitous, location independent context, hence disturb the traditional uniqueness and originality of a place set through its buildings and iconic physical architecture. Similarly, McCullough points out people's *"dismay at surveillance, saturation marketing, autonomous annoyances, and relentless entertainment"* (2006, p. 29) as a consequence of cities being increasingly layered with digital systems.

Such notions show how digital information systems in the urban environment can amplify the negative effects that globalisation has had on local places: Auge (1995) critiques that more and more of our space on earth is taken up by *non-places*, i.e., places that miss a specific local character. Shopping malls, freeways, convenience stores and fast-food chains look and feel the same across the globe. The traditional cultural uniqueness and specific *sense* of a local place are overlayed by standardised landscapes

and cultural globalisation. Modernisation and globalisation has produced *Junkspaces* (Koolhaas, 2002), and places that feel *inauthentic* and *placeless* (Relph, 1976).

Towards a "Global Sense of Place"

Literature in urban studies has stressed the need to support city identities and cultural heritage in order to preserve their traditional sense of local place. In the meantime, however, effects of globalisation and supermodernities (Auge, 1995; Harvey, 1996), as well as electronic visualisations (Scherr, 2006) continue to endanger the unique qualities and features of local place. As an answer to such tensions, Massey (1991) suggests a new interpretation of place – a *global sense of place* – which I regard as timely and significant in the context of this research, in particular in relation to informing the role of ubiquitous computing to amplify connected learning as an experience in real-world environments. Massey recognises the cultural diversity, multiple identities and constant influences and interactions from 'outside' as the new specifics of local place in a global world. However, these specifics are not tangible, but rather invisible, permeable, transitory and hard to grasp. In order to explain her idea, Massey asks the reader to *"imagine for a moment that you are on a satellite, further out and beyond all actual satellites; you can see 'planet earth' from a distance"* (Massey, 1991, p. 2). Equipped with a magical telescope, she then zooms in and looks at a particular place, not only seeing the visible movement of people, but also the invisible communications and social relation and links between these people. Her interpretation of place is envisaged through the magical telescope:

> "In this interpretation, what gives a place its specificity is not some long internalized history but the face that it is constructed out of a particular constellation of social relations, meeting and weaving together at a particular locus. If one moves in from the satellite towards the globe, holding all those networks of social relations and movements and communications in one's head, then each 'place' can be seen as a particular, unique point of their intersection. It is, indeed, a meeting place." (Massey, 1991, p. 7)

This interpretation of place combines the local and global sense of place. Place is defined through its local context, but also the situated uniqueness and constellation of people who inhabit the space, e.g. their social, cultural and demographic diversity. This concept aligns with Tuan's idea of 'place as a pause' (Tuan, 1977, p. 6), but focuses on social, invisible aspects that are situated within this pause. These aspects continuously change as people traverse and move in and out of different places, hence *sense of place* is

regarded a process, rather than a product; it is dynamic, rather than static. Cresswell (2004) compares Massey's concept of this new 'progressive' sense of place to Harvey's traditional, more conservative understanding (Harvey, 1996, pp. 72):

- "A desire to show how the place is authentically rooted in history" (Harvey) vs. "Uniqueness of place is defined by its interactions" (Massey)

- "A close connection between place and a singular form of identity" (Harvey) vs. "Place as a site of multiple identities and histories" (Massey)

- "A need for a clear sense of boundaries around a place separating it from the world outside" (Harvey) vs. "Place defined by the outside" (Massey)

In contrast to Harvey's traditional notion of place, it appears that Massey's *global sense of place* is not represented by the physical appearance of urban architecture. We build statues to cherish national heroes, monuments to remind us of significant historical events and museums to display cultural heritage. We place old buildings under preservation orders and declare heritage areas and buildings to preserve the past. Compared to such efforts, soft and contemporary assets of place, such as social capital and collective intelligence embodied in the diversity of people in a place are underrepresented. They are either lost uncaptured in time and space or, if captured, mostly remain hidden in the *space of flows* (Castells, 2004), e.g. on database servers or webpages accessible only trough disembodied personal computing devices like laptops or mobile phones.

Opportunities for Technology to Amplify a "Global Sense of Place"

Massey used a magical telescope as a theoretical tool to illustrate her concept of a global sense of place. Twenty years on, innovations in ICT provide opportunities to create a lens on *place* similar to the one Massey had imagined through her magical telescope. Locative media (Chapter 2) provide means to capture and represent *social* aspects of a place beyond its temporal or physical barriers, hence have the ability to function as a 'magical telescope' in Massey's sense.

Previous studies on public screens, for instance, demonstrate their *social* potential for development of a local community around those screens, in particular when displaying situated and socially relevant content (e.g. E. F. Churchill, Nelson, Denoue, Helfman, & Murphy, 2004; J. F. McCarthy, Congleton, & Harper, 2008; J. F. McCarthy et al., 2009;

Schroeter, Foth, & Satchell, 2012; Struppek, 2006). Research on *responsive architecture* investigates the construction of buildings that can adapt their conditions such as shape, size, colour according to the in-situ needs and wants of users (Negroponte, 1975; Sterk, 2005). MIT SENSEable City Lab explored this idea further through sourcing digital input signals about the social environment to inform ways in which such responsiveness is managed (e.g. Frenchman & Rojas, 2006; TED, 2001). *Media façades* (Brynskov et al., 2009; Dalsgaard & Halskov, 2010) as a particular form of responsive architecture dynamically change the content and patterns of projection on buildings in response to social activities in the environment. The 2005 built soccer stadium 'Allianz Arena' in Munich, Germany, for example, glows in blue or red depending on which of the two Munich based home teams is hosting a game (Figure 3). Similarly, Villareal's (2004) electronic displays visualise patterns of pedestrian movement or traffic density providing an *organic* element to the otherwise synthetic urban infrastructure. Scherr (2006) refers to further successful examples how digital, electronic elements of architecture can be applied in a way that does not *blur*, but rather *highlight* what is real. He describes buildings that change the patterns of coloured light according to the dynamic social activities and bodies inside the building.

> "The transforming facade captures the dynamic spirit of movement itself, establishing a sense of place that stands apart yet relates to the vibrating mass media scene around it. Here, the architecture sharply resonates with something very real and majestic […]." (Scherr, 2006, p. 13)

In such scenarios, digital components are used to make physical architecture reflect, communicate and better highlight particular aspects of the contextual and situated social space. This accords to the organically and implicitly shaped appearance of buildings (Brand, 1994) and infrastructure in cities (Star, 1999) by the socio-cultural context of their inhabitants. The few examples from above embody McCullough's (2006) call for approaches that counteract the contemporary dominant top-down design and governance of digital installations in cities, towards shaping them according to their inhabitants' place-based needs and wants.

> "…the contextual design of information technologies must now reach beyond the scale of individual tasks to embrace architecture, urbanism, and cultural geography", and "…since place and culture are intertwined, it follows that more place-centered interaction design becomes a more culturally valuable endeavor" (McCullough, 2006, p. 29).

Figure 3: Allianz Arena glows in three different colours according to which team is hosting a soccer game, i.e. red for FC Bayern München, blue for TSV 1860 München and white for the German National Team. (Source: http://en.wikipedia.org/wiki/Allianz_Arena)

Whilst this work does not subscribe to any particular technology, it is inspired by the design spaces, opportunities and existing experiences from various fields under the umbrella of *ubiquitous computing*, and, in particular, *ambient displays* (described further below). They provide means to dynamically sense and reflect social aspects of a place, as well as offer place-based interactions towards amplifying meaning and sense of place. As such they provide opportunities for bottom-up approaches of architecture that can be organically shaped, re-shaped and controlled by the socio-cultural context of a place. According to the research questions and aims described in the previous chapter, this work explores and evaluates such opportunities in the context of social learning and coworking spaces.

Ubiquitous Computing

Ubiquitous computing follows the vision of moving computing from the desktop and integrating it into the "fabric of everyday live" (Weiser, 1991, p.3). Everyday objects in the physical environment are equipped with networked sensors and actuators, hence able to compute and respond to particular context situations accordingly (A. K. Dey & Abowd, 1999; Dourish, 2004). User input and output interfaces are subject to various subdomains of ubiquitous computing research.

Dourish introduces *embodied interaction* (Dourish, 2001) as a design approach for human-computer interactions that build upon intuitive, natural interactions with the world as well as the social-cultural context that such interactions are part of. *Tangible User Interfaces*

(Ishii, 1999), for instance, are electronically enhanced physical objects that serve as a user interface to interact with digital information. *Mobile Physical Interaction* (Rukzio, 2007) uses mobile devices as interaction mediators between the physical and the digital world based on intuitive gestures and communication metaphors such as 'touching' or 'pointing'. *Wearable Computing* explicitly focuses on how tangible interfaces can be embedded in everyday clothing, for example a jacket or glove.

The examples above relate to input and interaction. On the output side, research on *ambient displays* is concerned with ways to convey digital information through subtle changes in the physical environment, e.g., through sound, movement, light, smell or temperature to be perceived in the periphery of users' attention (Ishii et al., 1998). From a design point of view this thesis is positioned at the intersection of *locative media* (Chapter 2), and *ambient displays* as means to convey digital, contextualised and situated information in the real world.

Ambient Displays

Ambient displays are visible and accessible to everyone who is physically present in the space. They fall into a category of media that Falk et al. define as 'amplified reality' (1999), which "*enhance the publicly available properties of a physical object, by means of using embedded computational resources*" (p. 3). Previous work on ambient displays focused on different design aspects, including e.g., ways of integration in the physical environment (Ishii et al., 1998; McCrickard, Chewar, Somervell, & Ndiwalana, 2003), ways of conveying information without distracting the user's main focus of attention (Greenberg & Rounding, 2001; Mankoff et al., 2003; Matthews, Dey, Mankoff, Carter, & Rattenbury, 2004; Stasko, Miller, Pousman, Plaue, & Ullah, 2004) or aesthetic appearances (Mankoff et al., 2003; Skog, Ljungblad, & Holmquist, 2003; Stasko et al., 2004).

The nature of ambient displays as *amplified reality* is radically (Falk et al., 1999) different from *augmented reality* systems (e.g. Nischelwitzer, Lenz, Searle, & Holzinger, 2007) in the way digital information is rendered and made visible and accessible in the real world. Augmented reality systems present the digital through a head-mounted display or other personal mobile device – the information is kept private to the user and also controlled by them. Hence, different users experience 'augmented' realities differently, or no augmentation at all in the case that they do not use a specific device. Ambient displays, on the other hand, are embodied as part of the real world, hence are visible by everyone,

and have the potential to enrich the *collective* situated experience of people at that place (e.g. Veerasawmy & Ludvigsen, 2010). The key differences are depicted in Figure 4 as adopted from (Falk et al., 1999, p. 4).
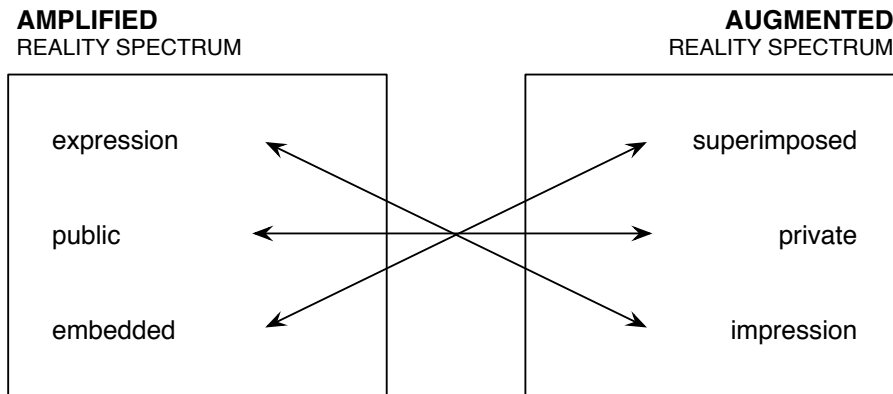
Figure 4: Media in the amplified reality spectrum present digital information as embedded elements of the real world rather rendered through a personal mobile device such as mobile phone or heads-up display. Adopted from (Falk et al., 1999, p. 4).

As a working definition for such displays, I use Pousman and Stasko's (2006) definition of 'ambient information systems' covering the following set of characteristics:

- Display information that is important but not critical;
- Can move from the *periphery* to the focus of *attention* and back again;
- Focus on the tangible representation in the environment;
- *Provide subtle changes* to reflect updates in information (should not be distracting);
- Are *aesthetically pleasing* and environmentally appropriate.

As such, the form factor of ambient displays – unlike smart phones, laptop computers and other personal ICT devices – do not afford cocooning (Mainwaring et al., 2005) and isolation from the surrounding social environment during use, but rather facilitate a collective use and experience.

Summary

This thesis is situated at the thematic intersection of trends discussed in Chapter 2, Chapter 3 and Chapter 4.

Innovations in ICT, in particular locative media and mobile and ubiquitous computing technology have transformed physical barriers and boundaries of space. They have changed the relationship between people and places, as well as social interaction and spatial practices within places. Public libraries present an example of urban public place that has been affected by these transformations, and seek new strategies towards transforming into 'hybrid places.' Contemporary library design strategies tend to focus on the library as a hybrid place merely by *providing* new media and technology, or *accommodating* their use in the space. Interactive whiteboards, WiFi, projectors and video conferencing systems, for example, are provided for connected work, power plugs and reconfigurable furniture on wheels to cater for flexible laptop work, and mobile library services to access via smartphones.

This thesis takes a different view on the *library as a hybrid place*. Rather than regarding *hybrid place* as a *physical place* in which *digital interactions* are merely supported through personal ICT, it interprets '*hybrid*' more literally – i.e. through the embodiment of ubiquitous computing technology as part of the physical space to facilitate collaboration, social encounters and connected learning among library users.

Following this goal, this thesis embarks on literature in urban studies that suggest a *'global sense of place'* (Massey, 1991; Wellman, 2001, 2002), i.e. appreciating the uniqueness of place through the preservation of its cultural, social and physical identity (Auge, 1995; Harvey, 1996), as well as the cultural diversity, multiple identities and constant influences through people continuously traversing through from *outside* (Massey, 1991). However, the latter specifics are not tangible, but rather invisible, permeable, transitory and hard to grasp. In this regard, previous work on mobile and locative media shows their potential to render physical space *socially translucent*, towards shaping people's sense of place (Willis, 2007) and interactions with co-located others (Gordon & de Souza e Silva, 2011).

The vision is to use the means of digital technology as a tool to augment the perceived existing qualities and features of the library as a physical place for social learning and coworking (see Aim 2 – Research Questions and Aims), e.g., through augmenting the perceived sense of community, scholarship or belonging as users enter the space. Based on examples of *socially* responsive architecture in the context of cities, I outline *ubiquitous*

computing and *ambient displays* as design spaces for combining the benefits of locative media and mobile social software applications on the one hand, and architecture on the other hand. The remainder of this thesis aims to understand, inform, design and evaluate opportunities and design strategies for ubiquitous computing as a *tool for hybrid placemaking*.

The literature in Chapter 2 also outlines some methodological challenges of designing place-based technologies. The next chapter seeks to elaborate on a methodological framework to tackle those challenges, towards shaping the design of tools for hybrid placemaking according to the socio-cultural context and place of their installation.

Chapter 5:

Towards Participatory Action Design Research: Adapting Action Research and Design Science Research Methods for Urban Informatics

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Statement of Contribution

This paper has been co-authored with Assoc. Prof. John Venable from the School of Information Systems, Curtin Business School, at Curtin University of Technology, Perth, Australia. I had planned to write a paper about a new methodological approach that combined elements of traditional Design Research and Action Research, which I felt was necessary in order to tackle the interdisciplinary nature of challenges that I encountered in my research project at The Edge. I met John at the "Making Links Conference 2010: Where Social Action and Technology Converge" in Perth, and found that he shares my interests and is knowledgeable about innovative methodological concepts at the intersection of Action Research and Design Research. He was excited to co-author this paper with me.

I contributed the main body of work, in particular the conceptual approach of transferring Action Design Research from the Information Systems field to the context of Urban Informatics. John contributed his expertise in Action Research and Design Research, and contributed to the formulation of the research questions as well as the conceptualisation of our resulting *Participatory Action Design Research* (PADR) method. His writing contributions are limited to the section on *'Action Research and Design Science Research in IS'* and the introduction to *'Participatory Action Design Research: Adapting Action*

Design Research for Urban Informatics' (up until Figure 9), as well as one paragraph on the problem formulation after Figure 9. We both revised and edited the paper several times in order to integrate both of our thoughts and contributions towards a coherent research narrative. I am grateful for John's collaboration and expertise input on this paper, which enabled a fruitful cross-fertilisation of our thoughts in the building process of PADR, which would not have been possible through individual efforts by any of us.

Preamble

My aim conducting this PhD study was not only to design and develop innovative ubiquitous computing technology, but to do so in a way that is informed by the socio-cultural context where this technology was to be deployed. Similar to other research in the context of Urban Informatics, my selected case study and prospective deployment site at The Edge came with some difficult methodological challenges in relation to user-centred design.

The nature of The Edge as a public library space meant that there was a plethora of stakeholders and their particular interests to take into account; those were, in particular, the government as a funding body, The State Library of Queensland as the mother institution and different stakeholders within The Edge – the general manager, the program manager, PR team, staff, facilities management and last but not least, an extremely diverse user community (the nature of The Edge as an open and public library space attracts a huge diversity of users from different socio-economic and educational backgrounds, ages, cultures, ethnicities, needs, pre-entry motivations, expectations and attitudes).

Given this research context, I was torn between two methodological frameworks. Design Research, having its roots in engineering, informs a research process towards an innovative technology artefact, but lacks methodological tools to gather a rich understanding of perceived issues within a socio-cultural environment. In order to understand the challenges, barriers and requirements of connected learning in the context of a place such as The Edge, a 'quick-and-dirty' ethnographic approach, as often encountered in Design Research studies, would not be sufficient.

Action Research, on the other hand, provides a rich methodological framework to identify challenges, barriers and issues in a social or organisational setting, and evaluate actions and interventions towards their impact on that setting. However, Action

Research does not implicitly foresee design and development of innovative technology as a research outcome.

The following publication arose in my quest to construct a methodological framework that combined the strengths of both Design Research and Action Research in order to inform and guide the design, development and impact evaluation of innovative technology in complex socio-cultural environments that involve multiple stakeholders and a huge variety of users. Embracing the philosophy of the Scandinavian Participatory Design tradition (Gregory, 2003), this approach also sought to increase the democracy in relation to design decisions and artefacts that affect people's experience in public spaces. The resulting 'Participatory Action Design Research' (PADR) framework guided my subsequent investigations at The Edge. However, the publication was written for a more general audience of designers in the broader domain of Urban Informatics, i.e. designers who are concerned with the creation of innovative technology for urban public places and general members of the public as users.

The PADR process consists of five iterative phases (Figure 9), comprising (1) *Diagnosing and Problem Formulation*; (2) *Action Planning*; (3) *Action Taking: Design*; (4) *Impact Evaluation*; and (5) *Reflection and Learning*. Figure 1 depicts how the individual chapters of this thesis report the outcomes of these PADR phases in two cycles. The chapters from PADR cycle 1 report findings from phases (1) and (2); the chapters from PADR cycle 2 cover phases (3), (4) and (5). The order of the PADR cycles and presented chapters was set to form a coherent research narrative rather than reflect the actual chronological order of the conducted research activities. Many of the research activities in cycle 1 and 2 were chronologically nested to enable a continuous feedback loop between the different PADR phases.

Abstract

This paper proposes a new research method, Participatory Action Design Research (PADR), for studies in the Urban Informatics domain. PADR supports Urban Informatics research in developing new technological means (e.g. using mobile and ubiquitous computing) to resolve contemporary issues or support everyday life in urban environments. The paper discusses the nature, aims and inherent methodological needs of Urban Informatics research, and proposes PADR as a method to address these needs. Situated in a socio-technical context, Urban Informatics requires a close dialogue between social and design-oriented fields of research as well as their methods. PADR

combines Action Research and Design Science Research, both of which are used in Information Systems, another field with a strong socio-technical emphasis, and further adapts them to the cross-disciplinary needs and research context of Urban Informatics.

Introduction: Urban Informatics – A Research Field at the Intersection of People, Place and Technology

The introduction of information and communication technology (ICT), particularly the more recent introduction of mobile and ubiquitous computing technology, continues to trigger profound changes in everyday life. ICTs have entered and become an established component of our cities, infrastructure and daily environments. They have blurred the borders between the physical and the digital and reshaped the way people interact and communicate with each other. People's interaction and communication patterns in everyday life constantly and seamlessly shift back and forth between physical and digital spaces. The domain of daily sociability and experience has become a 'hybrid space' (De Souza e Silva, 2006) – a space that encompasses the infrastructure (Dourish & Bell, 2007), affordances (Norman, 1999) and other characteristics of both the physical as well as the digital.[1]

Urban Informatics is a research field that has emerged through the rising significance and need to investigate this ecology in the context of urban life and environments. It has been defined as "*the study, design, and practice of urban experiences across different urban contexts that are created by new opportunities of real-time, ubiquitous technology and the augmentation that mediates the physical and digital layers of people networks and urban infrastructures*" (Foth, Choi, et al., 2011). In order to study urban experiences and everyday urban life, it combines members of three broad academic communities: "the social (media studies, communications studies, cultural studies, etc.), the urban (urban studies, urban planning, etc.), and the technical (computer science, software design, human-computer interaction, etc.) …" (Foth, 2009a, p.xxix). It engages in social, cultural and urban studies to understand the urban context, and works in close partnerships with city

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[1] In this context we look at the impact of recent ICT developments on urban life in developed countries. Though, as the mobile phone and other ubiquitous technologies enable developing countries to leapfrog into more advanced economies, similar impacts might be relevant for urban life in developing countries soon.

councils, communities, local organisations as well as public state and government institutions to adapt, develop and pilot innovative technologies and techniques from the fields of ubiquitous computing (ubicomp) and human-computer interaction (HCI) in real-world settings.

Urban Informatics is closely related to Community Informatics (CI), but goes beyond what is referred to as 'urban community informatics' (Gurstein, 2010), i.e. the application of CI goals to urban environments. Urban Informatics shares some common goals with CI, yet has a stronger focus on urban studies and addressing issues in the urban context through relevant innovations drawing on mobile technologies, ubicomp and HCI.

Whilst CI has a strong focus on empowering communities, i.e. "transfer responsibility and authority to communities and away from central institutions" (Gurstein, 2007, p. 79) and in doing so tends to look at communities as a whole, Urban Informatics regards communities more as a *network of individuals* (Wellman, 2002) and strives to enhance the connectedness between these networked individuals. It is not necessarily driven by the idea to enhance the notion or formation of a community as such, or to necessarily support shared community goals or ideals. Urban informatics is rather interested in how ubicomp artefacts can enhance the communicative ecologies (Hearn & Foth, 2005; Tacchi, Slater, & Hearn, 2003) of individuals in the context of their everyday urban life in general. Hereby, Urban Informatics research is actively involved in the design, development and evaluation of such artefacts.

The vision of ubicomp is to embed computing "into the fabrics of everyday live" (Weiser 1991), focusing on technologies and networked computing devices that become an integral part of people's daily communication and interaction habits as well as perceptions of the world (Schmidt et al., 2011). Mobile phone communication, wireless internet, location-based mobile services, interactive public screens and electronic road pricing systems are examples of ubicomp scenarios and technologies that have become mundane – their infrastructure is not only being actively lived by people, but also affects their spatial behaviour (Forlano, 2009; Gordon & de Souza e Silva, 2011; Willis, 2007) as well as practices in urban public spaces (Crawford, 2008; Humphreys, 2010).

Urban Informatics, as a core field of research in the intersection of urban studies and ubicomp, aims to understand and shape such communication and interaction patterns in the hybrid space as they evolve. It cannot wait until a new technology has become mundane, but needs to actively take action and learn through reflection by participating

in early design, evaluation and re-design of new forms of ICT. This endeavour requires not only the capacity and methods to design, develop and deploy innovative technology, but more so a deep understanding of individual people's everyday life and inherent interplay with their social environments and urban infrastructure.

The success of both CI and Urban Informatics applications depend on whether they are accepted and adopted by people and effectively used in their social or community processes. Whilst CI has a strong focus on investigating the 'effective use' of ICT (Gurstein, 2003), i.e. the ability for a particular community to benefit from a particular ICT, it does usually not engage in addressing experienced issues through proactive development or redesign of new technologies. Research on technology acceptance provides strong empirical evidence that people's acceptance of technology primarily has two determinants – perceived usefulness and perceived ease-of-use (Davis, 1989; Venkatesh, Davis, & Morris, 2007; Venkatesh, Morris, Davis, & Davis, 2003). The nature of most CI studies implicitly covers the evaluation of perceived usefulness (and sometimes, but to a far lesser degree the usability of deployed ICT), however, it usually lacks HCI related aspects such as user-centred iterative design-development-evaluation cycles to feed experienced issues back and keep amending prototypes until they reach a stable design. This gap has been addressed by the special issue on "Community Informatics and System Design" in the Journal of Community Informatics (JoCI, 2007), in particular (Bourgeois & Horan, 2007; de Moor, 2007), but in practice the vast majority of submitted CI articles has no or only weak goals towards exploring opportunities through proactive design, development and evaluation of new ICT. HCI and ubicomp on the other hand have a strong focus on design, development and evaluation, but traditionally not used to study how technology interplays with people's everyday lived experience (cf. J. McCarthy & Wright, 2004).

We regard Urban Informatics as a field of research that interlinks and complements the foci from various disciplines, i.e. (1) urban sociology and its broad focus on urban everyday life and issues in the urban context, (2) CI and its focus on evaluating effective use of ICT in real-world settings, (3) ubicomp and its focus on engineering and development of new ICT and (4) HCI and its focus on interaction design and usability studies. The underlying belief of Urban Informatics is that only through such an inclusive and cross-disciplinary approach can innovative ICT opportunities be successfully identified, designed, developed and deployed towards organically adding value to people's lives and everyday tasks. This approach also aims to avoid techno-

utopianism (Pitkin, 2001) and to detect potential negative socio-cultural consequences of new technology at an early stage.

The topic of this paper is concerned with how the cross-disciplinary requirements described above can be tackled methodologically. How can the individual disciplinary lenses through which Urban Informatics is investigated be combined towards a methodological framework that comprises and mutually nourishes findings towards trans-disciplinary impacts? Hence, we formulate the underlying research question of this paper as following:

What would be the characteristics and structure of a good method for conducing Urban Informatics research?

In particular, Urban Informatics researchers often find promising opportunities in ubicomp technology when studying the urban context. The question is what happens when the analysis process identifies that a design intervention, based for example on a new technology has a potential to provoke the desired action and change? At this point researchers face challenges related to incorporating action and social change, with design and development-oriented process models and inherent goals. How can goals to improve a social setting be incorporated with engineering oriented goals towards design, development and evaluation of a new technology artefact?

The Scope of Cross-Disciplinary Research Activities in Urban Informatics

Urban Informatics as a discipline is primarily concerned with bridging the gap between needs and issues of people in the urban context, and opportunities provided by ICT. Urban Informatics involves both studying and understanding socio-cultural aspects of people, space and place and also solution-finding through planning, designing, building and evaluating innovative technology artefacts. Urban Informatics embodies a "transdisciplinary approach to understanding the city as an ecology that consists of technological, social, and architectural layers" (Foth, Choi, et al., 2011). Its research agenda covers topics, methods and issues raised across all three of those layers (Figure 5).
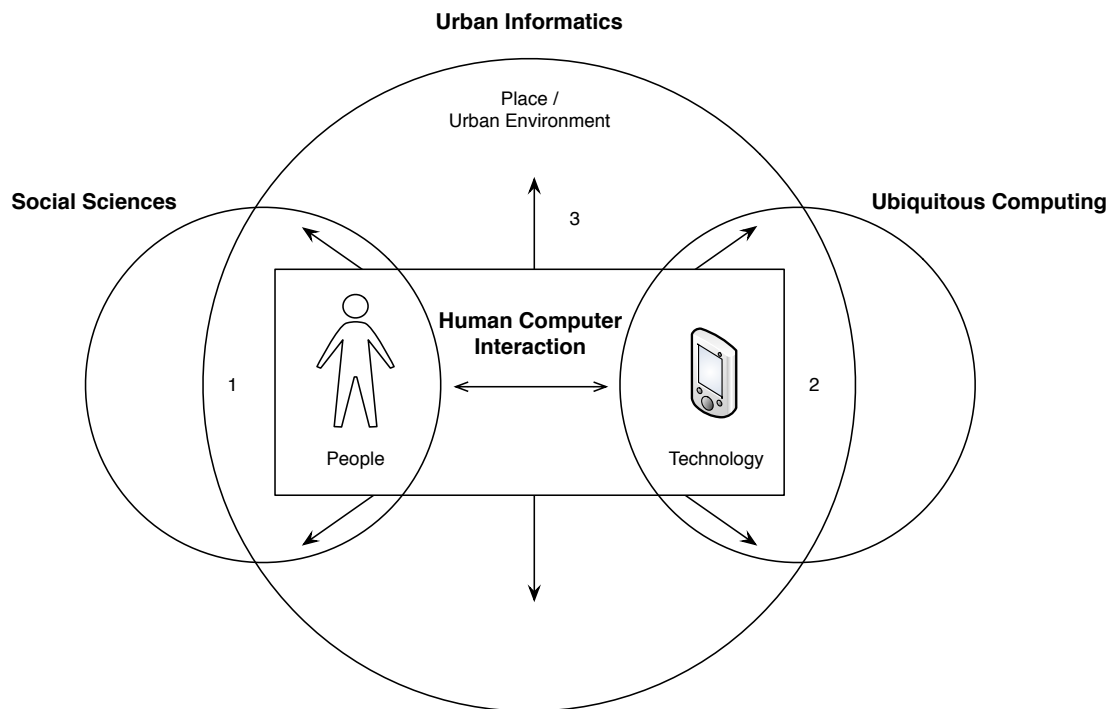
Figure 5: Urban Informatics covers topics, methods and issues across social, technology and design-oriented sciences applied in the urban context.

The underlying belief is that people networks, places and infrastructure cannot be studied merely as social and physical phenomena, but rather as an ecology of social, physical and technological domains. The *Discussions in Space* project at the Urban Informatics Research Lab at Queensland University of Technology for example has spread across urban planning, HCI and communication design to explore opportunities of interactive public screens to engage local residents in urban planning related questions. Research outcomes address the urban planning (Schroeter & Houghton, 2011b) as well as HCI community (Schroeter & Foth, 2009) creating interdisciplinary links and identifying opportunities for practitioners as well as researchers in both fields. Other Urban Informatics projects have studied different residential lifestyles to inform the role and design of ubicomp technology in inner-city apartments (Foth, Satchell, Bilandzic, Hearn, & Shelton, 2012), or have investigated ways to facilitate community networking in an Australian urban renewal site through location-based mobile phone services; hereby the study has again produced cross-disciplinary outcomes, i.e. for managers and researchers of urban renewal sites on the one hand (Klaebe, Adkins, Foth, & Hearn, 2009) and the mobile systems design community on the other hand (Bilandzic & Foth, 2009b; Bilandzic et al., 2008).

These projects illustrate how Urban Informatics forms a nexus of social, urban and technological studies towards understanding urban life from a holistic point of view. This nexus builds strong ties between academia and public institutions or industry in order to design and evaluate digital technology artefact as organic parts of people's experiences in the context of urban life. Based on this understanding, we propose following tasks and activities to frame the cross-disciplinary spectrum of research efforts that an Urban Informatics project can have:

First, it engages in understanding and analysing a wide spectrum of contemporary issues and needs in the urban context, e.g. sustainable and healthy living, well-being, citizen engagement or social connectivity and experiences. Hereby, it embraces social, cultural and urban studies (e.g. Gordon & de Souza e Silva, 2011; Jacobs, 1961; Meyrowitz, 2005; Putnam, 1995; Watters, 2004; Wellman, 2002; W. H. Whyte, 1980), theories of space and place (e.g. Auge, 1995; Lefebvre, 1991; Massey, 1991; R Oldenburg & Brissett, 1982; Relph, 1976; Soja, 1996; Tuan, 1977), critiques of everyday life (e.g. Certeau & Rendall, 1984; Lozanovska, 1989, 2002), place-making strategies (Project for Public Spaces, 2000; Schneekloth & Shibley, 1995; Walljasper, 2007) and relevant tools from these fields that help understand and address urban issues and phenomena from a social and cultural perspective.

In parallel, Urban Informatics studies keep track of opportunities provided by ubicomp technologies (Hornecker et al., 2006; Poslad, 2009) and focuses on ubicomp as a domain for potential solutions to the identified issues. Analysing the characteristics of the identified issues as well as capabilities and opportunities provided by ubicomp technology, an Urban Informatics study informs the role which ubicomp could and should have in the identified context. It proposes important contextual parameters to be facilitated or improved by an existing or future ubicomp artefact. At the same time, based on the elaborated analysis and understanding of the social and cultural context, it informs the design of the technology according to its role. Once the purpose and role have been defined, it embraces human-centred design and development methods (e.g. Ballagas, 2008; Foth & Axup, 2006; Hagen & Robertson, 2009) to shape a first prototype of an artefact.

Reflecting on the initial definition of its role and purpose, the artefact is iteratively evaluated in the real-world context against its effective use and impact on the social setting, and re-shaped until it reaches a stable design. Eventually, the outcomes are reported to two different stakeholder groups; on the one hand, urban planners,

architects, and managers who are concerned with design of urban public spaces in general, such as local governments or institutions in the urban context; For this audience, it is not of upmost importance which technology comes to use, or whether it is an innovative or existing design artefact, but rather if a particular social or organisational impact can be achieved by the artefact, and if yes, how? Technology is not considered for the sake of introducing technology, but to solve a targeted issue. It is seen as a means to tap opportunities (Hornecker et al., 2006) that would not exist otherwise. On the other hand, Urban Informatics studies feed evaluation of real-world use results back to design and technology-oriented research fields such as ubicomp and HCI. These can then be incorporated into requirements for future work in those fields.

Methodological Challenges in Urban Informatics

With the cross-disciplinary orientation of research efforts embodied in the mission of Urban Informatics come some significant methodological challenges. In particular they raise questions situated in the intersection between the social and technology-oriented goals, i.e.

- How can outcomes from social, cultural and urban studies be interpreted and translated into implications for design of new technology?
- How can the social and cultural context of an urban site organically shape the design of an artefact as it is being developed?
- How can a new artefact be evaluated in a way that the outcomes feed new questions back to social as well as technology oriented members of the research community?

Engineering as a field focusing on design and technology-driven studies, has powerful tools to build useful technology artefacts and continuous technological improvements to these artefacts, but generally lacks the potential to deal with "messy human situations" (Baskerville et al., 2007). It has little or no tradition in understanding the social context, which is necessary to shape an artefact's design from a socio-technical perspective. Shaping technology so they fit into messy human situation is "highly relevant to the success or failure of IT artefacts" (Baskerville et al., 2007, p.17).

Dealing effectively with complex, messy human situations is especially critical when ICT becomes a significant part of everyday life and infrastructure, such as through mobile and ubicomp technology. In this context, Bell and Dourish propose that "…perhaps

dealing with the messiness of everyday life should be a central element of ubicomp's research agenda" (Bell & Dourish, 2007, p.134). Coyne notes "the move to the everyday promotes methods of research that engage with narrative and socially situated ethnographic study, rather than the transportation of phenomena to the laboratory, or isolation into the calculative world of variables and quantities" (Coyne, 2010a, p. 74). Based on such thoughts, we consider the very transition from understanding the dynamics of a social-cultural environment towards informing the design and organically embedding a technology artefact in this socio-cultural environment as crucial for the success of an Urban Informatics project. However, using isolated tools from either engineering or social sciences does not meet the methodological requirements to achieve these goals. The question is, what would be effective mechanisms to incorporate and cross-fertilise insights from the social as well as technological perspective? Ethnography provides explicit tools to help understand the facets of a socio-cultural setting in a detailed and fine-grained manner. However, having its roots in social sciences, traditional ethnographic research does not necessarily imply or propose specific implications for the design of an artefact (Hughes et al., 1995). Furthermore, an ethnographic study in its traditional form can sometimes take years, a "prolonged activity" (Hughes et al., 1995, p.59) largely unsuitable to informing system design. A compromise established to bridge the dichotomy between understanding social aspects of a setting and technology design goals are methods that follow a "quick and dirty" principle of ethnographic research.

 However, such ethnographic techniques – mainly applied to inform the design of a specific artefact – might 'marginalise' theory (Dourish, 2006a) and miss important social contexts and human factors of the targeted environment that are crucial to understand what role design and technology can or should have at the targeted site in the first place. From this point of view, 'quick and dirty' ethnographic studies explicitly aimed at finding implications on design seem to be methodologically paradoxical in some sense. The role and significance of ethnography in the context of ubicomp and HCI has caused some earlier confusion. Dourish (2007) reminds us that ethnography might not outline obvious implications for design, but should rather be recognised through its core strength, i.e. understanding, describing and capturing social and cultural phenomena, which inherently might embody aspects relevant to designers.

In Urban Informatics, we recognise the importance of ethnographic research, yet we are specifically interested in how it informs the role and design of future technology. Thus,

in its constant efforts to investigate 'implications on design', Urban Informatics continuously seeks for methodological approaches that provide an informed trade-off between traditional ethnographic studies, that are often too lengthy and time-consuming for the sake of 'just' informing design, and 'quick and dirty' methods that might 'marginalize theory' hence miss important social or cultural aspects of the underlying site. From a methodological point of view, an umbrella framework that addresses these needs requires tools from soft as well as hard science disciplines.

Situated in a similar dichotomy between design-oriented thinking and investigation of relevant social aspects in organisational settings, research in Information Systems (IS) has faced similar methodological challenges as Urban Informatics. IS research targets information technology that is implemented to improve effectiveness and efficiency in organisational settings (Silver, Markus, & Beath, 1995). The IS research field is concerned with technical as well as social issues related to the effective use of information technology in the organisational context. Based on this interdisciplinary setting, IS research embraces various ontological and epistemological traditions, as well as applied methodologies.

Review studies of established IS journals show two predominant research approaches in IS research (Schauer & Frank, 2007; Wilde & Hess, 2007). On the one hand, there is more design-oriented IS research (predominantly focused on by for example, the German 'Wirtschaftsinformatik'), and on the other hand, studies that are more aligned towards behavioural sciences and theory building or testing (e.g. particularly in the American field of IS Research). Implicitly, the practical as well as theoretical contributions of different IS studies are often polarised, i.e. either focused on design and technical innovation of new IS artefacts (Hevner et al., 2004; March & Smith, 1995), or oriented towards IT-related, but social, cultural and behavioural organisation specific issues.

Realising the importance of a dialogue between both ends of the IS-Research spectrum, IS methodology literature has extensively discussed Action Research (AR) and Design Science Research (DSR) as two methodological frameworks that address design-oriented issues from a technical, as well as socio-cultural perspective (Baskerville et al., 2007; R Cole, S Purao, M Rossi, & MK Sein, 2005; Figueiredo & Cunha, 2006; Iivari & Venable, 2009; Jarvinen, 2007). In the following section we discuss the relevant outcomes of this discussion and how Urban Informatics, as a comparatively young field of research that faces similar methodological challenges, can learn and benefit from it.

Action Research and Design Science Research in IS

Action Research (AR) is research which investigates a phenomenon through intervention in a problematic situation. It is distinguished by simultaneously working to achieve two goals, that of making an improvement in the problematic situation while at the same time researching the phenomenon or phenomena of interest. Typically a researcher who acts as an expert works together with laypeople (the clients) who have an interest in resolving or improving the problematic situation. The researcher and the clients decide upon a course of action (typically recommended by the researcher), carry out the course of action, and the researcher studies what happens during and after the intervention. Both the client(s) and the researcher benefit from the collaboration. The act of intervening allows the researcher to study complex organisational phenomena that occur before, during, and after the intervention and usually to study and characterise the benefits and difficulties of the intervention itself. Indeed, the research may (but also may not) involve development and/or application of new techniques and technologies that are the main topic of the research (Iivari & Venable, 2009).

Action Research has had a long history, both within and outside of the field of Information Systems. While at its heart, the idea of collaborative investigation by researcher and client is a simple one that has probably been conducted as long as people have been engaged in 'research', AR has its modern roots in work conducted at the Tavistock Institute, as exemplified by that reported by Kurt Lewin (Lewin, 1951). Another seminal work on AR is that of Susman and Evered (Susman & Evered, 1978), who laid out its key principles. As the field of IS became more interested in the social issues of technology intervention in organisations (e.g. the application of power and its consequences during IS development), AR was a natural approach to adopt. AR has been used heavily in researching and developing systems methodologies. For example, Checkland and others used AR as the main approach for the development and refinement of Soft Systems Methodology (Checkland, 1981; Checkland & Scholes, 1990). The rise of the use of AR within the field of IS has coincided with a general broadening of the IS field to accept (if not embrace) a plurality of both positivist and interpretive research methods and paradigms. A watershed event in this broadening was the 1984 IFIP Working Group 8.2 working conference held in Manchester in the UK (Mumford, Hirschheim, Fitzgerald, & Wood-Harper, 1985).

There are many versions of Action Research, both within and outside of the field of IS (Baskerville, 1999). Within the IS field, the work of Susman and Evered (Susman &

Evered, 1978) continues to be heavily cited, but today the approach of Canonical Action Research (Davidson, Martinsons, & Kock, 2004) is the most commonly cited and applied. Participatory Action Research (PAR) (Argyris & Schön, 1989; Wadsworth, 1998; W. F. Whyte, Greenwood, & Lazes, 1989), which was developed in the field of Organisational Behaviour (OB) has also been used in IS. PAR is Action Research that "involves practitioners as both subjects and co-researchers (Argyris & Schön, 1989, p. 613). The involvement is extensive rather than just consultative, with active participation "throughout the research process from the initial design to the final presentation of results and discussion of their action implications" (W. F. Whyte et al., 1989, p. 514). Participatory Design (PD) or its earlier version Cooperative Design (Kensing, 2003; D. Schuler & Namioka, 1993) address similar issues, but can be considered to be related to information system development in practice rather than in research per se. Closely related to PAR and closely related to each other are Community Based Research (CBR) (Israel, ASchulz, Parker, & Becker, 1998) and Community Based Participatory Research (CBPR) (Minkler & Wallerstein, 2003; Wallerstein & Duran, 2010), which both arise in the field of Public Health. CBR and CBPR extend PAR by involving members of a community with the goals of improving the research rigor and relevance, but also addressing power imbalances and empowering the community (Israel et al., 1998; Wallerstein & Duran, 2010).

Ethnographic Action Research (EAR) was developed for use in research on community-based ICT for development in the field of media and communication studies (Tacchi et al., 2009; Tacchi et al., 2003). In comparison with PAR, EAR extends the engagement with the participants or client community by studying its needs using ethnographic methods, such as observation, participant observation, in-depth interviews, and feedback mechanisms. In comparison to more traditional ethnographic methods, EAR facilitates practical application through activities of planning and action based on what is learned through the ethnography. Network Action Research (NAR) (Foth, 2006a) can be considered a form of CBR or PAR in which the intent is to increase the enfranchisement and participation of a community by seeking to understand and involve its different social networks and sub-networks and helping the community to develop not just one but a set of AR projects in which the members of the different networks become actively involved and lead for themselves. This variety of different AR approaches offers many possibilities for developing a research approach to support Urban Informatics.

In general, the various approaches to AR described above differ largely in the manner and extent to which the practitioner/participant community is engaged, its needs understood, and its empowerment to decide how the research will be conducted and it what ways it will benefit.

Setting aside the issues of the manner and extent of participation by the clients (or co-researchers) for the moment, the AR process is largely the same. Baskerville (1999) describes the action and change orientation of the Action Research approach in a simple two stage process: the diagnostic stage and the therapeutic stage. This simple process is more commonly expanded with three iterative activities relating to the therapeutic stage and a final stage specifying the learning (which is related to both the action to improve and the research outcomes), resulting in five stages as shown in Figure 6 (Lewin, 1951; Susman & Evered, 1978). In the diagnostic stage (stage 1), the researcher and the group of problem owners collaboratively analyse a social (or socio-technical) setting, and hypotheses are formulated about the nature of the research domain. The therapeutic stage includes iterative steps of action planning (stage 2), action taking (stage 3), and evaluating (stage 4). Learning (stage 5) is concerned with reflection and capturing lessons both for the benefit of the participants and to be reported as the outcomes of the research (Lewin, 1951; Susman & Evered, 1978).

| 1 Diagnosing | 2 Action Planning | 3 Action Taking | 4 Evaluation | 5 Learning |
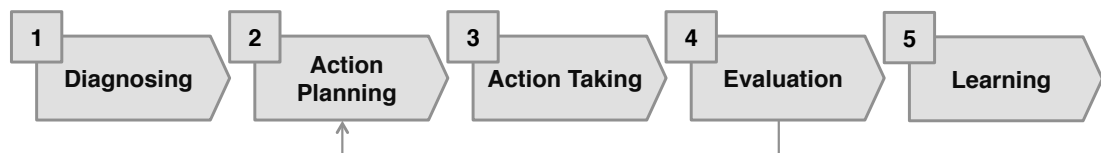
Figure 6: The Action Research Process Model

As described above, there is a long history in the Information Systems field of the use of Action Research. Somewhat more recently, the Design Science Research paradigm has received significant renewed attention, culminating in the 2004 MIS Quarterly paper by Hevner et al (2004) and the DESRIST (Design Science Research in Information Systems and Technology) international conferences (2006-2011). The renewed interest in DSR stems from a frustration by some in the IS field with its increasing focus on gaining an empirical understanding of the current situation and its (seeming) lack of respect for research that creates new technologies to solve existing problems.

The discussion of DSR in the IS field has covered a broad methodological and theoretical ground, including fitting DSR activities into a broader set of research activities, development of formulations of IS Design Theory (Gregor & Jones, 2007;

Venable, 2006b; Walls, Widmeyer, & El Sawy, 1992) and methodologies for conducting DSR (e.g., Peffers, Tuunanen, Rothenberger, & Chatterjee, 2008).

In relating DSR to other forms of research, Venable (2006b) developed a framework of four activities: problem diagnosis, solution technology invention, evaluation, and theory building. He noted that the solution technology invention is the key activity that distinguishes DSR. The activities of problem diagnosis and technology evaluation are conducted in other (empirical) research paradigms, whether positivist or interpretive. An important aspect of DSR is that it seeks to solve general problems, not just specific, situated (one-of-a-kind) problems, so that the knowledge produced about the solution developed can be adapted and applied (in practice) to other specific, situated problems (instances of the general problem) (Venable, 2006a).

A number of papers have set out processes for conducting DSR, including Nunamaker et al (1991), Vaishnavi and Kuechler (2004), Venable (2006a), and Peffers et al (2008). Figure 7 below distils out the key activities.
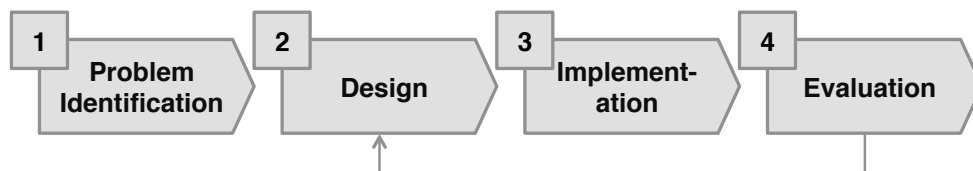
Figure 7: The Design Science Research Process Model

While the above papers concern DSR in the information systems field, the same ideas can be applied to Urban Informatics. In order to make improvements (in this case to the urban environment and people's experiences of and in it), problems must be investigated and diagnosed (using empirical methods and paradigms) to inform design of novel solution technologies (e.g. applications using mobile and ubicomp) using the DSR paradigm. Following the development of new technologies, they should be evaluated to provide evidence that the new technology has utility with respect to solving the relevant problem or making a desired improvement. It is proper evaluation that justifies the use of the word "Science" within DSR.

In the DSR methodology area, somewhat more recently, there has been extensive discussion of the differences and similarities between AR and DSR (Iivari & Venable, 2009; Jarvinen, 2007), their respective roles (Iivari & Venable, 2009), and why and how they could be fruitfully integrated (Baskerville et al., 2007; Baskerville, Pries-Heje, & Venable, 2009; R Cole et al., 2005; Sein et al., 2011). Such an approach ensures a more relevant grounding of a DSR effort in realistic understanding of relevant organisational

problems and supports naturalistic evaluation (Venable, 2006a) of the designed new technology.

Baskerville et al (2009) take inspiration from Soft Systems Methodology (Checkland, 1981; Checkland & Scholes, 1990) to develop a method they call Soft Design Science Methodology. The method includes explicit steps for identifying a problem, generalising the problem, developing a generalised solution, checking that the generalised solution relates back appropriately to the original problem, and implementing and evaluating the solution.

Sein et al (2011) explicate their Action Design Research methodology. A key tenet of the method is that new information systems are or should not be developed in isolation from the environment(s) in which they would be used in a top down fashion and are not designed and implemented fully formed, ready to go. Indeed, designs for new technologies instead *emerge* from the interaction of designers and users and the authentic evaluation of the new technology (*cf*. "naturalistic evaluation" in Venable (2006a)). They propose that there should be tight coupling between the research activities of building, intervention, and evaluation (BIE) in a cycle, with extensive participation by key stakeholders (researchers, problem owners, and system users).

From this perspective, one could assert that it may be fruitful to borrow Soft DSR or Action Design Research wholesale for use in Urban Informatics research (Figure 8). However, it is fruitful to more critically consider how IS and Urban Informatics are similar and different before doing so. In fact, there are significant differences between the two research fields, which will warrant adapting rather than adopting IS research methods combining AR and DSR.
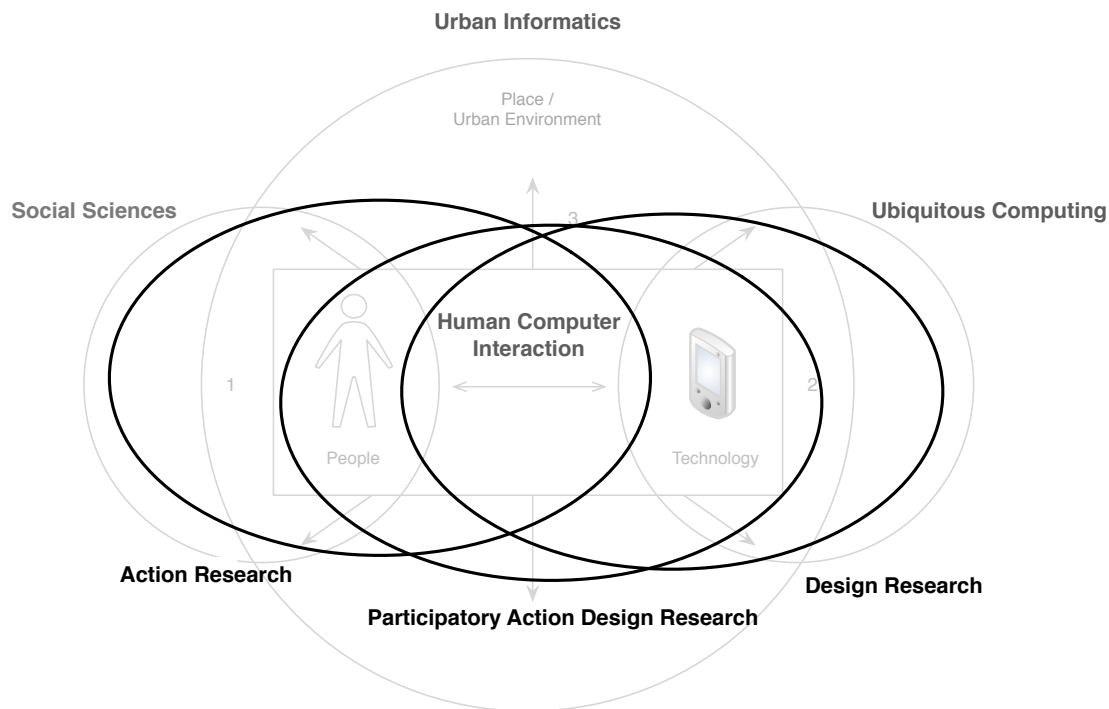
Figure 8: Participatory Action Design Research incorporates technological innovation with methods to shape design according to the socio-cultural context.

Participatory Action Design Research: Adapting Action Design Research for Urban Informatics

Table 1 below contrasts the IS and Urban Informatics research disciplines. The information systems discipline focuses largely on improving organisations, largely businesses, and therefore largely on goals relating directly or indirectly to profit. Urban Informatics on the other hand focuses largely on the community or societal level, and therefore mostly on social good as a goal. Perhaps more importantly for our purposes here, the decision makers for information systems are largely managers, who mostly agree about the goal of profit, and therefore largely can reach agreement on the goal(s) and the solution(s) to pursue, as well as the kind of improvement desired and how one can determine whether it is achieved or not. In Urban Informatics on the other hand, there may be a multiplicity of clients and other stakeholders, e.g. city planners, government, developers and local organisations, not to mention the public. It is important to build effective partnerships (Foth & Adkins, 2006) between these communities and to get a mutual understanding of their individual goals and motivations when conceptualising solutions to shared problems.

Another significant difference is the relatively closed nature of the environment of IS versus the quite open nature of Urban Informatics. This includes aspects such as the technological environment, the users, and the context of usage itself. Urban Informatics largely targets members of the public as end users. Their backgrounds, motivations and needs can be very heterogeneous and relatively hard to predict compared to the ones of employees in an organisational setting. Similarly, the technological environment in Urban Informatics is almost completely open – anyone can use or not use (Satchell & Dourish, 2009) whatever application they want within a given public space. Furthermore, any member of the public can typically select the space where s/he uses (or doesn't use) an application. The user context in Urban Informatics is open, mobile and widely varying from situation to situation in people's everyday lives, whereas in business organisations, the environment is typically more closed, fixed (although wireless access changes this) and predictable. Finally, a key difference is that the role of place, space, and location is essential to Urban Informatics as they significantly affect the user's situated context and experience (Lentini & Decortis, 2010) whereas it is of low relevance, largely incidental within the IS field (although its role is increasing for some application areas).

Characteristic	Information Systems	Urban Informatics
Level	Organisational	Community, Urban dwellers
Dominant Goal	Profit	Social good
Sub-goals (e.g.)	Efficiency, Effectiveness	Well-being, health, social connectedness
Decision maker	Management/employer	Government / public institution
Environment / User context	Closed, fixed, predictable	Open, mobile, diverse
User access	Private, limited access	Public, access for all
Users	Employees	Public
Usage	Largely mandatory	Completely discretionary
Location and Place	Low relevance	Essential

Table 1: Contrasts between Information Systems and Urban Informatics Research

The implications of these differences are important when considering an appropriation of IS methodologies for Urban Informatics. A combined AR and DSR approach needs to consider these issues carefully, be able to cope well and clearly with them, and be adaptable where possible. To sum up, Soft DSR (Baskerville et al., 2007, 2009) or ADR (Sein et al., 2011) from the IS domain, would need to be adapted to the context of Urban Informatics, not simply adopted wholesale. Indeed, rather than adapting Soft DSR or ADR, it might be more fruitful to pick and choose different aspects of the AR

and DSR approaches described above to fit the unique requirements of research in Urban Informatics. We do so and propose a new method called Participatory Action Design Research (PADR) below.

Figure 9 below gives an overview of the PADR method we have developed, which combines variations of AR and DSR approaches to meet the needs of Urban Informatics. The reminder of the section will explain how this adaptation might be achieved, according to the usual context and stakeholders of an Urban Informatics project.
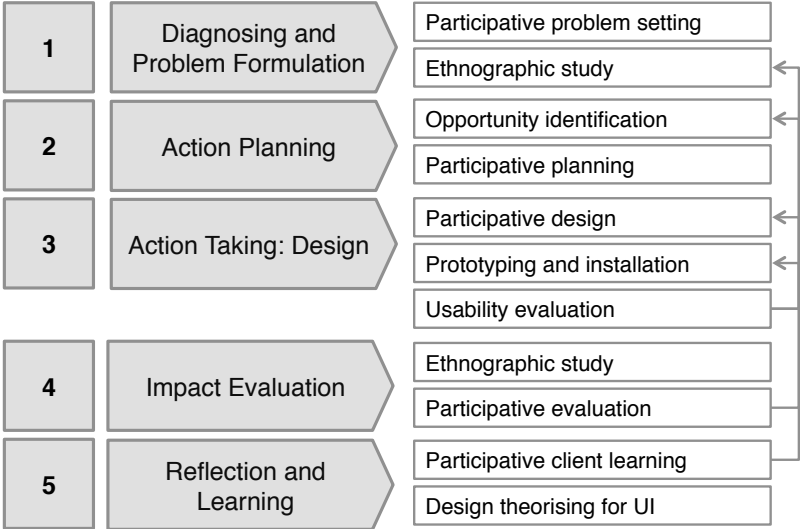
Figure 9: Participatory Action Design Research – a research method for Urban Informatics

As can be seen in Figure 9, PADR has five phases or activities: diagnosing, action planning, action taking design intervention(s), impact evaluation, and learning and creation of actionable knowledge for the client. These five phases/activities are explained below.

(1) Diagnosing and Problem Formulation: For problem diagnosis, approaches are needed to identify stakeholders, analyse problems and develop shared understandings and agreement about "the" problem(s) to be solved. However, the phenomena to be researched in an Urban Informatics setting are not objective, but rather are socially constructed. The problem needs to be understood as variously experienced by a diversity of members of the public. Hence, usually not only the ones who the research is for (i.e. clients), but also the ones who would be affected by and who would be users of the technologies to be developed (i.e. the wider urban community and members of the public) need to be embraced as stakeholders and research partners in the Urban Informatics context. They need to be given a voice and treated as research collaborators

rather than subjects when it comes to identifying issues in their everyday urban lives and finding solutions to these issues. Thus, an approach for participative problem setting (or problem formulation) is needed as shown for phase 1 in Figure 9. We therefore propose that suitable techniques be borrowed from other Action Research approaches (see earlier descriptions above) such as Participatory Design (Kensing, 2003; D. Schuler & Namioka, 1993), Community Based Research (Israel et al., 1998) or Community Based Participatory Research (Minkler & Wallerstein, 2003; Wallerstein & Duran, 2010), Network Action Research (Foth, 2006a) or Participatory Action Research (Argyris & Schön, 1989; Wadsworth, 1998) to better engage stakeholders as clients and co-researchers.

Where the problem domain is complex and not already well understood (which is generally the case in Urban Informatics), ethnographic methods (as shown for phase 1 in Figure 9 above) need to be used to gain a sufficiently rich understanding of the communicative ecologies in a particular site, and can be appropriated with Action Research goals. As described in the section of Action Research further above, colleagues from social as well as technology-oriented fields have recognised the need for a more integrated approach that bridges the gap between ethnography and action taking or design. As noted above, Tacchi et al. (2009) developed and tested a tailored AR variation, Ethnographic Action Research (EAR), combining Action Research principles with ethnographic inquiry. The primary goal of EAR is to gather a rich understanding of a social setting, in particular identify problem areas and their roots. The goal in the PADR context is to understand the underlying problems in their social setting, and thus also inform the design and requirements of technological solutions. This is the basic goal of what Taylor refers to as design-oriented ethnography (Taylor, 2009). Such approaches are largely (but not completely) ignored in the IS field, especially in DSR. Importantly, in Urban Informatics the context is one that rapidly changes, particularly as new technologies and social media applications are adopted and gain momentum on a monthly and sometimes even weekly basis. In their recent book Gordon and De Souza e Silva describe how "location and location-based media are evolving so rapidly that we are sure that between now and when this book is actually published, we will be looking at a different world" (Gordon & de Souza e Silva, 2011, p. ix). With the rapid developments and uptake of such technology, people constantly appropriate and change their everyday practices and patterns of sociability, interaction and communication. To accommodate this, one cannot simply use ethnographic methods wholesale as

traditionally used because they would take too long. Therefore, a shorter, simpler approach needs to be taken, e.g. as described in Tacchi et al (Tacchi et al., 2009; Tacchi et al., 2003), which typically take a month or less.

Furthermore, problem analysis and formulation techniques can be borrowed from Soft System Methodology (Checkland 1981, Checkland and Scholes 1990), Soft Design Science (Baskerville et al., 2009), or other problem solving methods. Techniques such as rich pictures from SSM, cognitive maps (Eden 1988, Eden and Ackerman 2001, Ackerman and Eden 2001), or a variation called coloured cognitive maps (Venable, 2005) may be more helpful in eliciting and sharing problem understandings. Definitions of utility and what is to be evaluated in the application of and intervention with the artefact arise out of the formulation and definition of the problem(s) to be solved. These approaches also provide techniques to facilitate and obtain agreement about the problem(s) to be solved.

Summing up, the Urban Informatics researcher together with the clients and other stakeholders needs to make use of ways to organise and facilitate participation, ethnographic means to investigate the diversity of needs from the variety of stakeholders in the community/public to be served (or just affected), as well as techniques for analysing, formulating, and socially constructing the problem(s) and obtaining agreement about it/them.

(2) Action Planning: As described further above, Urban Informatics often faces the situation where action requires a design intervention, e.g. creating a mobile phone application or ubicomp artefact. Design, development and evaluation of such artefacts usually follow the traditional DSR process (Hevner, et al., 2004; Iivari, 2007), i.e. problem identification/requirements analysis, design, implementation, and evaluation. As shown in Figure 9 phase 2, action planning for using DSR begins with opportunity identification (*cf.* 'suggestion' activity in Vaishnavi and Kuechler (2004) and the early part of 'theory building' in Venable (2006a, 2006b)), in which an idea for a suitable new technology to address the issues at hand is identified for development.

Another problem at this phase is how to translate the findings from diagnosing (phase 1) to design implications for the artefact to be developed. How can the findings be captured and communicated to all stakeholders as a basis to collaboratively work towards a shared solution? Design personas, a common tool in interaction design might be useful here, in particular to create "composite user archetypes" (cf. Cooper,

Reimann, & Cronin, 2007, p. 82) with the main motivations and needs of members from the wider community.

Further, since a fully participative approach is being taken, it is important that the participants are involved as co-planners (i.e. participative planning as shown in Figure 9) for the action taking, i.e. the design, development, testing, and implementation and evaluation of the new technology. This should lead to increased participation, better fit of the design to the diverse requirements, and more complete and realistic evaluation in the action taking and impact evaluation phases (phases 3 and 4).

(3) Action Taking: As essentially a DSR project at this point, this phase is concerned primarily with design and development of the technology, as well as preliminary testing (particularly including usability testing of prototypes of the designed system). As shown in Figure 9, this phase involves participative design, prototyping, and usability evaluation. Participative design has been discussed earlier in this paper and in the literature (Kensing, 2003; D. Schuler & Namioka, 1993). In terms of prototyping, ADR (Sein et al 2011) recommends the use of various prototypes – alpha and beta prototypes – in regular and "authentic" evaluation as part of the BIE (building, intervening, evaluating) activity (i.e. phases 3 and 4). How one can evaluate an artefact with a prototype in such an open environment, without unnecessarily disrupting people's lives and without a full implementation needs to be carefully considered. Here the recommendations in Baskerville et al (2011), who identify evaluation goals and how to achieve them using a combination of ex ante and ex post evaluations, may be helpful. How to keep the clients and end users actively involved in the cycles of this activity also will require care (which should also be considered during the Action Planning phase). Experience Prototyping (Buchenau & Suri, 2000) provides opportunities to gather an understanding of existing and future conditions through actively engaging end users with early prototypes and communicating ideas between designers, clients and end users at an early stage. At an absolute minimum, a usability evaluation is important before releasing a system to the public at large. Indeed, as shown in Figure 9, iterating back to the participative design and prototyping activities during Action Taking may be warranted, both due to usability issues or other issues discovered using other ex ante evaluation approaches.

(4) Impact evaluation: In respect to the overall goal in Urban Informatics, the first step (diagnosing) and last two steps (evaluation and learning) are pre-set by the AR framework. In step 1, researchers, clients and stakeholders collaboratively define an

issue or point of focus and any actions or design interventions taken are evaluated according to how they have contributed to the initial setting. As shown in figure 9, impact evaluation should also be conducted participatively, following a CBR, CBPR, or PAR approach. Furthermore, since the impacts may be subtle and varied across the different stakeholders and the use of the technology in its socio-technical context may create a whole new ecology, ethnographic methods may again be very useful and we suggest their use at this phase. Longer term evaluation may be useful, but again a quicker form of ethnographic study may be appropriate as in EAR. Furthermore, embedding design and usability evaluation methods from HCI will also provide valuable insights to the HCI community about new artefacts and interaction methods being used in real world, rather than in artificial laboratory settings (Ballagas, 2008; Brush, 2009; Hagen, Robertson, Kan, & Sadler, 2005).

Where the impact evaluation is found to be wanting, i.e. where the original design goals are not met or important new problems arise from the technological introduction, a decision may be made (by mutual agreement) to iterate back to an earlier phase of the research (as shown by the middle arrow in Figure 9) and to replan the research and then to redesign and re-implement the system to better meet those needs based on what shortcomings have become apparent. This decision will of course be impacted by many factors including resources and the interest of the participants.

(5) Reflection and Learning: At some point in the study, the development has ended (for the time being) and the evaluation has reached a conclusion of sorts (although longer term, longitudinal evaluation may be ongoing). At that point it is essential that all the participants take time to reflect on what has happened and determine what has been learned. This is in line with all forms of Action Research and PADR is no exception. Guiding the participant client(s) and stakeholder(s) through a careful and explicit process of reflection and learning will ensure that the learning is authentic and realistic. Collaborative reflection and learning will also enable client(s) and stakeholder(s) to carry that knowledge forward for the benefit of themselves and the rest of the involved community – in the ongoing adoption and use of the developed technology as well as for the next round of development, adoption, and/or use of future technologies by the community and its members. The feedback of client and stakeholder (and researcher for that matter) learning to the next round of development and adoption is shown by the outer arrow in Figure 9 above.

Furthermore, it is important that the learning be communicated to those not involved in the PADR research project. In the field of IS, DSR strongly suggests that the knowledge learned about the designed artefact and its utility in the context of the community and its situation be specified in the form of a Design Theory (Gregor & Jones, 2007; Venable, 2006b; Walls et al., 1992), in this case as a UIDT (Urban Informatics Design Theory) rather than an ISDT (Information Systems Design Theory)!

Conclusion

Early in this paper we posed the following research question.

What would be the characteristics and structure of a good method for conducting Urban Informatics research?

In answer to this question, we have developed and proposed a new research method for Urban Informatics – Participatory Action Design Research (PADR). PADR supports Urban Informatics research to develop new technological means to resolve contemporary issues or support and improve everyday life in urban environments, e.g. using mobile and ubiquitous computing.

We described Urban Informatics as a research field that studies the convergence of the physical and the digital towards hybrid space infrastructures, emerging technologies and their impact on this hybrid space in the context of urban public places. We drew requirements for a methodological framework that meets the cross-disciplinary needs of the Urban Informatics research landscape, in particular studying socio-cultural urban life and context as well as opportunities to develop new technologies to improve them. Such research has to recognise the urban hybrid space as an ecology of people, place and technology, rather than viewing them as separate entities in their disciplinary research silos. We highlighted methodological challenges in combining these domains, in particular in respect to bridging the gaps between ethnography (understanding the community-based socio-technical problem space), participative involvement and empowerment of the community of concern, action taking (solving the problem) and design-orientation (creating innovative design artefacts).

We identified IS as a research discipline that is situated in a similar dichotomy between design-oriented thinking and investigation of relevant social aspects, which hence faces somewhat similar methodological challenges to Urban Informatics. We broadly discussed literature and recent developments in IS methodology aimed at tackling these challenges, in particular the convergence of Action Research and Design Science

Research (Baskerville et al., 2007; R Cole et al., 2005; Figueiredo & Cunha, 2006; Iivari & Venable, 2009; Jarvinen, 2007). We further discussed various forms of Action Research that draw in participative and ethnographic approaches. However, drawing on differences between IS and Urban Informatics research disciplines we highlighted the need for AR and DSR approaches to be adapted rather than adopted for Urban Informatics and suggested various aspects to be considered.

In particular, we suggested drawing techniques from different variations of AR, such as EAR, PAR or Network AR, and including principles of PD or CBPR according to the particular setting of the research project. Design-oriented ethnography and design personas might serve as tools to bridge the gulf between outcomes from social, cultural and urban studies and implications for design of new technology. As artefacts are not only technologically, but more so socially constructed, they have to evolve, grow and be shaped by and within the organisational context (Iivari, 2003b), rather than introduced overnight.

With these suggestions for adapting AR, its variants, and DSR, we propose an outline of a new method – Participatory Action Design Research (PADR) – to suit the needs of Urban Informatics and its usual research context and stakeholders. We believe that PADR has the potential to bring the design of ubicomp in the urban context closer to what has been earlier discussed as 'social construction' (Bijker et al., 1987) or an 'ensemble view of technology' (Orlikowski & Iacono, 2001, p.26). In doing so it will also enable closer collaboration between academic researchers and the communities that they serve and benefit.

While we have carefully reasoned about the requirements and design of PADR, thus far, the new methodology has not been tried out in practice. A next stage in its development would be to do so.

Chapter 6:

Libraries as Coworking Spaces: Understanding User Motivations and Perceived Barriers to Social Learning

Bilandzic, M., & Foth, M. (2013). Libraries as Coworking Spaces: Understanding User Motivations and Perceived Barriers to Social Learning. Library Hi Tech, 31(2).

Statement of Contribution

This paper has been co-authored with my principal supervisor Assoc. Prof. Marcus Foth. I am grateful for Marcus' help in setting up the connection and research collaboration with The Edge, which became a pathway for the study reported in this paper, as well as four other papers that form part of this PhD thesis. Marcus contributed with editorial comments and revisions, which helped my flow of thoughts and improve earlier drafts of the paper.

Preamble

The paper is published in Library Hi Tech, a journal that is concerned with the potentials and implications of computing and new technologies in the context of libraries. The paper presents initial findings from my fieldwork at The Edge, in particular towards shedding light on user motivations, attitudes and behaviour. I present five Design Personas that embody the challenges and barriers experienced by different users in relation to connected learning, and suggest four design strategies for future technology to address those challenges. The Persona descriptions were subject to

several revisions over a period of two years in order to embrace iterative findings from my ongoing Participatory Action Design Research activities at The Edge. The findings presented in this paper formed a basis and guided my further research, thinking and design interventions at The Edge.

In the first three sections, the paper re-introduces some themes that the reader might already be familiar with from reading Chapter 1, in particular, in relation to the motivation, research questions and contextualisation of The Edge in library literature. At the time of writing and publishing this paper, I used the term *social learning* to refer to the core construct of this study – a term that has broadly evolved and been re-defined several times over the past few decades (see *Chapter 1 – Research Context and Definitions*). In parallel to this study, Ito et al. (2013) have worked on, and recently published a design and research agenda which they labelled *connected learning*. *Connected learning* as a term and concept better describes the subject matter, but was not accessible to me at the time of writing this paper.

Abstract

This paper aims to inform design strategies for smart space technology to enhance libraries as environments for coworking and informal social learning. The focus is on understanding user motivations, behaviour, and activities in the library when there is no programmed agenda. The study analyses gathered data over five months of ethnographic research at 'The Edge' – a 'bookless' library space at the State Library of Queensland in Brisbane, Australia, that is explicitly dedicated to coworking, social learning, peer collaboration, and creativity around digital culture and technology. The results present five personas that embody people's main usage patterns as well as motivations, attitudes, and perceived barriers to social learning. It appears that most users work individually or within pre-organised groups, but usually do not make new connections with co-present, unacquainted users. Based on the personas, four hybrid design dimensions are suggested to improve the library as a social interface for shared learning encounters across physical and digital spaces. The findings in this paper offer actionable knowledge for managers, decision makers, and designers of technology-enhanced library spaces and similar collaboration and coworking spaces.

Introduction

Literacy in the 21st century requires a different set of knowledge and skills compared to literacy in the previous century. In today's knowledge economy, core skills include creativity, interdisciplinary thinking, problem solving, and the ability to collaborate with others – skills that cannot be learned easily from books, but rather through learning-by-doing and social interaction. Libraries, as facilitators of education and learning, have been challenged to reshape their approaches to meeting these changing needs. Scholars have outlined the significance of libraries as places that accommodate social activity (Gaus & Weech, 2008; Leckie & Hopkins, 2002; Pomerantz & Marchionini, 2007; Shill & Tonner, 2004; B. Sinclair, 2007; Weise, 2004), community gatherings and meetings (Aabo & Audunson, 2012; Aabo et al., 2010; Audunson, 2005; Audunson et al., 2011), and social learning and collaboration (B. Sinclair, 2007). In practice, we see more and more libraries removing bookshelves to make way for infrastructure and interior design elements that invite such activities (LaPointe, 2006; Martin & Kenney, 2004; McDonald, 2006; Shill & Tonner, 2003), such as lounge areas, couches, meeting rooms, whiteboards, projectors, video consoles, and cafés and food bars.

However, libraries mostly do not cater for a social or collaborative learning experience per se. Rather, their curation efforts focus on the aforementioned spatial and infrastructural elements that visitors might or might not end up utilising as part of a collaborative learning journey; e.g. student study groups in a library.

The focus of this paper is on the library as a place when there is no agenda or programmed activities (e.g. workshops, presentations, exhibition events). In particular, it aims to shed light on the following two sets of questions: (1) *How do library users make use of collaborative library spaces? How do they experience social learning as a result of working in the library? What are the perceived challenges for social learning?* (2) *What are adequate design strategies for smart space technology innovation, such as ubiquitous computing and ambient media, to overcome the identified challenges and facilitate social learning among library users?*

This paper presents results from a case study at The Edge, an innovative 'Digital Culture Centre' and prototype concept by the State Library of Queensland (SLQ). As a 'bookless' library space, the vision of The Edge is to provide a coworking space where social learning emerges as a result of people sharing the same workspace for their creative activities. It is conceived as a public community centre for peer collaboration and creativity around digital culture and technology, i.e. a place for people to meet,

explore, experience, learn and teach, and share and discuss topics around creative practices in various areas related to digital technology.

The Edge provides technical infrastructure, multimedia equipment, and collaboration spaces. Most prominently, however, it envisions a community of users to help, learn, teach, and collaborate with each other. The Edge's management describes this as

> "…curation with a small 'c' rather than a capital 'C.' It is that mix of hard programming where we have four or five key areas where we want to program in, whether it is robotics, or music or whatever it might be, but that we also allow ourselves enough time and space not to be too prescriptive about the curation… and to actually let people come together and do that curation themselves as well."

Launched in February 2010 as the Queensland Government's flagship Digital Culture Centre, The Edge is the first library initiative of its kind in Australia. With its focus on social learning and collaboration, it serves as a cutting-edge case study to investigate the current status as well as explore future opportunities of social learning among visitors in libraries and other informal learning environments.

Relevant Work

Social learning is a result of interaction and shared encounters with other people. This section discusses previous studies on shared encounters and meetings between library users outside of programmed library agendas and events.

Libraries as Meeting Places

Aabo et al. (2010) identify local libraries as places that host six different types of meetings and social encounters between people, three of which include joint activities with friends and family, serendipitous encounters with neighbours and other acquaintances, or encounters with local community information. Aabo and Audunson (2012) find that such meetings vary significantly in their degree of interaction and instrumentality. Thereby, the meetings they list as examples of a high degree of interaction are among users who already knew each other before they came to the library, e.g. a group of friends chatting over a cup of coffee or students collaborating on an assignment (p.148). On the other hand, interactions between strangers and "users with different cultural backgrounds were in most cases indirect and nonverbal" (2012,

p.146). Based on these observations, Aabo and Audunson suggest that meetings and interactions in the public library primarily contribute to bonding social capital (strengthening the links between already integrated groups), rather than bridging social capital (creating new links between unacquainted others) (cf. Putnam, 2001). Bridging social capital was rarely observed, and if so, only during library-initiated and organised events.

They further claim that the library stands out as a typical public place in the public realm where the majority of other users are regarded as strangers, and where people mostly work within their "individual bubbles" (2012, p.143), many even weaving "an individual net around themselves that does not invite communication with others" (2012, p.143). In accordance, McKechnie et al. (2004) find users marking their work space with coats, bags, notebooks, and other possessions (p. 44). It appears that library users perform their individual activities next to each other, rather than with each other, which Aabo and Audunson (2012) compare to the social setting typically found in fitness studios. On the other hand, McKechnie et al. (2004) report observations of social interactions between strangers. The examples listed indicate that these conversations were triggered by obvious common interests between people (e.g., a particular book, or mothers with children), when users requested help from other users (e.g., how to use a computer) or random informal conversations (e.g., when queuing for a coffee) (McKechnie et al., 2004).

Low-intensive and high-intensive meetings

Aabo et al. (Aabo & Audunson, 2012; Aabo et al., 2010) point out a subtle yet crucial quality of the library as perceived by its users: even though people mainly engage in individual work or isolated meetings with acquainted others, the library as a place exposes them to a diversity of people, activities, and information that they would not encounter if they worked at home or from a regular office space. This quality of the library comes to the fore, for example, when users take a break and stroll around serendipitously browsing through brochures, community information, and other materials, or see other individuals and groups working on projects that are different from their own. The library provides rich opportunities for people to explore and randomly stumble upon new information across physical (book, magazine, newspaper), digital (website, online archive), or social (librarian) interfaces (Björneborn, 2008, 2010).

From this point of view, the goals of this paper are specifically concerned with social interfaces.

Andunson (2005) has coined the term *low-intensive meeting place*, to describe and promote the library as a physical place where highly heterogeneous individuals and groups of people are exposed to each other. Low-intensive meetings describe social situations where a person is exposed to diversity and otherness, e.g., social and cultural beliefs, values, or interests that are different from their own. In contrast, Audunson defines *high-intensive meeting places* as places where people live out and interact around their primary interests, e.g., in the context of a particular subculture, interest, or hobby.

Whether a meeting is low-intensive or high-intensive is subjective and depends on each participant's background and core interest in life. For a professional photographer participating in a photography club to discuss photography techniques and processes, that meeting is a high-intensive meeting, as photography is part of their core interests in life. For a friend of that photographer who joins serendipitously out of curiosity to learn what photography is all about, that same meeting is a low-intensive meeting, as they are exposed to a topic and subculture that may be quite different from their other core interests in life.

Aabo et al. (2012, p.146) find that libraries function as "arenas" for high-intensive as well as low-intensive meetings. For example, one of their interviewees would choose to work from the public library rather than the university library due to the rewarding experience of being exposed to a wider age range of people (children, youths, adults, pensioners) and their activities (playing game consoles, reading newspapers, surfing the net, etc.). He appreciates the public library's quality as a place for low-intensive meetings, i.e. where he is exposed to diversity and 'otherness.'

In the context of the knowledge economy in the 21st century, the library's function as a place for discourse, peer collaboration, social learning, and particularly inspiration through and learning from people that are different to ourselves, is more important than ever before. Despite libraries investing a lot of resources in widely open physical architecture and interior design that lowers the barriers for making new connections and being inspired by others, previous research indicates that there is still untapped potential for such low-intensive meetings (Aabo & Audunson, 2012; Aabo et al., 2010). The case study, as described in the following sections, aims to shed light on people's attitudes, motivations, and perceived challenges of low-intensive meetings, and how smart space technology innovations can address those.

Case Study at The Edge: A Space Designed with Social Learning and Collaboration in Mind

The space at The Edge has been architecturally constructed in an open and accessible manner. As the executive manager explained, "*the physical architecture of the space is designed with collaboration and open sharing in mind.*" While it has several distinct spaces, there is little separation between them (Figure 10). The entrance, foyer, and 11 collaborative lounge spaces ('window bays') are essentially one big open environment. The lounges can, if needed, only be divided by semi-transparent curtains, and the computer, audio recording, and physical computing lab (labs 1-3) are separated by transparent glass walls rather than concrete or bricks. The intention of this setup is to facilitate serendipitous discoveries and inspiration among people who work side-by-side.
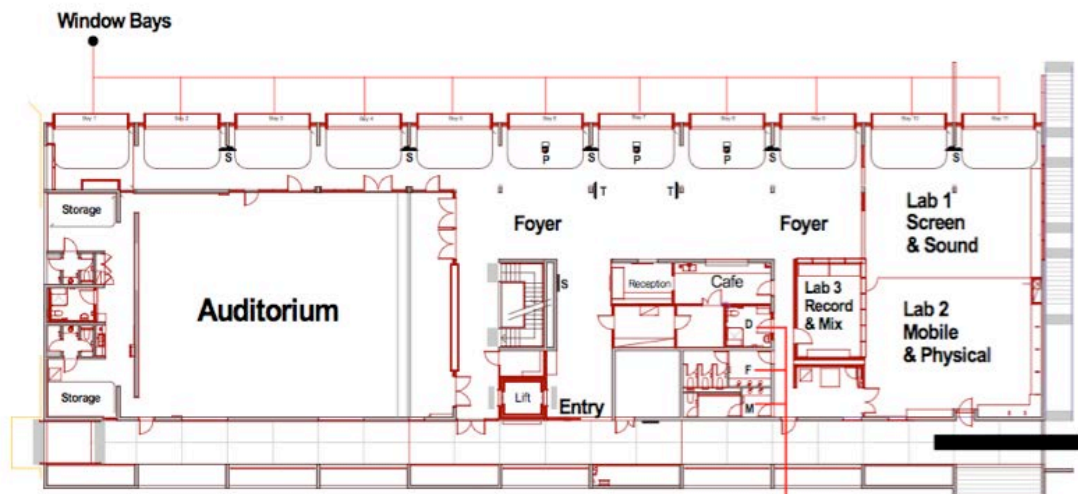
Figure 10: Floorplan of The Edge: Multiple work lounges (window bays) and labs provide space for collaborative work activities and meetings.
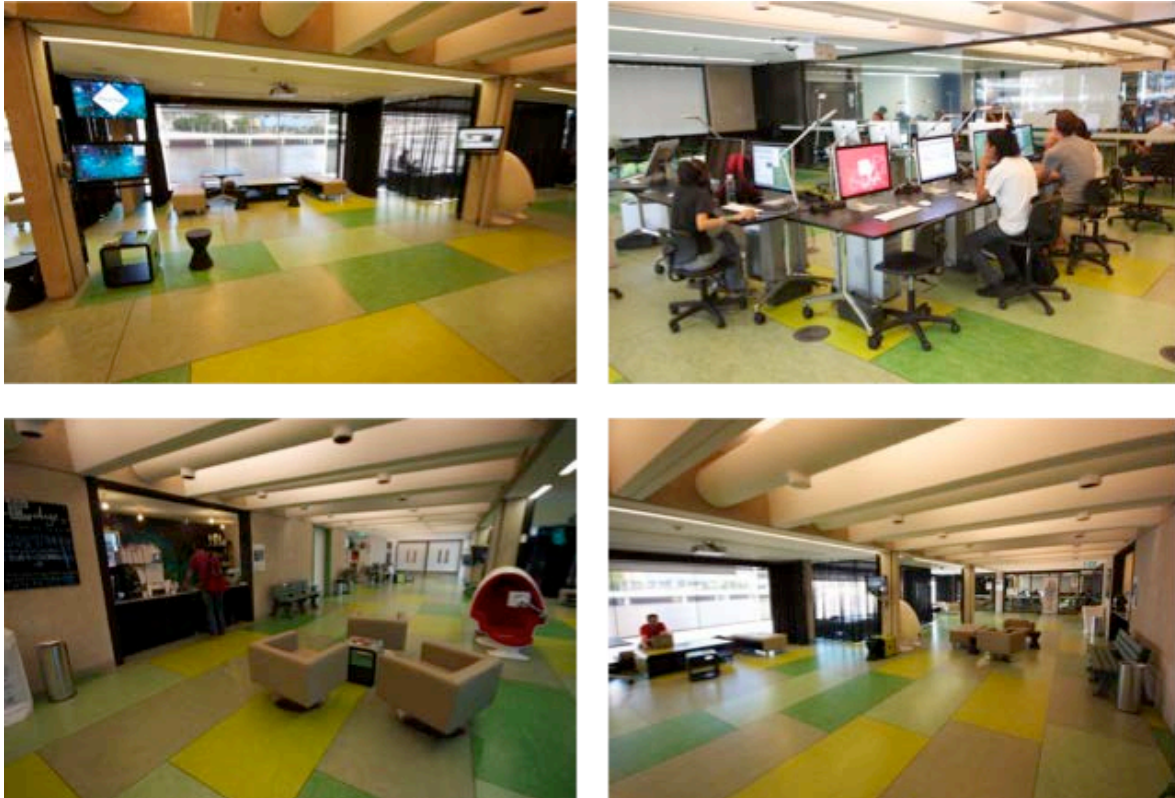
Figure 11: The open architecture and interior design at The Edge has few physical barriers for line-of sight. It was built with peer collaboration, open sharing, and serendipitous discoveries in mind.

In addition to its open architecture (Figure 11), the idea of The Edge being a place for collaboration is actively promoted on The Edge website, its brochures, and a welcome sign at the entrance: "*We encourage The Edge's facilities to be used in ways that are constructive towards the development of creative projects, digital education and peer collaboration.*"
The Edge's programming provides a range of workshops, presentations, exhibitions, and other events on specific topics, but most of the time it functions as an unscheduled space for coworking with no imposed agenda.

Methodology

In an attempt to gather a holistic understanding of the social space at The Edge, we used Lefebvre's triad of social space (1991) as a conceptual framework to drive the investigations. Lefebvre provides a trialectic lens (Soja, 1996) for spatial thinking, i.e. from a (1) conceived, (2) perceived, and (3) lived point of view. In the context of this study, we regard the conceived space of The Edge as the vision and long-term goals set by the Queensland Government and SLQ as the funders and initiators of The Edge.

The perceived space represents the infrastructure, services, and facilities that The Edge as an institution provides to fulfill its purpose and mission, and how those are perceived by its visitors. The lived space represents how individual visitors live, practice, and use The Edge as a social space on an everyday basis, as well as the underlying motivations for their visits.

Following Lefebvre's trialectic view, we studied different stakeholders of The Edge. To gain an understanding of The Edge's conceived vision and mission, we interviewed the director and three executive managers of The Edge's organisational parent department at SLQ, The Edge's executive manager, as well as three high-level management staff members. We also interviewed seven of the ten Visitor Service Operators (VSO), i.e. operating staff members who are in close daily contact with Edge users. VSOs are also in charge of operating a small coffee and snack kiosk in the foyer of The Edge and, at the same time, function as the main point of contact for users who need to ask for technical assistance, book a computer or work space, or have general questions. Furthermore, we engaged in five months of ethnographic visitor observations with more than 70 informal conversations and 30 in-depth interviews with selected visitors during their informal everyday visits and activities at The Edge. The observations were made at different times and days of the week. Visitors were selected for interviews according to their spatial distribution, activities, distinct behavioural patterns, and personal objects of use such as books, work material, headphones, smartphones, or laptop computers.

All interviewees were offered a free coffee voucher as compensation for their time. The interviews were based on a semi-structured interview guide and audio-recorded for later transcription purposes. Field notes were taken during the visitor observations. For the analysis of the data collection, we borrowed a grounded theory approach (Strauss & Corbin, 1997). We looked for emerging patterns, particularly in regards to people's motivation for coming to The Edge, what activities they engaged in, and their attitudes towards other co-present users at The Edge.

Findings: Some User Archetypes of Library Spaces

By way of solidifying our findings towards informing future action and design interventions, we have developed five design personas – archetypal users as they emerged from the ethnographic observations and interviews during our fieldwork. Design personas are a common tool in interaction design to "identify significant and

meaningful patterns in user behaviour and turning these into archetypes that represent a broad cross-section of users" (Cooper et al., 2007, p. 76). Rather than focusing on different demographics or market segments, personas aim to reflect the various motivations, attitudes, needs, activities, and behavioural patterns of visitors when they use The Edge. The personas do not illustrate real individuals, but rather a "composite user archetype" (cf. Cooper, et al., 2007, p. 82); i.e. a group or subset of visitors with distinct (sometimes extreme) motivational and behavioural patterns. As such, the five personas represent the core distinct motivations, attitudes, behavioural patterns, and perceived challenges in relation to social learning in the case study (Figure 12). Based on these personas, we later suggest design strategies for smart space technology innovations to overcome the perceived challenges of each persona and enhance social learning and collaboration in public library spaces in general. The personas are also intended as an invitation and tool for other designers to help brainstorming, conceptualising. and designing for smart space technologies in library settings.
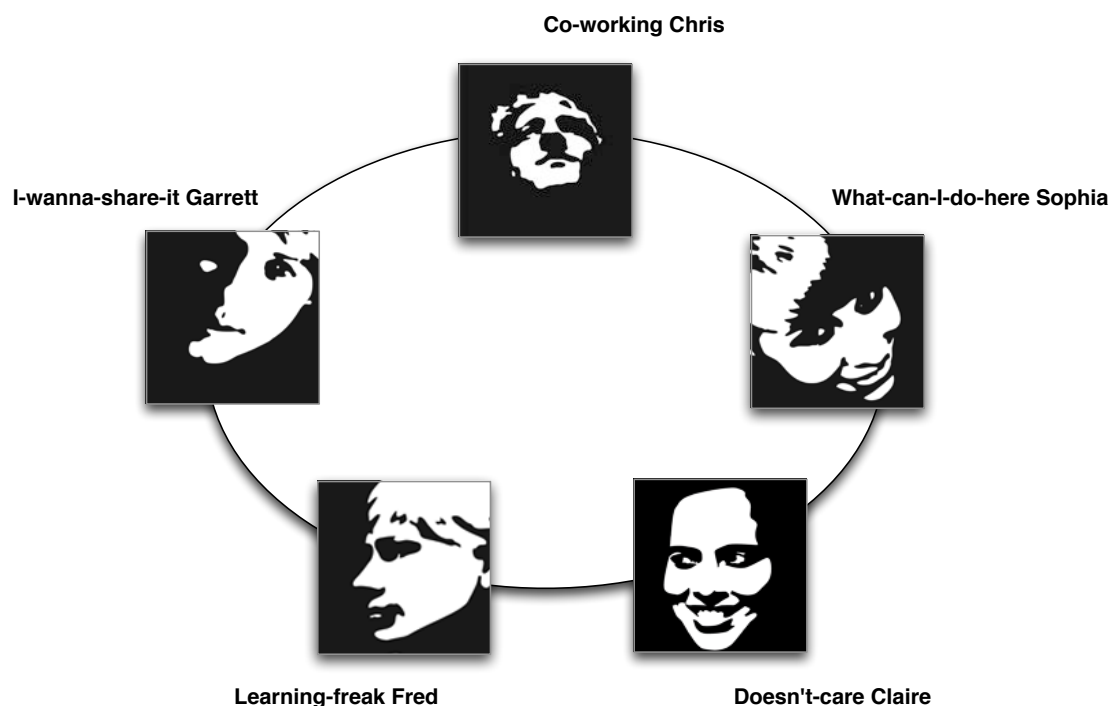
Figure 12: Based on ethnographic observations and user interviews, we have developed five Personas that represent the core motivations, attitudes, and behavioural patterns of visitors at The Edge

Doesn't-care Claire

Claire uses the Edge as a free access point to computers, the Internet, multimedia equipment, hardware, and software that would otherwise be too expensive to buy (e.g.,

music studio, computer lab, Adobe Photoshop, etc.). She is not particularly interested in The Edge as a collaboration space (e.g., for meeting, chatting or getting inspired by other users), but rather, comes to The Edge with tunnel vision to use or access a particular resource. Such users we talked to included high-school and university students, unemployed people, pensioners, backpackers, and homeless people.

> "Over 70% of that [computer] lab is used by people like guys over 27, definitely over 27. Surfing the net, like YouTube and Facebook. 70% of that lab, and that's every single day."
>
> "They don't work on creative projects… they're travellers or they are just like people who have passed by. Maybe they are writing or something as well... but talking to people, the majority are here to use the WiFi, just to get connected... not really for anything else."
>
> (Visitor Service Officers at The Edge)

One of our interviewees, a pensioner in his late 70s, effectively illustrated the ignorance towards the social and collaborative vision of the space. He visits The Edge on a daily basis to read news and e-books in the computer lab, and would regularly complain to staff about students being too loud, who were in fact collaborating on a project for university. To him The Edge is a library, and in his view of a library everyone is supposed to be quiet.

We often met backpackers and homeless people sitting on the concrete ground outside the actual building, utilising the free Wifi and working on their laptops. We sat next to some of these people while working on our own laptops and attempted to engage them in informal chats. Mostly they were just after WiFi access, and had no interest in coming into the building or even using the more comfortable couch and lounge areas. We sensed that many did not know that The Edge is actually part of the library, but perceived it as some sort of Internet café where they are expected to buy a coffee or snack in compensation for using their space and internet access.

What-can-I-do-here Sophia

Sophia is unfamiliar with what The Edge is or what it has to offer. She has heard or read about the Edge, or stumbled in as a serendipitous passer-by. Seeing the space for the first time, she is a bit confused. "*What is this place, and what can I do here?*" are usually the first questions she asks after entering the building. In contrast to the other institutions at the Cultural Precinct such as the Queensland Museum, the State Library, the

Queensland Art Gallery or the Gallery of Modern Art, The Edge has few elements that catch a first-time visitor's attention. Sophia usually looks around for a bit, sees people working on laptops and computers, struggles to find any engaging activities, and eventually leaves again. Two VSOs describe their experience with 'Sophia' visitors as the following:

> "What is this place, what can I do here? That's definitely one of the most frequent questions we get from visitors… and it's kinda hard to explain in one-sentence really what we do here at the Edge."
>
> "When they walk in [for the first time], everyone is really always confused. They're just looking around, but they don't really know what the space actually does."
>
> "…just like two girls just before, they go oh we're just sneaking around. And I go, no don't sneak around, I will tell you about the place. So there is this sneaky element here. I reckon 50% of the time that's how people find out about the place, sort of wander in and then they explore […] and then they walk out again unless you stop them."
>
> (Visitor Service Officers at The Edge)

In terms of social learning, the barrier for Sophia is that she does not recognise the purpose and function of the space. As a 'bookless' library, the space lacks means and perceived opportunities for engagement.

Therefore, what can libraries do to increase awareness and opportunities for social learning?

Learning-Freak Fred

Fred likes the idea of The Edge as a centre for creative individuals to hang out, meet, and collaborate on projects related to digital culture and technology. As someone who is keen to be inspired and learn new things constantly, he knows that interaction and collaboration with like-minded others is crucial to his creativity. A singer and sound artist, for example, who is a weekly visitor at The Edge, stated that as an artist

> "it's about meeting other people, and supporting them and they support you […] I mean you have to work on it by yourself. You can try to do it in a vacuum, but it's much easier doing it with other people around."

However, people like Fred find it extremely difficult to identify peers that have complementary skills or interests to his. As a VSO reports,

> "I remember when we first opened, this guy came in… he is like... oh I am here for the networking. And we were all like... ahh okay yeeeah [laughing], well just hang around mate, and talk to the next person that walks through the front door."

There are two main issues as perceived by users like Fred. The first issue is that there is no sense or transparency about other people's backgrounds, interests, or potential topics to learn about or collaborate on. There is a lack of opportunity to identify and access skills and social capital within the user community.

> "I think that's probably one of the criticisms that I have of [The Edge], although there are these interesting people who are there, you don't necessarily know that they are there because you don't know what resources are available to you."
>
> "For me it's about communicating with other people in the industry or other industries. I mean that was one of the things I really wanted to get out of the Edge. In the fact that I could say, I wanna talk to an electrical engineer to proof this. And I didn't see that that was available to me through the Edge. Even if it possibly was, I didn't find those facilities through it."

The second issue is that other users in the space appear as strangers, rather than potential collaboration partners. When asked about their actual relationships and interactions with other users, people generally state that they perceive a social barrier to approaching other users. Social interaction with unacquainted others does not come naturally.

> "I think it's human nature. People are strangers, you don't really interact with them."
>
> "I don't want to disturb others, they are already doing stuff…"
>
> "I don't talk to anyone, no one talks to me […] I don't know, I am shy (laughing). …usually people are not by themselves. For example, they are in group or they are with their friends, but I am alone, so..."
>
> "… you can't drill anyone's privacy, they actually do stuff"

Fred sees the potential of places such as The Edge, but does not see much benefit in visiting unless he is likely to meet someone interesting and learn something new. Learning and expanding his skills and knowledge is crucial to his visiting experience. As a result, he only visits the space for programmed workshops, presentations, and other events.

In order to satisfy their social learning needs, users like Fred visit other places. One user reports that he regularly attends eleven different meet-up groups to learn new things relevant to his interests in different personal and professional domains (including game design, user experience design, anthropology, psychology, life drawing, and web development). For example, the

> "…Brisbane Game Development group showcases a lot of what the local game artists are doing. So you get to learn the new emerging technologies in the local group. […] I have seen a lot of technology that I would not know about if I didn't go to that group."

He finds it difficult or nearly impossible to find one particular place, institution, or social group that satisfies his desire to improve his skills and knowledge in all these areas, so he attends various special interest meet-up groups, each of which focus on a particular interest domain of his. In some of these groups he feels like an "alien," but this exposure to diversity and people who think differently is what he appreciates and feels that he learns from.

> "I can't say that I always feel totally comfortable when I'm with artists. It is hard to go to that group and sometimes because I feel a little bit like an alien. Because I don't think exactly the same as they do. And sometimes being around programmers, I feel a bit like an alien as well. Because they are programmers, and they think differently. […] but at the same time I do get a lot from them, like I learn a lot. I learn a different way of thinking. and I guess I like to maintain that. […] I think I would say that I have learned what I don't know and have been able to go about reading about things that I could improve on."

This is an example of incidental learning through low-incentive meetings – learning that happens as a by-product of socialising and interacting with people from other backgrounds who have different core interests in life, and being exposed to their subcultures (in this case, game development).

Another Edge user reports his positive experiences from being a member at the local Hackerspace: "Sometimes you read something and it doesn't 'make click'. But when someone manages to phrase it in a way that works for you, it suddenly makes sense. And that's one of the things that Google can't do. You need to get someone you know... a good communicator who knows what you're trying to learn you know and where you're struggling. And who also knows the topic really well, so they can then phrase it in

such a way that it makes sense for you… like aaaaah that part is missing… and I find that quite to be the case at the Hackerspace."

Hackerspace's function as a high-intensive meeting place stands out in this example. The user values having the opportunity to ask like-minded, more knowledgeable people specific questions to fill personal knowledge gaps.

When asked about places where they have rich social learning experiences through low-intensive or high-intensive meetings, users like Fred usually name environments outside the library (Hackerspace, meet-up groups, community/sports clubs, etc.).

Therefore, what can libraries do to become similar forums for social learning activities?

I-wanna-share-it Garrett

Garrett is what some people would call a 'geek'. He is exceptionally knowledgeable in particular domains and is driven by enthusiasm, curiosity, and ideals rather than money or materialistic value. He engages in topics for the sake of knowing, understanding, creating, or finding out. In a continuous attempt to grow and expand interest in his subcultural domain, he likes to 'infect' other people with his knowledge, ideas, and enthusiasm. He is intrinsically motivated to share and pass on his skills, experiences, and know-how.

Most of the users that fit into Garrett's profile were found during a dozen workshops and events that we attended as part of The Edge's events program such as "Robowars," "Making Things Sense with Arduino," "Video Editing," or "Library Hack." Robowars, for example, was organised as a two day Australian national robotics competition at The Edge, where robotics amateurs come together with their self-assembled and programmed combat robots to let them fight each other. As part of the Robowars weekend, two members of the Queensland Robotics Sports Club (QRSC) volunteered to run a workshop for kids and lay users on building a combat robot using a miniature starter kit (Figure 13).

> "The workshop has given me an opportunity to express myself and participate in the broader community… and at the same time follow my own interests in electronics and being a parent and seeing people enjoy things. So that's what motivates me […] It's all about getting young kids interested… the toolkit robots are not anything complex, they are very, very simple. But it's sort of sparkling that interest which leads them on to something bigger and gets them in there… That was a very positive experience, that's rewarding and satisfying.

It has been a lot of fun. Yeah, people just jump in there and have a great time. That's good, isn't it?"

Figure 13: Robotics workshop. Knowledgeable robotics enthusiasts teach kids and lay users how to build combat robots using Do-It-Yourself Technology

Such workshops are highly successful, but at the same time almost exclusively observed examples of social learning. People like Garrett do not tend to use the space on an informal basis outside of such events, but rather gather in their private or community-owned places that provide the special tools and infrastructure they need for their hobbies:

"There is no real reason for me to be in there. It's a nice space, but there is no real advantage of facilities there that I need […] If they had equipment sort of like a 3D printer or laser-cutter, that would fit in really well with what we did […] When you build little robots, you don't get the tools and parts off the shelf, so you need to design your own in CAD and print it out in a 3D printer. Those are the sort of tools which most people can't just go out there and buy. […] Without this, I guess there is no real reason for us to ever go there and try to do these things, because we have our own space and there is sort of more of a hassle to go try and do anything there."

Therefore, what can libraries do to attract people like Garrett, hence increasing the amount of expertise, skills, and social capital in the user community?

Coworking Chris

Chris uses The Edge as a third place (Oldenburg, 2001); a public place that is away from the distractions and procrastination traps at home as well as the pressures at work. Chris brings his own laptop and work material, and is busy with the agenda dictated by his work. Actually, The Edge is not an optimal work place for him: he usually starts work early in the morning before The Edge opens; the bandwidth of the library's Internet connection is far below the standards he needs for work; the desks are too low for laptop work, and the social background noise sometimes gets distracting when he has a client on the phone. However, he enjoys the environmentally pleasing setup at The Edge and the social 'buzz,' e.g., the serendipitous conversations with other people while queuing for a coffee and snack at the kiosk. As one user reports:

> "I work from home and do consultant type of work. But working from home you don't get the social experience. You don't get that office experience, sitting at the water cooler and chatting about the cricket game last weekend […] we are social animals so… that's why even tech people are social and need that social interaction."

However, such social encounters (between users that have actually not known each other before) are limited to (a few) particular occasions. Our interviewees reported five different ways they met or became involved in social encounters with other (unacquainted) users at The Edge:

(1) Encounters between regular users:

> "with regular users, if there is somebody you see often eventually you get to start to talk I guess […] depends how many times I have seen them"
> "…with regulars, I see them all the time. We have conversations, but superficial…"

(2) Encounters between participants in an organised workshop: the mutual understanding of why everyone attends a workshop or event provides a motivation as well as ice-breaker for conversations.

> "…during lectures you know, it's a great way to meet people who are into your interests. So you have common bond with them. And it's easier to conversate

about that bond. It's easy to come across a conversation about something that you're into, because they're into it as well, because you're in the same course."

(3) Encounters in shared 'zones' – spaces that provide people a reason to remain in each others' immediate physical proximity even if they are strangers. Our interviewees reported random conversations with strangers, for example, while waiting for the library to open in the mornings, waiting in a line to buy a coffee. or smoking outside at the library entrance. Users who happen to share the same window bay sometimes engage in serendipitous conversations. Such zones, similar to a bus stop, encourage conversations that mostly do not occur. On the other hand, music studio users at The Edge quite often engage in transition with other users who have booked the studio in a timeslot immediately before or after theirs. The mutual interest and use of the music studio sparks conversations about their work and projects. Similarly, in the computer lab (which has a dozen computer workstations placed right next to each other), people sometimes initiate conversations with others who work on similar projects (video editing, photo editing, graphic design, etc.) or use the same program.

> "Someone's gotta be sitting very close to me to engage in a conversation with them. You know, I've gotta sort of take a peak at their screen (laughing) see what they're doing. That's how I came across Guan, and it was like oh you're doing 'Logic' – so am I! […] Guan, he is a sound producer. I was sitting next to him in the Mac Lab […] I am still friends with him, I even got his contact number."

(4) Encounters for the sake of helping someone: short conversations would occur between strangers when someone obviously needs help. Users, for example, were observed helping one another to find the paper cups at the water cooler or connect their laptop the WiFi network in the case of technical issues.

(5) Encounters for the sake of personal benefit: active approaches to strangers were made when a particular personal benefit was perceived. One interviewee reported, *"when I first came here, I would often talk to the German tourists and trying to keep up my German."* Similarly, a travelling backpacker from Italy and first time user at The Edge reported that he tries to make an active effort to talk to native English speakers. He would, for example, *"go inside a shop and ask an assistant for the price of something, even though I don't want to buy anything."*

These examples show that social interaction between unacquainted people does not occur naturally, but can be facilitated through particular social and spatial circumstances. What can libraries do to provide conversation ice-breakers for users like Coworking Chris?

Discussion

The personas show that the people in our case study of The Edge mainly use the space in three different ways: (1) to access computers, the Internet, multimedia equipment, hardware and software for free that would otherwise be too expensive to buy (Doesn't-care Claire); (2) as a third place for coworking among individuals and groups (Coworking Chris), and (3) as an informal learning environment, i.e. to attend workshops, presentations, exhibitions, and similar events (Learning-freak Fred, I-wanna-share-it Garrett).

Similar to previous observations in libraries (Aabo & Audunson, 2012; McKechnie et al., 2004), The Edge functions primarily as a high-intensive meeting place but is limited in terms of providing low-intensive meeting experiences for users. Users mostly work individually or collaborate within pre-organised groups (Doesn't-care Claire, Coworking Chris) but usually do not make new connections, interact with, or get inspired by other co-present users. The open and accessible architecture does facilitate occasional serendipitous encounters between people, in particular at shared 'zones' such as the computer lab or coffee kiosk, or during officially organised workshops. Libraries could facilitate social learning by setting up or announcing more specific and explicit zones, e.g. a particular room at a particular timeslot for people to meet around a particular interest or profession.

In order to provide rich low-intensive meeting opportunities, the library needs to attract a variety of people engaging in different high-intensive activities. The more people use a library for their high-intensive meetings, the more pluralism, diversity, and exposure to otherness the library provides as a space.

Users like Garret with their expert skills, knowledge, and particular interests could be a source of inspiration for other users such as Coworking Chris or Learning-freak Fred. Similarly, interviewees reported information on meet-up groups and hackerspaces as locales for social learning. Libraries can make an effort to attract such users or user groups from the local community, and advertise their presence in the space accordingly. Further ethnographic research in such groups might also reveal valuable insights into

what makes them such successful environments for social learning, and what libraries can learn about providing similar experiences for their users.

The main perceived barriers to approaching other users in the space are a lack of awareness of their skills and interests, as well as perceived anxiety to approach 'strangers.' Users such as Coworking Chris and Learning-freak Fred who are generally open to, or even actively seek to engage in conversations with creative and interesting others, lack the ability to find such peers.

Whilst traditionally, libraries provided catalogues and indices for their collections and archives, there are no catalogues that refer users to fellow users with particular knowledge or skills. Improving such social interfaces within libraries will help to overcome the identification problem, and might also lower the social barriers for approaching other users.

The findings show that the library in the case study is frequented by a diversity of users who, in general, remain unaware of and uninspired by each other's subcultural domains of interest and expertise. This provides an opportunity space for digital technologies. How can digital technologies capture and highlight opportunities for social learning among users? Business process management and other enterprise systems connect and facilitate transactions between manufacturers, suppliers, vendors, and other businesses along the value chain of a product, from raw materials to finished products. Following this analogy, what does a value chain for the creation of knowledge look like, and how can the library as a facilitator of access to knowledge, skills, and education connect different individual users, community groups, and institutions along that knowledge value chain?

Future digital technologies in libraries need to support the nurturing of a knowledge community among library users who would mutually benefit from their awareness of each other's interests, projects, and activities as a result of being collocated. Elsewhere, we provide an overview of previous work (Bilandzic & Foth, 2012) illustrating how locative media, mobile applications, and ubiquitous computing not only support people to connect to networks over distance, but also to coordinate and initiate social interactions in their physical proximity. Such technologies bridge spatial and temporal barriers in the physical world. Location-based social networks, for example, provide information on collocated people that would remain invisible otherwise, and hence have the ability to make the library building more 'socially translucent' (Thomas

Erickson & Kellogg, 2000). Users would not only see other users working on their laptops, but get a glimpse of what they are working on. Such technologies can enrich the library space as a place for inspiration, social learning, and collaboration by keeping track of high-intensive user activities and topics, and rendering them visible as objects for low-intensive encounters to other library users. Encounters such as these are not limited to the situated resources and users available inside the library building in the "here-and-now," but can expand to previous and future library users as well as other creative places and environments where relevant knowledge is produced.

Implications for Design and Future Work

Based on the personas from this case study, we suggest four strategic dimensions for designing and directing further research on digital technologies towards improving the library as a place that affords serendipitous inspiration, social learning, and collaboration by exposing the user to a diversity of other users and their subcultural topics. Figure 14 illustrates these four dimensions, each of which aims to facilitate low-intensive meetings that would not occur otherwise, between (1) library users or groups of library users that share the library space at the same time for different high-intensive activities; (2) current in-situ library users and users who engage in relevant high-intensive meetings at another place outside the library; (3) current in-situ library users and activities of previous users in the library, and; (4) library users in different high-intensive meeting places.
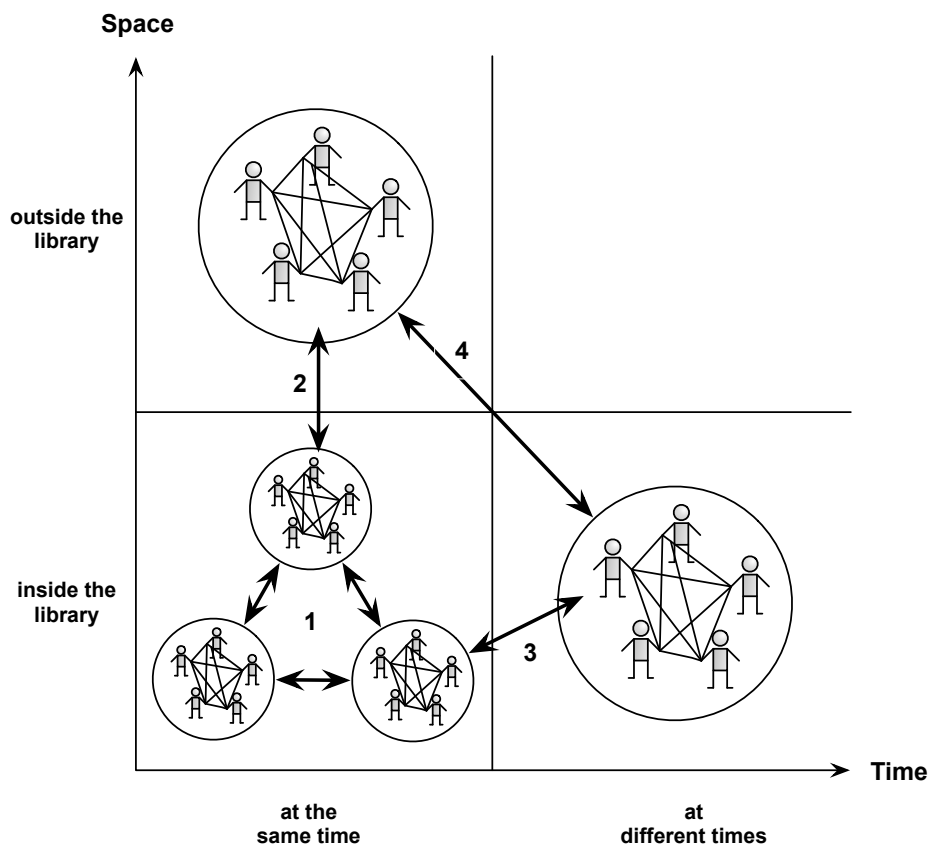
Figure 14: Strategic ways to design and apply digital media and technologies towards facilitating low-intensive meetings through the library as a place

Each dimension reveals opportunities for further design research on systems that facilitate the respective encounters in the context of a library.

(1) Studies on location-based, mobile social networking illustrate how displaying background information about other co-present people can facilitate face-to-face connections (Humphreys, 2010; Konomi et al., 2010). Further research needs to investigate and evaluate how such technologies can be applied to the library setting. What sort of information is suitable to facilitate low-intensive meetings between co-present visitors that would remain invisible otherwise (relevant to Fred, Chris and Garrett above)? Previous research about context-aware systems (Anind K. Dey & Abowd, 2000a, 2000b; Dourish, 2004), virtual co-presence (Schroeder, 2006), responsive architecture (Frenchman & Rojas, 2006; Seitinger, Taub, & Taylor, 2010), planned serendipity (Eagle, 2004), shared encounters (Willis, 2010), and ambient displays (Gellersen, Schmidt, & Beigl, 1999; Jafarinaimi, Forlizzi, Hurst, & Zimmerman, 2005; Pousman & Stasko, 2006; Wisneski et al., 1998) may provide valuable insights into how relevant but invisible information can be rendered visible, and potentially even leading to face-to-face interactions. Further insight might be gained from knowledge

management solutions of large scale organisations (e.g. Ziaie, Jayaram, Bilandzic, & Krcmar, 2009). How do organisations track what their individual employees know, and how do they make that knowledge (in particular tacit knowledge) accessible to other employees? How can such solutions be appropriated to suit library settings, where the stakeholders are not employees but visitors from the general public?

(2/3) Meetup.com (http://meetup.com) is a global online platform that enables local people to form and organise meet-ups easily around special interests ranging from Japanese Language and Culture, Spiritual-Energy Healing, to Book Clubs, Hiking Groups, Internet Business Meetups or Photography. As of October 2011, there are 409 groups registered with regular meetings within a two-mile radius of the Brisbane CBD; most of them in cafés, local community clubs, libraries and other (semi-) public places. The largest group has over 1,000 members, the top 60 groups have 200 members or more, the top 200 groups have 50 members or more, and most of the rest between 5 and 25 members. Meetup.com certainly does not cover all special interest groups in Brisbane, but the number and variety of these groups illustrate the immense creativity, skills, and knowledge within a local community, as well as people's needs and willingness to meet and engage with others in real-world settings around specific topics of interest. Those settings are locales of collaboration and the co-creation of local knowledge, and need to be nurtured by local libraries (see Garrett above). Local libraries can connect to such groups in their local community, take part in their discourse, and promote the existence and availability of their respective subculture to other locals. Further research that addresses the nature, interactions, and needs of these groups may reveal ways to embrace them as part of the resources that the library can provide or link to. What can the library do to attract meet-up groups and other high-intensive meetings to hold their meetings in the library? Or, how can modalities of mediated presence be used to connect library users with users from special interest groups from other locations? Such modalities include virtual co-presence across a continuum of real and digital environments (Schroeder, 2006), as well as connected presence (Licoppe, 2004) between distant people. Popular contemporary examples are video-conferencing systems or massive multiplayer online games. How can virtual co-presence and connected presence be applied as design concepts to break down the library's physical boundaries to provide potential low-intensive meetings with users at other places?

(4) Locative media, such as location-based mobile phone applications, enable people to leave and annotate digital traces of their interactions in space, hence providing

inspiration as well as local knowledge and intelligence for later navigators of the same space (Gordon & de Souza e Silva, 2011). Digital libraries and e-catalogues mostly provide access to books, collections, archives, and other resources. However, they provide little information about other library users and their skills, interests, projects, and areas of expertise. Libraries can encourage and support their users to document their meet-ups, projects, discussions, and results using photo, video, and audio sharing platforms as well as blogs, microblogs, and other social media. Library information systems that aggregate this data and further broadcast through the library website, email-newsletters, or ambient media such as public screens inside the library can afford further low-intensity meetings. These features could help users like Fred and Chris to identify in-situ knowledge embodied in users such as Garrett, as well as help first time visitors such as Sophia gain an understanding of the social learning purpose of the place.

Such technologies, applied in the context of a public library, do come with constraints. In contrast to organisational settings, the library as a public place needs to adhere to stronger privacy expectations, settings, and regulations. Furthermore, provided services must be socially inclusive, i.e. accessible to non tech-savvy users and users who do not own personal high-end technology (e.g. laptops or smartphones).

Conclusion

There is little previous research and development in programs that recognise the library user as an asset and resource for other library users. This paper presented a case study of a public library space that was built with collaboration, sharing, and social learning in mind. User observations and interviews show that social learning between strangers in such a public library place does not come naturally. There is a perceived lack of affordances to directly or indirectly learn from other unacquainted creative users in the space. Users find it difficult to identify or approach other likeminded users. They, in general, remain unaware of and uninspired by each other's subcultural domains of interest and expertise. We argue that this provides an opportunity for smart space technologies and suggest four strategic design dimensions that facilitate library users to get more out of simply working "next to each other," gaining inspiration and a learning experience as a result of coworking and socialising in the library.

We present five personas that encapsulate core user motivations, attitudes, and challenges for social learning. As the personas are based on insights gathered from the

case study environment at The Edge only, limitations exist due to the population and potential socio-cultural idiosyncrasies of the case study. Further user research in other libraries and specific social learning environments is needed to amend or extend the presented persona framework. Meet-up groups and hackerspaces (as encountered through user interviews in this study) might be good locales for further research to gather more insights into socio-spatial and technological aspects that facilitate social learning.

Chapter 7:

Connected Learning in the Library as a Product of Hacking, Making, Social Diversity and Messiness

Bilandzic, M. (2013). Connected Learning in the Library as a Product of Hacking, Making, Social Diversity and Messiness. Interactive Learning Environments.

Preamble

The work presented in this paper was motivated by the findings reported in Chapter 6 – in particular the challenges and barriers in relation to connected learning that were represented by the Personas *Learning-Freak Fred*, *I-wanna-share-it Garrett* and *Coworking Chris*. Aiming to address those challenges, I initiated *Hack The Evening* at The Edge – a weekly meetup event for people to get together, socialise and exchange ideas and skills around DIY technology. This theme was selected to satisfy people's interest and desire to learn about open source hardware technology such as *Arduino*, *Raspberry Pi* and *3D printing*, which, at the time the meetup was launched in June 2011, appeared to rise not only on a global level, but also among some Edge users as well as the wider local Brisbane community of artists, designers, hackers and technology enthusiasts. The group soon started to organically grow through word-by-mouth and develop its own life as a locale to meet, hang out and learn with and from other local enthusiast about DIY technology. 18 months of observations and participation in the weekly group meetups helped me identify core factors relevant to the learning experience within the group. The findings from this study in the context of The Edge provide answers to RQ5, i.e. suggesting ways that libraries and coworking spaces can better facilitate and nourish connected learning activities for and among their user community.

Abstract

Learning is most effective when intrinsically motivated through personal interest, and situated in a supportive socio-cultural context. This paper reports on findings from a study that explored implications for design of interactive learning environments through 18 months of ethnographic observations of people's interactions at "Hack The Evening" (HTE). HTE is a meetup group initiated at the State Library of Queensland in Brisbane, Australia, and dedicated to provide visitors with opportunities for connected learning in relation to hacking, making and do-it-yourself technology. The results provide insights into factors that contributed to HTE as a social, interactive and participatory environment for learning – knowledge is created and co-created through *uncoordinated interactions* among participants that come from a *diversity* of backgrounds, skills and areas of expertise. The insights also reveal challenges and barriers that the HTE group faced in regards to connected learning. Four dimensions of design opportunities are presented to overcome those challenges and barriers towards improving connected learning in library buildings and other free-choice learning environments that seek to embody a more interactive and participatory culture among their users. The insights are relevant for librarians as well as designers, managers and decision makers of other interactive and free-choice learning environments.

Introduction

Informal learning is defined as *"any activity involving the pursuit of understanding, knowledge or skill which occurs without the presence of externally imposed curricular criteria"* (Livingstone, 2001, p.4). Falk and Dierking refer to such intrinsically motivated forms of learning as *free-choice-learning – "the learning people do when they get to control what to learn, when to learn, where to learn, and with whom to learn"* (2002, p. 6). More than 70 percent (Grebow, 2002; Tough, 1979) of the knowledge and skills that people acquire and adopt throughout their lifetime, are based on free-choice learning activities, as opposed to the formal education system and educational programs with a dedicated curriculum.

Public libraries are an example for learning spaces that are deliberately curated to support free-choice learning. Much of the previous design focus of library spaces has been around providing a pleasing physical architecture, interior infrastructure and information resources to facilitate learning activities. However, apart from a person's personal context (prior knowledge, interest, intrinsic motivation) and physical context

(supportive / inspiring physical environment), the socio-cultural context is a key factor affecting the learning experience (Falk & Dierking, 2002). Learning is a social process; people, whom we encounter or interact with in our everyday lives, shape our awareness and exposure to different ideas, interests, activities, hobbies and themes. In particular, through interaction with other, more knowledgeable people, we learn things that we would not be easily able to grasp on our own (Vygotsky, 1978). Social learning has been found as a crucial factor in learning spaces both physical (Caldwell, Bilandzic, & Foth, 2012; Falk, 2009; Falk & Dierking, 2002) and digital (Downes, 2007; Ito et al., 2009; Siemens, 2005; Thomas & Seely-Brown, 2011); yet most curated free-choice learning environments, such as libraries or museums, do not cater for a social or collaborative learning experience per se. Their curating efforts rather focus on spatial and infrastructural elements that visitors might or might not end up utilising as part of a collaborative learning journey (e.g., family in a museum, student study group in a library). Ito et al. (2013) have recently coined the term *connected learning* as a design goal for learning environments in the 21st century; they understand learning as an *interest-driven* and *socially embedded* experience, which is facilitated through connections across social, physical and digital environments.

This paper is concerned with the question *how free-choice learning environments can provide connected learning opportunities, in particular through an interactive, participatory and inspiring socio-cultural context for learning?*

Much previous work on interactive learning environments has investigated ways to support social elements of learning in virtual learning environments (Brown, 2010; Cornelius, Gordon, & Ackland, 2011), or the design of specific technology to enhance social learning in face-to-face settings, e.g., mobile applications (Larua, Järveläa, & Clarianab, 2012), ubiquitous computing (Chen & Lib, 2010), or multi-touch surface computers (Hwanga & Sub, 2011). The study in this paper took a different approach. It sought to explore opportunities, challenges and barriers for connected learning in a public library context. The insights are based on participation and observations in a social meetup group that was established from scratch with connected learning in mind. Rather than focusing on a particular technology, the study investigated social aspects that contributed to connected learning as experienced by the participants. The aim was, in particular, to shed light on the following three questions:

1. *What factors facilitate the connected learning experience of members within the group?*

2. *How does the public library as a location for the meetup group affect the participants' learning experience?*

3. *What are challenges and barriers for connected learning as experienced by the group, and how can libraries address those?*

The following section discusses informal, self-directed, social and connected learning as defined in the literature. Then, a short section introduces The Edge at the State Library of Queensland as a case study environment of this study. The core of the paper describes the concept, ideas and methodology behind the HTE group as a social intervention at The Edge, and presents the findings. The last section discusses relevant outcomes for other free-choice and interactive learning environments, and suggests means to address the main challenges and barriers of connected learning as experienced by the group in this study.

Connected Learning: Informal, Self-Directed, Social

Literature distinguishes three main forms of learning – formal, non-formal, and informal. The distinction between these categories is based on the agent that controls *what* is being learnt and *how* (Mocker & Spear, 1982). Formal learning is institutionalised (e.g., schools or universities) and follows a mandatory curriculum that defines the learning goals as well as means. Non-formal learning takes place outside the formal education system and is based on voluntary participation in an educational institution (e.g., cooking classes, driving lessons, language courses). Hence, the learner implicitly controls the learning goals, but the means how these goals are achieved are controlled by the institution, e.g., through a pre-defined learning agenda or milestones. Informal learning comprises the forms of learning outside both formal and non-formal settings. In practice, the lines between these categories are often blurred (Belle, 1982), e.g., a person might engage in informal learning by reading a self-selected book on a new software tool that was introduced in their workplace. Informal learning projects where the learner "makes all decisions regarding the *what* and *how* of learning" (Mocker & Spear, 1982, p.2) are referred to as *self-directed*. That is, the learning goals, as well as means and processes to achieve those goals, are intrinsically motivated and self-defined by the learner themself (Figure 15). Similarly, Livingstone defines such learning as "any activity involving the pursuit of understanding, knowledge or skill which occurs without the presence of externally imposed curricular criteria" (Livingstone, 2001, p.4). Falk and Dierking name it *free-choice-learning* – *"the learning people do when they get to control what to learn,*

when to learn, where to learn, and with whom to learn" (2002, p. 6). The term free-choice
learning has been coined to better reflect the *"bottom-up, individual-driven way to think about
learning rather than a top-down, institution-driven view"* (Falk, 2005, p.272).

WHAT
(Objectives)

		Institution	Learner
HOW **(Means)**	**Institution**	Formal Learning	Nonformal Learning
	Learner	Informal Learning	Self-Directed Learning

Figure 15: In self-directed learning projects, the learner is in full control of the learning
objectives as well as means. Such learning is intrinsically motivated and pursued outside of
external curricula. Figure adopted from (Mocker & Spear, 1982)

Social constructivists describe learning as a social phenomenon (Vygotsky, 1978;
Wertsch, 1997) – an individual learns as a result of social interaction with other people
in their environment. The term 'social learning,' as defined by Bingham and Conner
(2010), encompasses this notion of learning as *"… people becoming more informed, gaining a
wider perspective, and being able to make better decisions by engaging with others."* Acknowledging
the significance of a learner's socio-cultural context, Schugurensky (2000) suggests that
informal learning can take three forms, namely *self-directed learning*, *incidental learning*, and
socialisation. These forms describe different learning situations depending on the learner's
intentionality and awareness at the time learning occurs (Figure 16). In contrast to self-
directed learning (the learner intentionally follows a particular goal, and is fully aware of
their learning), incidental learning happens without the learner having set an explicit
learning goal beforehand. Such learning is often a result of social interactions or simply
the exposure to particular social or spatial environments (e.g. joining a friend's birthday
party and getting involved in a political discussion with other guests, playing a game at
the local chess club and being surprised by the opponent's opening move). Socialisation
refers to things that people learn without being aware of it, e.g., behavioural norms or
practices as a result of growing up in a particular culture.

FORM	INTENTIONALITY	AWARENESS (at the time of learning experience)
Self-directed	yes	yes
Incidental	no	yes
Socialization	no	no

Figure 16: Three forms of informal learning according to Schugurensky (2000)

Much of above mentioned insights, despite being well established in theory, are not implemented well in practice. How can interactive learning environments be designed to foster self-directed learning, incidental learning, and learning through socialisation? Ito et al. (2013) have coined the term *connected learning* in quest to foster such design thinking on innovative learning environments that accord with contemporary learning models, theories and tools. Connected learning is a design concept developed for a new generation of learning environments that aim to support *interest-driven* activities, where learning is driven through *social interactions* with other like-minded people. As such, the learning experiences of a connected learner are *intrinsically motivated* and *socially embedded* through connections across social, physical and digital environments. These connections form what has been termed *Hybrid Personal Learning Environments* (Caldwell et al., 2012). The remainder of this paper reports on the case study of a social meetup group that was initiated to create an experimental environment for connected learning in the context of a public library space. The next section provides short background information on current practices and design trends to facilitate connected learning in libraries, as well as previous studies on library spaces that revealed barriers and motivated the initiation and launch of the meetup group in this study.

Background: Lack of Connected Learning Experiences in the Library

How does the vision on connected learning translate into current practice and design of libraries? *Commons 2.0* (B. Sinclair, 2007) is a widely pursued trend towards accommodating collaboration, peer-to-peer learning, informal social hangouts, meetings or comfortable work in library spaces. More and more libraries remove bookshelves in order to expand floorspace for infrastructure and interior design elements that invite

social activities (LaPointe, 2006; Martin & Kenney, 2004; McDonald, 2006; Shill & Tonner, 2003), e.g., lounge areas, couches, meeting rooms, whiteboards, projectors, video consoles, café and food bars. Open architecture approaches such as no walls or only glass between different work spaces are used to facilitate serendipitous cross-disciplinary discoveries from people who work side-by-side; reconfigurable furnishing and continuous connectivity through free WiFi allow flexible formations that suit different modes of interaction and learning, such as individual study, group work, or presentations (McDonald, 2006; Niegaard et al., 2009). The purpose behind such Commons 2.0 spaces is to better facilitate open sharing, collaboration, and human interaction in general, thus fostering the learning principles of social constructivism (cf. Vygotsky, 1978; Wertsch, 1997). Such library spaces foster the evolution of the library role away from being a 'gatekeeper' of books, more and more towards being a facilitator for learning and knowledge. Learning and the acquisition of knowledge is recognised as a social phenomenon which – according to the principles of *social constructivism* (Vygotsky, 1978; Wertsch, 1997) – is created through social interaction, conversation and collaboration.

However, user studies show that such physical affordances in library spaces are necessary, but often not sufficient to support connected learning among their users. The motivation to conduct the case study in this paper dates back to June 2011. At that time, I had been engaged for almost one year in ethnographic visitor observations and interviews at The Edge – a new digital culture centre and collaboration space launched by the State Library of Queensland. The core findings (Bilandzic & Foth, 2013b) reveal a lack of connected learning experiences among visitors, as well as a lack of opportunities to identify, interact and collaborate with other users with similar fields of interest and passion. The Edge offers a range of educational workshops and events that are curated around particular themes related to digital culture and creativity, for example, "High Speed Photography," "Getting Started with Electronics," or "Programming Interactive Graphics." However, outside of such workshops, i.e., when The Edge simply functions as a free space with infrastructure for people to work, study and engage in self-driven activities around digital culture, most people worked *next to each other* in isolation, rather than *with* each other. When collaborative activities were observed, then mostly among people who have known each other prior to coming to The Edge. The conceived vision of The Edge's designers as a space for serendipitous encounters and collaborative, incidental learning did not translate into user activities

during their everyday visits. Other user studies in library spaces report a similar dominance of isolated activities; Aabo and Audunson, for example, report that unacquainted library users perform "their activities in parallel, somewhat similar to people exercising in a fitness studio. The degree of interaction and communication is low" (2012, p.143), and "in most cases indirect and nonverbal" (p. 146).

This lack of social interactions and connected learning activities at The Edge as well as other libraries motivated and marked the point of departure for this study. I initiated the "Hack The Evening" (HTE) meetup group in an attempt to stimulate connected learning among users at The Edge. The study was driven by an action research approach (Bilandzic & Venable, 2011) with The Edge as a *living laboratory* for research interventions and evaluations. In contrast to the existing, curated workshops at The Edge, my idea was to set up an environment where people with a particular shared interest could get together and learn from each other, rather than from an expert facilitator or lecturer in a formal workshop setting. This reflected my theoretical and empirical insights to that point of the study.

Social Intervention: Hack The Evening

The idea to initiate HTE was born in one of many informal conversations with Edge users, where it became apparent that there is quite some interest within the user community in tinkering with electronics, and making new things with Do-It-Yourself (DIY) technology, such as Arduino microcontrollers, 3D printers, or gesture recognition devices. In collaboration with The Edge management, I started the first HTE meetup session in June 2011. We advertised it on The Edge website as a weekly meetup around the topics of hacking, making and do-it-yourself (DIY) technology, to be held every Thursday from 5.30 till 8pm. The invitation targeted not just the typical programmers, software developers, and hardware hackers, but also artists, tinkerers, educators, students, and other like-minded people to join, meet, talk, inspire and learn from each other. Additional announcements were made via Twitter and Facebook.

As an entry point for the first HTE session, I prepared a short 30 minutes introduction and tutorial on Arduino (http://arduino.cc) – an open-source microcontroller platform that many people showed interest in. Even though the presentation was well received, it became apparent that people had more interest in interactive and hands-on experiences. As one participant stated in the follow-up feedback focus group, *"…you should have opened the Arduino boxes earlier. That's when I got really excited, when you opened the box!"* In response

to such feedback, future HTE sessions had no predefined learning goals or structured elements, and we adopted a 'drop-in whenever you feel like it' culture, without the need for registrations or to be on time. We maintained our official Thursday 5.30pm start, but people would come to The Edge and start their own little HTE subgroups as soon as 3pm or join in after work around 6 or sometimes 7pm. Soon people started developing their own agendas working on different individual, as well as collaborative projects using a plethora of tools, platforms and technologies of their interests.

By June 2013, HTE has had more than 90 meetups, and has grown organically mostly through word-by-mouth and people who have read about it on The Edge's website. Usually, around 10 to 12 people attend the HTE sessions (Figure 17), but numbers have been as low as 3 and as high as 25. The group has about 12 core members who join the Thursday evening sessions on a regular basis, most of them every, or at least every other week. HTE sessions are also regularly made up of one-time visitors, random passersby, backpackers from overseas, and people who come in just to quickly get some advice or feedback on their project and then leave again.

In parallel, we set up a Facebook group (facebook.com/groups/hacktheevening), which has grown to over 100 members to date. Over time, the group became a popular channel for HTE members to support and complement their interactions and connected learning beyond their meetings in the physical space. Members use the group almost on a daily basis for sharing relevant links, ideas, tutorials and inspirations that they think might be interesting or useful for other group members, asking for tips and advice on their individual projects, as well as for organising and discussing collaborative project matters in between their physical meetups at The Edge. Posts are mostly submitted by people who are regulars at the physical meetings, which suggest that the Facebook group primarily supports, extends and complements the interactions of the group in the physical space, rather than having a life on its own. However, as per the Facebook group statistics, posts are also regularly seen by between 20-40 and sometimes more than 60 users. These digital traces of passive 'lurkers' (Nonnecke & Preece, 1999, 2000), reveal that the Facebook group also functions as a medium to reach out and create awareness of HTE activities beyond the library walls.

Figure 17: The Hack The Evening group during their weekly meetup sessions: Group interactions are mostly unstructured, uncoordinated and follow no pre-defined agenda. They are made up of a mix of informal hangouts, individual and collaborative work, serendipitous discussion, and socialising.

Methodology

As an initiator and organiser of the group, I participated in 62 of 70 HTE meetups between June 2011 and December 2012, engaged in ethnographic observations during each session, and took field notes during as well as after every session. After the very first HTE session, I conducted two 30 minute focus groups with 8 participants each, and one follow-up focus group with 9 participants after 18 months. Prior to the second focus group, I held in-depth interviews with 10 individual regular as well as irregular members to gather personal insights undisturbed from the typical group dynamics in a focus group setting. The focus groups and interviews targeted questions that were difficult to gather through observation, e.g. personal pre-entry expectations, key

motivations and perceived benefits of participating at HTE, or relevant individual needs that are not being fulfilled at HTE. All focus groups and interviews were audio-recorded and transcribed. The field notes and transcriptions were analysed using a grounded theory approach (Glaser & Strauss, 1967). The findings reported in the next section are based on prevalent themes that emerged from the focus group and interview data as well as the ethnographic observations in the group.

Findings

It appeared that two key aspects drive the learning experience as perceived by participants at HTE. (1) HTE is made up of a *high diversity* of people with different skills and backgrounds not limited to technology and 'hacking' per se, and; (2) people get to engage in *self-directed activities and interactions* rather than follow a pre-set agenda. As a result, the learning that HTE participants experienced was *intrinsically motivated, self-directed and social* (Figure 18). Those learning experiences accord to the design goals of connected learning (Ito et al., 2013). The following sections de-construct and describe the socio-spatial setting that led to connected learning at HTE in more detail.
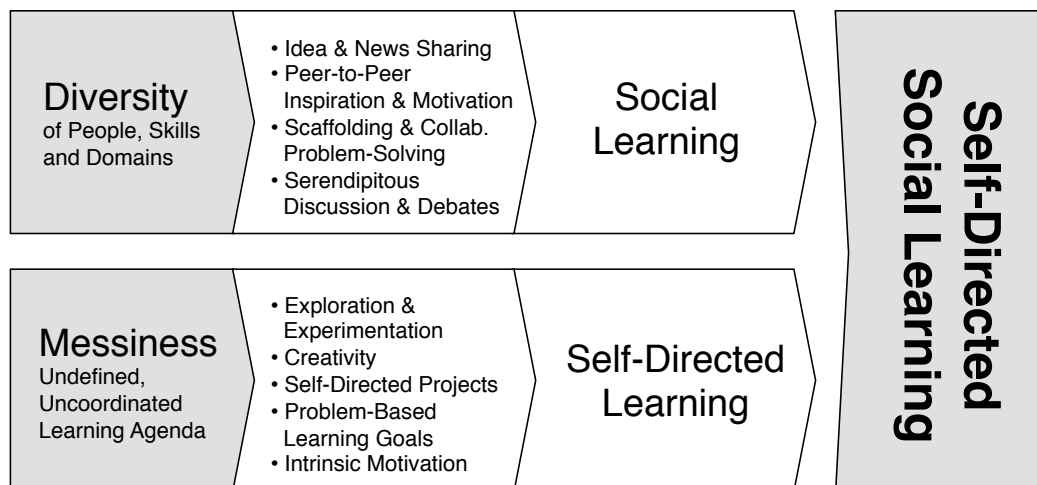
Figure 18: Hack The Evening provides a platform where a high diversity of people with different skills and backgrounds get to 'hang out' together in meetup sessions with an undefined and uncoordinated agenda. Learning that participants experience as a result of this setting is intrinsically motivated, self-directed and social.

Diversity – When People with Different Skills, Domains and Backgrounds Share the Same Space

HTE has attracted a high diversity of members in regards to age, occupation, educational level, socio-cultural backgrounds, and areas of expertise and interest. Members range from 12 to 45 years and include students from undergraduate to doctoral level, parents and their kids, men and women, unemployed people, software engineers, artists, accountants, graphic designers, and freelance programmers. The experience and skillsets in regards to the group's core theme (i.e., hacking, making, DIY technology, electronics, physical computing and programming) vary a lot; people range from professionals, amateur experts and knowledgeable hobbyists to lay users who are interested in learning the basics or simply "hanging out" to see and be inspired by what others do. As Participant (P) 3 describes,

> "I would call it a diverse group of people, experienced in a heap of different things, that are interested in building stuff, and modifying things and learning" (P3).

Running HTE at The Edge as a 'universal' library space was both a blessing and a curse: The conditions for the HTE activities at The Edge were by no means optimal. Brisbane has a local Hackerspace (http://hsbne.org), which in general would be much more appropriate and better equipped for the group's activities. For example, it provides 24/7 access, high speed internet access, tools such as soldering and de-soldering stations, power supplies, multimeters as well as heavy machinery such as a bandsaw or milling machine. However, despite the flaws of the physical infrastructure, running HTE at The Edge was a factor that significantly affected the learning experience and creativity within the group. The Edge, as part of the State Library of Queensland, is a *universal*, *open* and *socially inclusive* space; hence attracts a remarkably different and more diverse audience from the one usually found in Hackerspaces. This setting facilitated to inspire and enable people to participate in the DIY technology culture, who would normally not have access to or remained unaware of the local Hackerspace (Figure 19). P8 regularly, for instance, brings his 12 year old daughter and two 14 and 15 year old neighbour's boys to HTE, an age group rarely observed at the local Hackerspace. P3, an unemployed person, would be unable to afford AUD 30 membership fees per month at the local Hackerspace. He joined HTE as a free alternative to participate in the local hacking and making culture.

"I haven't been there [to the Hackerspace] yet, I mostly just read some stuff about it and took a look at their website. It does look cool, but the payment is what prevents me from actually going there and try it out." (P3).

To P1, a female HTE participant, the social atmosphere and balance between men and women is more appealing than at the Hackerspace. Socially, she feels more comfortable at HTE.

"…the Hackerspace seems to be less friendly than HTE. It's a bit more nerdy. And not so many girls. There is more girls here [at HTE]. There have been times when there were half as many girls as guys."
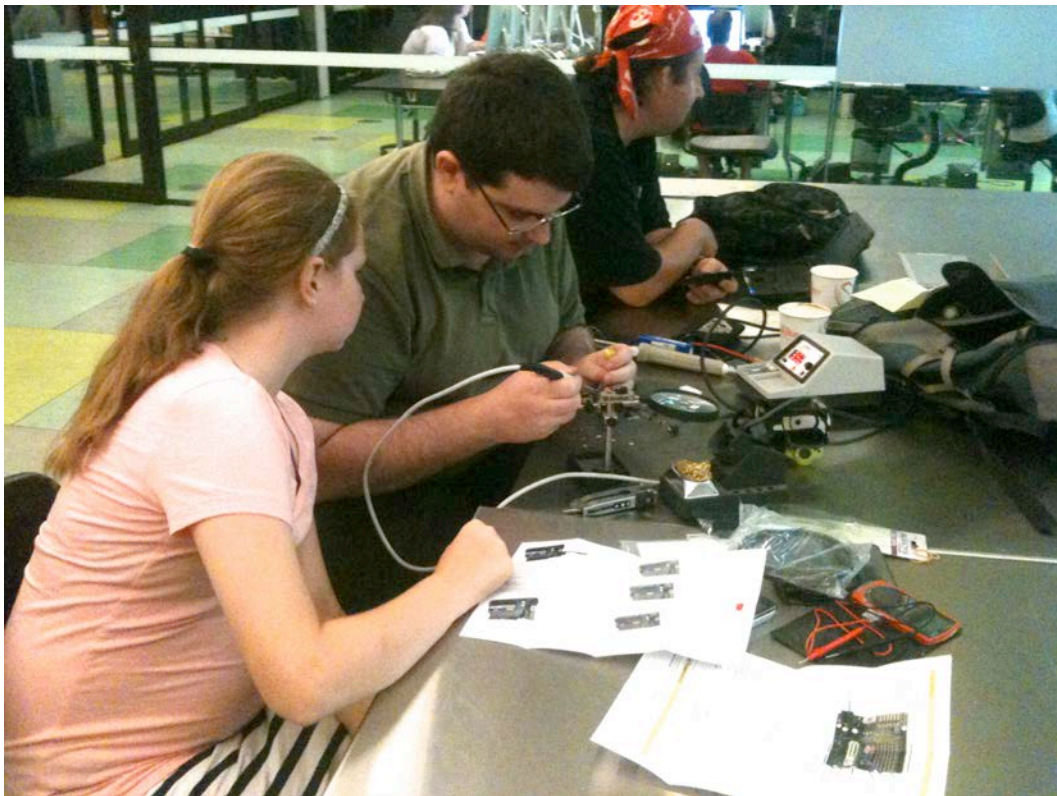
Figure 19: Hack The Evening attracts people from a high diversity of age, socio-cultural and educational backgrounds as well as interests and areas of expertise. Placed in a library setting, the group provides social learning opportunities between people that would probably not have met otherwise. The picture shows an electronics 'geek' teaching a school kid how to solder.

On the other hand, four members of the local Brisbane Hackerspace also became regular HTE participants. One of them, P7, explains that

"… the Hackerspace tends to [attract] a lot more technical people, a lot of the guys there are from a technical background or have aspiration to do technical jobs. Here [at HTE] it tends to be a lot more artistic and creative people, so we

tend to get people who have the ideas for the interesting stuff, but don't know how to implement it. Whereas at the Hackerspace, we know how to implement it, but you know… the ideas that we come up with aren't necessarily off-the-wall or crazy." (P7)

For P7, HTE complements the local Hackerspace by cross-pollinating two user communities, a *specialised* and *universal* 'lay user' community. On average, people at HTE have less 'hardcore' hacking and technology skills, however, given their often non-technology centric interests and backgrounds, are able to identify opportunities by DIY technologies and transfer those to a broader range of other disciplines and application areas. A good example of such cross-pollination of skills and creative ideas was a young couple that engaged in burlesque dancing as a hobby. The couple heard about HTE from a friend of a friend, and came along one Thursday looking for someone to help them build an LED costume for a dance performance they were preparing. The costume should glow and blink in different colours according to their dance movements. The couple had a creative idea, but not the technical skills to implement their idea. At HTE they got in touch with a local Hackerspace member, who introduced them to the Hackerspace and showed them how to utilise particular tools and concepts to complete their project. As P6 later reported,

"I discovered the Hackerspace. That's really interesting. I haven't even thought about a place like that existed." (P6)

Similarly, participants at HTE often introduced each other to their hobbies, subcultures, creative spaces and learning environments in the local area outside of HTE or the library. HTE participants would, for example, join other participants to a local life drawing class, a local cultural event, a workshop by a local software innovation centre, a web developer meetup or other local meetup groups. As such, HTE functions as a locale where various learning environments and opportunities are introduced to and shared with other participants – revealing the urban learning ecology of Brisbane. A number of other innovative projects emerged as a result of collaboration between HTE participants with different creative backgrounds and participants with complementary areas of expertise and technical development skills (Figure 20). As such, the products are iteratively designed and shaped from a technological as well as application domain specific perspective (e.g., neuroscience, citizen journalism).

Figure 20: Hack The Evening group projects are brainstormed and built in a collaborative effort by participants from different backgrounds and complementary areas of expertise.

Messiness – When Everyone can Follow Their Interests, Learning about What They Want and How They Want

HTE is a forum where people can apply their skills and express creativity not in ways they *have* to, but in ways they *want* to. Participants perceive this as a significant benefit over other learning environments.

> "A lot of the time you are doing things at work that you know that you have to do, and that are not that much fun. But [HTE] was just set up so it's fun and it deals with technologies that I haven't worked with before, and it felt like a creative environment." (P1)

> "[At university] everyone is really focused on what they have to do, no one is really focused on what they want to do. There is no real conversation surrounding things that people would like to do, like exploring things… I guess it feels unimaginative." (P6)

Comparing HTE to their typical experiences at university or work, P1 and P6 feel more free to follow their own interests, do creative things and experiment rather than follow activities imposed by the university or work agenda. The unstructured and

uncoordinated setting at HTE, with no predefined goals allow them to share and engage in activities, discussions and projects that are intrinsically motivated and self-driven. As P8 describes,

> "…it's free range, you can do what you like; there is no structure. And you can start when you want, so there was definitely a sense of excitement. There was a sense of almost like a playground. And it was probably like a lolly shop, too, as well, when they said to me a few things where I could get involved in and not knowing where to start." (P8)

At HTE most projects are explorative and experimental, and, more often than not, fail. However, learning is perceived as an interactive and iterative process of doing, failing and practical problem-solving. The learning experiences of going through that process are more important than the actual project outcome. As participant 1 explains,

> "…the Blimp project was fun to play with, it didn't have any hard defined goals; it was just something to experiment with, and it had to change because the ideas we had weren't really feasible […] but I'm learning new things, you know…" (P1)

The unstructured 'sandpit' like environment at HTE provides a platform for people to practice and live out their passion. The self-directed nature of their activities leads to learning experiences that are intrinsically motivated and perceived as a more creative, explorative and fun than the ones driven through formal curricula and agendas at formal learning or work environments.

Diversity and Messiness – Hack The Evening as a Platform for Connected Learning

> "They [other participants] are really important to me; the whole reason for me to come along is because other people come along. For Christmas time a lot of people didn't come for a couple of weeks because you know, it was Christmas. And it was really quiet. I was just sitting there by myself doing things and it wasn't so much fun." (P1)

The social diversity and uncoordinated agenda at HTE amplify the participants' social learning experience. The exposure to a diversity of other participants' skills and areas of expertise allows each individual at HTE to overcome cross-disciplinary barriers that they would not be able to easily overcome on their own. The group's capability and

knowledge is bigger than the sum of its individuals. P5 describes this social knowledge network of diverse people as the key benefit of participating in the group.

> "I haven't got the skills that most people in this group have. I studied mathematics and, so I know a bit of programming from that. I picked up bits and pieces here and there, but I am not an electrical engineer, I am not a software engineer, or not a designer by trade or anything like that. So it was sort of about meeting those people who were [software engineers and designers] and learning from them…" (P5)

Further, the group is perceived as an *encouraging* and *motivating factor* to start projects. P1, for example, describes the benefits of knowing that there is a community of likeminded, knowledgeable others at HTE who can back her up if she needs help.

> "I don't have the patience to sit with a book at home, and if I hit a roadblock I don't know how to keep going. Whereas here I just ask someone and they'll show you. Or someone else will have the same problem. Like with the 3D printing, that's a good example. I have been reading about them for ages, and it wasn't until somebody here was building a printer, that I felt I could actually go and build one by myself, because I could ask them questions, and hear their feedback on how to do something, and not waste, you know, weeks and weeks of my time trying to work that out." (P1)

The unstructured and uncoordinated nature of HTE sessions with no fixed agenda provides an opportunity for everyone to engage with anyone. Interactions in the group are usually dominated by a messy mix of conversations, discussions, debates, exchange of ideas and news, collaborative problem-solving and other peer-to-peer based activities around their shared interests and passions. The co-presence between group members allows everyone to communicate personal knowledge gaps at the time they hit a roadblock, and seek for personalised solutions and answers to the problem. The high diversity of people with different backgrounds and skillsets in the room increases the chance that someone is able to help. It is a typical observation that every time when someone raises an individual problem that they struggle with, one or sometimes two and more other participants would come and try to help. The group complements each other's needs and knowledge, and collaboratively engages in solving someone's individual problem.

> "…maybe nobody else in the group knows how to do it either, but we can solve it together, and everybody has their input. If I was at home, I wouldn't have other people giving suggestions. So I find that useful." (P1)

Many conversations in the group, whilst not being centred around technology or educative in an explicit sense, serve as a source for *incidental learning*. Almost every Thursday, the group continues their HTE sessions at nearby snack bars after The Edge closes at 8pm (Figure 21). Conversational topics usually go across many levels of everyday life, e.g. family, relationships, flatmates and friends, jobs and professional life, and other hobbies and interests. The following extract from the field notes illustrates a typical example of learning experiences made during such interactions.

> […] Later when our burgers arrive, PX mentions he has an autistic brother. PY asks how his brother is affected by autism, and PX explains the nature of autism, different types of autism and autistic people with special skills. PZ mentions the movie 'Rain Man'; PQ pulls out her iPhone and makes a note about the title for her 'to-watch' list. PR mentions "Drawing on the right side of the brain" – the book PQ recommended to him a few months ago to improve his drawing skills. He explains that the book is not really about drawing, but more about learning how to train the brain to perceive the world in a way it makes it easier to draw – it's really about "brainhacking." PX refers to a TED X talk about a woman who experienced literally loosing her brain functions, and what psychologists learnt from her case. PT continues with nanotechnology and 'Diamond Age' – his favourite book. PU never heard of it and writes it down.

Even though such dinner conversations are more about socialising than being educative, participants get exposed to each other's interests and subcultures, and learn things incidentally. In the above example, one participant mentioned an autistic family member, which then unfolded into a discussion about autism and then shifted across various different topics on neuroscience in a matter of a few minutes. Both digital and physical learning material, such as books, movies, YouTube videos or TED talks that are situated in the context of the conversations, are often shared directly or later via the group's Facebook page. Such interactions often result in unexpected, serendipitous learning, inspiration, and generation of new ideas that would not easily happen if participants were working on their own, or involved around a pre-defined or coordinated activity, such as in a themed workshop or lecture.

Figure 21: The group usually migrates to a local snack bar after the library closes at 8pm. Group interactions are mostly around socialising, but often lead to discussions and conversations that result in incidental learning.

Discussion

This study shows how HTE as a bottom-up, grass-roots social intervention in the context of a public library created a forum for connected learning. As the insights show, HTE participants experience all three elements of informal learning as defined by Schugurensky (2000). It combines the benefits of *self-directed* (individual as well as collaborative) learning, *incidental learning* and *learning through socialisation*. These learning experiences, as observed in the HTE case, are facilitated through a few socio-spatial aspects that the group was situated in. Those are, in particular, the *diversity of people* and their interests, backgrounds and skills in the group, and; the flexibility for people to engage in interest-driven activities as a result of an *undefined, and uncoordinated meeting agenda.*

The library as a meeting place and learning environment did not necessarily affect the learning experience per se. In fact, in the case of HTE the spatial infrastructure of the library is challenged by the group's needs. However, the library's quality as a free, open, neutral, and 'truly' public and socially inclusive place (Leckie & Hopkins, 2002) attracts

people from a broad cross-section of society, high diversity of socio-cultural and educational backgrounds as well as areas of expertise and interest. Some participants, especially women, kids and the unemployed, would or could not have joined HTE easily if it was held elsewhere. At the same time, this social heterogeneity provided a high mutual exposure to diversity and 'otherness' among participants, hence a rich platform for connected learning, creativity and innovation. HTE's enriches the library as what Audunson et al. refer to as a *low-intensive* meeting place (Aabo et al., 2010; Audunson, 2005; R. Audunson, A. Varheim, S. Aabo, & E.D. Holm, 2007b) – a place that provides exposure and inspiration to themes, topics and subcultures that are different to one's personal core interests in life. In contrast to the usual "indirect and nonverbal" (p. 146) behavioural norm between strangers in libraries, HTE facilitated rich, social face-to-face interactions between visitors that have not necessarily known each other before. Whilst social (face-to-face) interfaces (Björneborn, 2010) in the library were mostly limited to user inquiries and interactions with the librarian, HTE sets an example how collaborative knowledge and wisdom of fellow users can be leveraged as an additional social interface of and within the library. The participant interviews illustrate how the library as a meeting place for HTE complements more *high-intensive* (specialised) meeting places. The local Hackerspace, as a particular example that emerged in this case study, tends to attract members with higher levels of domain specific expertise, but lacks the low barriers of entry and the diverse nature of inspirations, ideas, skills and practices that are embodied in a heterogeneous social environments such as HTE.

However, the HTE group also faced some barriers and challenges that libraries and other free-choice and interactive learning environments can overcome towards further improving opportunities for connected learning in their spaces. The findings suggest implications for design of social, spatial, and technological interventions in learning environments.

1) Increase Awareness of Social Learning Opportunities

HTE regularly attracted visitors who browsed The Edge website or deliberately searched for local DIY technology meetups through an online search engine and found the HTE announcement. However, the majority of other library users who happened to share the library space at the same time as our HTE sessions were running, did not perceive HTE as an event they could freely join. Similar to many other user meetings (student study groups, language study groups, etc.) in the library, HTE was often

perceived as a closed and private function. Libraries can counteract that notion and advertise user-driven meetups through posters, brochures or signs, similar to how they advertise official, library-initiated events and workshops. This concept might also work on a micro-level – providing a platform where individual users can announce and share what they work on, and invite other, serendipitous passersby to join if they are interested. Smart space technologies such as locative media or ubiquitous computing can deliver and visualise such information in real-time. As an example of such design thinking, we have developed Gelatine – a user checkin-system connected to public screens that visualise such information. Elsewhere, we describe the design concept (Bilandzic & Foth, 2013a) and evaluation of Gelatine (Bilandzic, Schroeter, & Foth, 2013). Further, libraries can arrange 'show and tell' events where users and user groups can exhibit their individual or group projects. Special interest hobby groups or individual amateurs need to be encouraged to share their skills, projects and passion with the general public, hence spark interest, create links and awareness to people who are different from them.

In summary, library management should recognise individual users and user groups as an asset that enriches their space with opportunities for connected learning. Social as well as technological interventions can improve the library as a connecting place for people to encounter, be exposed to and inspired by different practices, areas of interests and skillsets.

2) Facilitate an Open, Collaborative and Interactive Culture

The group interactions at HTE required a significant amount of social facilitation. In particular, new visitors would often take a seat in the room, open their laptops, and sit by themselves unless someone talks or introduces them to other HTE participants. Depending on a participant's personality, it sometimes took a few weeks or months of 'warming up' and getting to know the others before fruitful interaction and collaboration started. It takes a few key people and personalities to build an open, collaborative and interactive culture within the group. Such a culture, however, sometimes caused friction points. Whilst the continuous openness to new people and visitors is perceived as a significant source of new ideas and "fresh breeze," it also hinders the progress of individual and group projects, and is sometimes even perceived as a barrier to getting actual work done, e.g., as P10 reported, *"'tourists' wanting to ask questions and see demonstrations took several hours of productive time away from the project" (P10).*

As a consequence, new visitors would sometimes be left alone for a longer period of time during their first visit, and then, usually, never came back.

While the benefits of connected learning depend on each participant's personal engagement and active participation in conversations and collaboration with others, it takes a few altruistic individuals dedicating time to facilitate and maintain the internal group dynamics towards an open, welcoming and collaborative social setting. Library and other learning environments can acknowledge such individuals through, e.g., digital peer-to-peer recommendation or reward systems, as known for example from online auction and shopping sites. Further, they can provide assistance to their role. Similar to how librarians facilitate users to find books, archives and other information resources to their particular needs, a dedicated staff member can act as a *socio-cultural animator* (Foth, 2006b) or *connection catalyst*, and link and introduce people with a mutual interest to each other, thus highlighting opportunities for connected learning. That social facilitator would need to maintain an overview of knowledge and potential social capital available in the learning environment, and continuously nourish it by attracting or creating links to external special-interest community groups.

3) Provide Access to Learning Materials

Effective acquisition of knowledge cannot be acquired by books only, but requires 'learning by doing' activities. Similar to the renewal of books and collections on particular themes, libraries and learning spaces in general need to provide access to tools and equipment that enable users to engage in 'learning by doing' activities. Management and staff in learning environments can engage in conversations and discussions with their user groups to maintain a feel for their current needs and wants, and try to fund appropriate learning material. Such material can be particular to the context of the group. One HTE participant formulated his wish, *"…just take a look at kickstarter.com [a social fundraising website for innovative technology products], and pledge for the top 10 products. That's what I would love to play with…"* Other users at HTE expressed needs that might be too particular or expensive, e.g. *"I would like to use oscillators and logic analysers, which we don't have here. More specialised stuff." (P3).* A potential model would be to fund such individuals with *micro-scholarships* to access specialised places that provide access to and expertise for using such equipment (e.g., membership with the local Brisbane Hackerspace costs AUD 30 per month). In return, the scholarship receiver could share their learning and experience by giving a workshop or informal 'show and tell' presentation to the wider

library audience. Library managers need to recognise and evaluate such strategies as enablers for learning experiences to their users that could not be made through books or other traditional facilities in library spaces.

4) Support Informal Socialisation between Participants

A major barrier for connected learning faced by some participants at HTE was regularly observed after the The Edge closed at 8pm. The majority of the group usually migrated to a closeby snack-bar to continue their discussions and social hangouts. However, some core members from the group usually could not join. One of them once stated, *"sorry, would love to join, but I have AUD 2.70 left. That's it for the rest of the week."* What can learning environments (in particular libraries in their role as socially inclusive facilitators of education and knowledge for the general public) do to support valuable connected learning experiences that happen through informal hangouts and socialisation? As illustrated through observations at HTE, a lot of social and incidental learning happens through informal conversations and hangouts among group members at dinner, after they have to leave the library at 8pm. However, with the closing hours of the library, the group has to leave a socially inclusive meeting place, and migrate to a bar or restaurant that are usually not socially inclusive; they require people to consume food and drinks. As a consequence of some group members being unable to bear these costs, the group splits which affects social inclusivity, diversity, and hence the connected learning experience. Libraries and learning environments need to recognise that learning interactions not only happen *within*, but more so continue through informal conversations and interactions *outside of* their dedicated premises. In terms of designing effective learning environments, informal hangouts and interactions need to be facilitated and made socially inclusive not only inside, but also as much as possible outside their premises and opening hours. Whiteboards, lounge areas and ubiquitous WiFi have become established design factors; maybe it is time to think about group vouchers for burgers and drinks as equivalent means of facilitating connected learning?

Conclusion

Designing spaces for connected learning is a paradox. Informal learning environments provided by the GLAM sector (galleries, libraries, archives, museums) are traditionally designed in a top-down fashion. Social and connected learning, on the other hand, is a bottom-up phenomenon, which cannot be externally imposed or 'socially engineered.' It

is similar to community development, which, as Gilchrist (2000) points out, "involves human horticulture rather than social engineering" (p.269). However, spaces can be designed to facilitate organic growth and nourish a connected learning community. The intention of this study was to explore the core factors that facilitate connected learning through an organically grown and nurtured meetup group in the local library's user community.

The insights from Hack The Evening (HTE) – a meetup group initiated as a social intervention in a public library context – reveal various facets relevant to the design of interactive environments for connected learning. In particular, the library's quality as a free and democratic social place brought together people with a huge diversity of skills, backgrounds and areas of expertise. This *social diversity* as well as the *open, uncoordinated and flexible meeting agenda* enabled the group members to have rich and serendipitous learning experiences through informal social interactions while coworking. At HTE, participants pursue self-driven activities, which they care and feel passionate about, rather than following an externally imposed agenda or learning goals. At the same time, they enjoy doing this with and around a group of like-minded others, who provide a rich socio-cultural context for learning. HTE has become a destination for people to connect, socialise, have fun, explore, experiment, exchange, learn, teach and support each other. As such, HTE is a community-driven, self-maintained and sustainable locale that attracts people primarily for the purpose of self-directed, connected learning. In contrast to traditional free-choice learning environments where learning is primarily supported through the physical environment (e.g. exhibition in a museum, books in the library), HTE facilitates individual learning by means of providing an interactive, stimulative and inspirational socio-cultural context for people to participate and learn in a self-directed, *as well as* social and collaborative way.

However, the group also experienced some barriers for connected learning that can be overcome if actively counteracted by libraries or learning environment managers. The discussion suggests implications for the design of future social, spatial, as well as technological interventions. Those are targeted at (1) increasing the awareness of social learning opportunities within a learning environment; (2) facilitating an open, collaborative and interactive culture among users in learning environments; (3) providing access to contemporary learning tools and materials for "learning-by-doing" activities, and; (4) supporting informal socialisation and hangouts between participants inside as well as outside the learning space premises and opening hours.

This case study has limitations due to its focus on one particular meetup group. Future ethnographic studies in other user-driven learning communities where people meet with an intrinsic motivation to learn with and from each other (e.g. hackerspaces, hobby / meetup groups, coworking spaces) will help identify further socio-spatial aspects relevant to the design of informal learning environments to grow, nurture and foster connected learning among their users. Future work also needs to investigate how such learning communities facilitate specific aspects that were found in this study (diversity, messiness, self-directed and social learning) to drive their connected learning experience.

Chapter 8:

Towards Visualising People's Ecology of Hybrid Personal Learning Environments

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Statement of Contribution

I co-authored this paper with my supervisor Assoc. Prof. Marcus Foth, as well as my colleague and fellow PhD candidate Glenda Caldwell. Glenda is a lecturer in architecture at QUT, and shares my research interests in digital fabrication and hybrid architecture approaches that combine bits and atoms. Glenda is the first named author. However, this does not reflect the quantity or quality of our individual contributions. All stages and tasks throughout the paper were very much a collaborative effort, where we scaffolded each other's thinking in relation to architecture and computer science respectively, and discussed and applied these thoughts in the context of learning environments. The conceptualisation of the research topic, research design, conduct of experiments as well as data analysis were elaborated collaboratively, as well as writing the abstract, research questions, methodology and conclusion. Writing contributions that were exclusively contributed by myself include the introduction, background literature and discussion, while Glenda contributed the section on findings as well as the figures in the discussion. The paper was revised and edited by all three authors several times before publication and presentation at the Media Architecture Biennale Conference.

Preamble

The findings from *Hack The Evening* (see Chapter 7) revealed *self-directed* and *connected learning* as the key motivational factors for people to participate in the group. This paper was inspired by these findings, and aimed at exploring other places and social environments in people's everyday lives as well as online channels, where they experienced a sense of learning. The vision was – by means of aggregating such personal ecologies of learning environments – to create a digital representation of connected learning opportunities. In particular, the idea was to inform the design of an *ambient media architecture*, i.e. digitally augmented physical spaces that increase awareness and connections among collocated users in library spaces that can serve as information or learning resources for each other.

Abstract

Ambient media architecture can provide place-based collaborative learning experiences and pathways for social interactions that would not be otherwise possible. This paper is concerned with ways of enhancing peer-to-peer learning affordances in library spaces; how can the library facilitate the community of library users to learn from each other? We report on the findings of a study that employed a participatory design method where participants were asked to reflect and draw places, social networks, and activities that they use to work (be creative, productive), play (have fun, socialize, be entertained), and learn (acquire new information, knowledge, or skills). The results illustrate how informal learning – learning outside the formal education system – is facilitated by a personal selection of physical and socio-cultural environments, as well as online tools, platforms, and networks. This paper sheds light on participants' individually curated ecologies of their work, play, and learning related networks and the hybrid (physical and digital) nature of these places. These insights reveal opportunities for ambient media architecture to increase awareness of and connections between people's hybrid personal learning environments.

Introduction

It is out of lived experiences and through applied meaning that people as groups or as individuals change spaces into places (Carmona, Heath, Tiesdell, & Oc, 2010, p.120). Architecture as a discipline is concerned with informing the design of physical infrastructure in a way that accommodates the conceived function of a particular space, therefore creating place. Information and Communication Technology (ICT), in particular social media, helps to overcome proximity and time challenges within physical space, thus affording social interactions that would not be otherwise possible. Ambient media are a combination of both, architecture and ICT, combining assets and affordances of the physical as well as digital space. Ambient media is said to "convey knowledge distributed in time and space throughout the natural environment of consumers through a digital overlay morphing with physical daily objects" (Lugmayr, Risse, Stockleben, Laurila, & Kaario, 2009, p.338). Ambient media has the ability to create an embodied hybrid space with publicly visible and accessible properties that form part of the physical environment. This can be done using digital assets, allowing people to bridge spatial, temporal, and social barriers as part of their situated spatial experience. In contrast to mobile phones or laptop computers, ambient media is, similar to physical architecture, continuously perceived in the periphery of people's attention. The nature of ambient media shapes people's spatial experience when at a place, rather than just providing information. The adaptation of location-based services, social sensor networks, ubiquitous computing devices and the Internet of Things, promises semantic ambient media installations (Pogorelc et al., 2011) that are capable of providing context-aware, personalised, and interactive services.

The design space of ambient media embraces both bits as well as atoms. Hence, ambient media designers make use of skills and practices from traditional architecture as well as ICT and digital media. This gives rise to a new discipline that is specifically concerned with the design of ambient media. We hereinafter refer to this discipline as "ambient media architecture." Ambient media architecture provides opportunities for situated experiences and social interactions by combining digital space with physical place. However, similar to traditional architecture and media development, the design of ambient media architecture needs to be informed by the socio-cultural nature, needs, and issues of the place that the artifact is targeted at.

This paper aims to inform designers how ambient media architecture can augment public library spaces in their role as informal learning environments. By examining the

opportunities for ambient media architecture to reveal personal learning environments, the library user experience can be enriched.

Background literature

Informal learning is learning that happens outside the formal education system, such as by visiting a library, zoo, museum, or reading a book during one's leisure time. Public libraries, as traditional advocates of open and free access to knowledge and learning, try to attract people from all kinds of professional, cultural, and socio-economic backgrounds. This exposure to diversity has been shown to generate trust, tolerance, and social capital among people in the local community and society at large (Audunson et al., 2011; Cox, 2000; Goulding, 2004), but also claimed to be a fruitful platform for the peer-driven creation and co-creation of knowledge (Aabo et al., 2010; B. Sinclair, 2007; Talve, 2011). In addition to the socio-cultural diversity of its user community, the library as a place provides opportunities for serendipitous discoveries and learning. For example, library visitors find a particular book and are exposed to other books, magazines, community event brochures, and co-present visitors that are dispersed within the library space. These encounters provide affordances for people to serendipitously stumble upon information that they would not otherwise browse or explicitly search for (Björneborn, 2008, 2010). Such room for game and serendipity is a useful quality of the library as a place, and a reason why people often prefer it to e-library services.

Björneborn argues for libraries to provide design interventions that encourage divergent (explorative) information behaviour across physical, digital, and social library interfaces (Björneborn, 2010). However, serendipitous exploration of physical and digital information resources is limited by their ambience and visibility in the physical space that library visitors are exposed to. Open bookshelves, signs, posters, and event brochures are examples to facilitate divergent behaviour. In terms of online resources, a sign or a pointer to a URL somewhere in the physical space increases the chances for being serendipitously stumbled upon by an interested user. With social library interfaces, Björneborn refers to the librarian as an additional information resource who can be consulted by visitors for questions and issues. Recent research studies recognise libraries as attractive meeting places (Aabo & Audunson, 2012; Aabo et al., 2010; Audunson, 2005; Audunson et al., 2007a), not only librarians, but in particular other, co-located

library users are seen as potential information resources and facilitators to acquire new knowledge.

This paper is concerned with ways of enhancing such social library interfaces; how can the library facilitate the community of library users to learn from each other? Information, knowledge, experiences, and skills of co-located users in the library, which might potentially trigger interest, shared encounters and serendipitous discoveries, remain invisible and hard to identify. While online spaces, such as blogs, forums, wikis and social networks are more transparent and provide powerful tools to search and discover specific (social) information, they lack the richness of face-to-face encounters, and all benefits of immediate social interaction. Ambient media architecture has the potential to combine the benefits of online and physical spaces by materialising relevant information through digital fabrication, interactive public screens, 3D projection mappings, amplified or augmented reality, and other technologies in the hybrid space. This research matches learning theories with opportunities provided by ambient media to augment the library as a place for social and informal learning. What are the opportunities for ambient media architecture to tap into the knowledge of its user community and provide it as an additional (social) information resource to other, co-located library users?

Informal Learning Environments

Learning is situated in and facilitated by different environments. Formal learning environments such as schools or universities are highly institutionalised and follow a strict curriculum. Non-formal learning environments are based on voluntary participation outside the formal education system, but are still organised and coordinated by a central institution with a fixed curriculum, such as schools providing cooking classes, driving lessons, and language lessons.

However, not all learning occurs in the classroom. Informal learning environments are often places of physical, emotional, and social comfort that provide stimuli to the senses outside of the typical educational setting. In contrast to formal and non-formal learning, informal learning is learner-centric, driven by the learner's personal needs, interests, and motivations. Livingstone defines informal learning as "any activity involving the pursuit of understanding, knowledge or skill which occurs without the presence of externally imposed curricular criteria" (Livingstone, 2001, p.4). The significance of informal learning is substantial. According to Grebow (2002), 75% of the knowledge and skills

people acquire and adopt through their lifetime, are based on informal learning activities, as opposed to only 25% through formal learning. Learning is more effective when driven by intrinsic motivation and interest, rather than extrinsic motivations such as grades or certificates.

Schugurensky describes such self-directed learning as "learning projects undertaken by individuals (alone or as part of a group) without the assistance of an 'educator' (teacher, instructor, facilitator), but it can include the presence of a 'resource person' who does not regard herself or himself as an educator" (2000, p.50). Learning can take place anywhere, anytime, but what is critical for informal learning is that the learner decides when, where and how they learn (Pesanelli, 1990). There are many places (i.e. informal learning environments) that facilitate different types of learning. Falk and Dierking (2002) define such environments "Free Choice Learning Environments" (FCLE). FCLEs such as history and science museums, wildlife parks, zoos, or aquariums facilitate learning, but leave it to the individual visitor "to control what to learn, when to learn, where to learn, and with whom to learn" (Falk & Dierking, 2002, p.6). However, the physical and socio-cultural context of the space (Falk & Dierking, 2002, p.37) stimulates, facilitates, and supports learning.

In accordance to that, Schugurensky (Schugurensky, 2000) highlights that informal learning does not always have the form of dedicated learning projects that follow intentional and conscious activities. It is often incidental and socialised, embodied in physical and social experiences that we make through interactions with the external world and the social system that we are exposed to. Such learning often happens serendipitously and sometimes without the learner being actually aware of what they have learnt. It is part of human nature to learn through sensuous connections and relationships with the physical environment and the social world. Thus, different types and qualities of learning environments, places or spaces – physical or virtual – can provide alternative learning experiences (de Carteret, 2008, p.507; Mathison, Wachowiak, & Feldman, 2007). Mathison et al. (Mathison et al., 2007, p.206) found that addressing emotional states and stimulating the senses triggers brain function and assists in the learning process. The informal learning process is an individual experience where different types of environments are suitable to different types of people.

Crucial to the success of informal learning environments is the creation of communities around these environments and their development. Communities are not defined by fixed or homogenised collectives but are fluidly created by the diverse people that act

within the group through informal networks (de Carteret, 2008, p.509). "Context is relevant to informal learning. It involves the interrelationships of people and place" (de Carteret, 2008, p.507).

Physical and Digital Learning Environments

Physical, digital, or hybrid environments can facilitate learning, where the digital and physical properties augment each other. The matrix in Figure 22 provides an overview depicting how different environments facilitate formal, non-formal, and informal learning.

Universities exist as physical places, however sometimes also offer dedicated e-learning platforms to pursue courses or entire degrees over distance that do not require physical attendance. Non-formal learning environments such as language schools exist as purely online or offline services. Many universities have joined the open courseware consortium (OpenCourseWare Consortium, 2012), providing free and open study materials to the general public. These materials still follow a structured curriculum and evaluation tools, but in contrast to enrolment in official university programs, they do not require previous schooling and do not offer an official degree upon completion.

Figure 22: The physical, digital, and hybrid nature of formal, non-formal, and informal learning environments

Formal learning institutions have recognised the benefits of blended (or hybrid) learning. Schools and universities increasingly provide digital platforms that complement their offline courses with supplementary learning materials, links to external resources, online communication channels between learners and teachers, etc. Those tools are often controlled by the educational institution, and provided as integrated parts of the courses.

However, communities of practice and informal learning evolve due to the nature of mobile devices and increasing possibilities to connect virtually outside of the physical classroom (Skiba, 2011). Students augment their social learning experience by connecting through their selected online environments of choice such as Facebook or Skype rather than the digital platforms and infrastructures provided, mandated, or supported by the learning institution (Beetham, 2008; Guldberg & Mackness, 2009). Mobile learning by way of iPad, iPhones, smart phones, and other intelligent devices affects how and when students learn. Many students of today have embraced using technology to communicate, socialise and access information (Behling, 2010). Such practices, as Beetham puts it, form an "underworld" (2008, p.465) of informal learning outside the "classroom," but are frequently enabled and sustained by the use of technology.

Siemens (2005) describes connectivism, a learning theory that builds upon the self-directed style of informal learning, the social aspects of learning highlighted by social constructivism, and the significance of digital tools and media and communication channels as part of the learning experience. Connectivism values learning as knowledge that does not reside in an individual's head, but rather spread across a complex environment of many external resources, for example social networks, online databases, fact sheets, books, videos, and blogs. Hence, learning in this sense is based on the learner's ability to recognise and connect to specialised nodes of other knowledgeable people and information sources. As Siemens describes, one of the core principles of connectivism is that the "capacity to know more is more critical than what is currently known" (Siemens, 2005, p.5).

Every learner creates their own Personal Learning Environment (PLE) according to their needs and preferences. In contrast to a Learning Management System that is course-oriented and controlled by the educational institution, a PLE is an individually curated ecology of online tools (search engines, social bookmarking platforms, etc.), sharing services (YouTube, Flickr, WordPress, etc.), information resources (wikis,

databases, e-books, e-journals, etc.) and communication channels (instant messaging, video-conferencing, forums, etc.) that people use to assist, document, and share their learning progress (Educase, 2009). The nature of PLEs, evolved through the rise of Web 2.0, are interactive and collaborative in a way that they enable learners to provide feedback and comment on each other's content. Such connections between PLEs form a Personal Learning Network (PLN), a network of individual people and their PLEs established to support and accompany each other's learning processes.

Hybrid Learning Environments

Most literature on informal learning environments study informal learning either as a phenomenon that is situated in the physical space, or online. Former are focused on the design or nature of physical settings that facilitate learning, such as in museums (Bamberger & Tal, 2007; Falk, 2009), wildlife (Falk, Heimlich, & Foutz, 2009) and other educational leisure environments (Packer, 2006), libraries (Martin & Kenney, 2004; Niegaard et al., 2009; Shill & Tonner, 2004), and dedicated learning environments in general (Chism, 2006; Chism & Bickford, 2002; Joint Information Systems Committee (JISC), 2006; Oblinger, 2006). Connectivism and PLEs are described as purely online-based networks of tools, platforms and services.

Blended learning as a phenomenon that is fertilised by both the richness of physical face-to-face interactions, as well as opportunities and connections provided by digital tools, is mainly discussed in formal learning literature. Behling and Klinger (Behling, 2010) question the appropriateness of technologically rich tools within formal learning environments to support face-to-face learning. Osborne et al. (Osborne, Franz, Savage, & Crowther, 2011) investigate the effect of blended learning environments on architectural education and conclude that blended learning has different levels of success within the formal education of architecture based on factors ranging from pedagogy, technology, and environmental compatibility. Attention needs to be paid to the range of learning environments – face-to-face and blended learning – to allow for different experiences for students with different learning styles.

Research Question

The learning theories described previously point out that informal learning is facilitated by many factors, in particular personal context, physical context, socio-cultural context, digital tools, and media, to collaboratively create, share, discuss, interpret, and evaluate

information, skills, and knowledge. Individuals shape their personal ecology of learning environments in the physical as well as digital space. The ecology's curation is made up of physical places to read, work, socialise, and to pursue personal hobbies and leisure activities; through the choice of one's social environment such as meetup groups and community clubs; as well as through digital channels of choice, such as blogs, wikis, forums, or YouTube channels. We call an ecology of learning environments that is diversified and spread across digital and physical spaces: *Hybrid Personal Learning Environment* (Figure 22)

The public library as a space strives to facilitate peer-to-peer learning, and embrace its user community as an information resource and asset for fellow library users. One way of doing this is to expose people's personal learning environments and networks to each other. When these are exposed and communicated to each other, they can be enriched and built upon by others. Seeing objects or places that are relevant to an individual may attract others with similar interests and lead to a face-to-face interaction based on serendipitous discoveries of new topics and interests. Ambient media architecture provides tools to morph such social user information with the physical space of the library building.

This is the point of departure for our study which asks, what should these mediated, social interfaces look like? What content and information should they provide? And, how should they be represented? In order to provide answers to these questions, we employ a participatory design research method that asks participants to reflect on their personal learning environments.

Methodology

Rather than restricting the insights to learning resources within the library, the method focuses on revealing any personal places, activities and social networks where people *work* (being productive, being creative), *play* (having fun, socialising, enjoying, being entertained) or *learn* (being inspired, acquiring or modifying knowledge and skills), as well as the relationships between these environments. The vision is an ambient medium within the library that visualises a collective network of personal learning environments and resources, enabling library users to explore, serendipitously stumble upon, and be inspired by each other's learning environments. The insights from this study will inform the design of such an ambient medium.

In response to our research question a participatory design (Greenbaum, 1991; D. Schuler & Namioka, 1993) method was devised. Participatory design is used in many fields including architecture, urban design, and computer systems design with the common goal of including stakeholders' participation in the exploration and development of a design problem. Our main concern revolves around how participants communicate their personal learning environments. As discussed by Sander et al. (Sanders, Brandt, & Binder, 2010, p.195) the participatory design method can be utilised to generate a starting point for subsequent development. Based on the framework for participatory design created by Sanders et al. (Sanders et al., 2010) we can describe our participatory design activity as a creative intervention.

The method is designed with two goals in mind: First, it aims to shed light on people's perceived geography and ecology of their learning environments, and how learning is embodied across their everyday lives, activities and places. Second, the methodological design aims to close the gap between ethnography, which is often regarded as a "prolonged activity" (Hughes et al., 1995, p.59) that causes time pressure if particularly dedicated to inform system design, and "quick and dirty" ethnographic methods, such as short term observations or quick user interviews. The method consists of a 30 minute + 30 minute activity with 1-2 researchers and 5-10 users to provide a first overview of people's learning environments. This serves as a stepping-stone to better direct follow-up ethnographic research or in-depth user interviews. We designed the method in particular to inform the role of ambient media architecture installations within an individual user's ecology of personal learning environments, however it might also be useful for researchers, curators, and managers of informal learning environments to inform other design interventions.

Research Participants

The *form* of the intervention was based on making tangible things such as drawings, followed by focus groups, allowing participants to describe their drawings. The *purpose* of the activity was to get a deeper understanding of participants' experience of places associated with work, play, and learning. The *context* involved face-to-face sessions with two different groups of people. Both sessions were conducted in participants' own usual environment. The first intervention was conducted with a meetup group that meets on a weekly basis at The Edge, the digital culture centre and collaboration space of the State Library of Queensland in Brisbane, Australia. The group is named "Hack The Evening"

(HTE) and consists of 14 people that regularly attend the meetings every week, including 3 high school students, and one young woman. The rest of the participants are male ranging in age from 22-55 years. During the meetings people usually socialise, exchange and discuss news, and collaborate on projects related to interactive technologies and media. Some of the participants have known each other from the Hackerspace Brisbane (HSBNE), a workshop space open to like-minded people interested in DIY technology and hacking. The HTE meetup group has been meeting weekly for approximately 18 months and participants were familiar and friendly with each other. This comfortable atmosphere may have assisted in the high level of engagement by all participants.

The second intervention included a group of five higher degree research (HDR) students that work together in a research lab at Queensland University of Technology, in Brisbane. The group consisted of 4 men between 25-38, and one 31 year old female participant. These participants have known each other for approximately 12 months or more. The HTE meetup group and HDR student group were selected as participants who are likely to have a rich established network of informal learning resources, hence providing valuable insights as pilot groups for the exercise.

Participatory Design Exercise

The participatory design exercise was developed utilising basic and familiar materials such as coloured markers, paper, and stickers. These materials were intentionally chosen to be low tech so that any person could relate to them. The use of coloured markers and stickers were used to distinguish information but they also gave the intervention a sense of fun and playfulness. The participatory exercise was explained to the participants asking them to draw places relating to three key themes: work, play, and learning. It was our primary concern to make participants feel comfortable with the drawing exercise; therefore the quality of the drawing was secondary.

In accordance with the theories described earlier, informal learning is a messy process, distributed across various physical places, online tools, platforms, and social networks embodied in other everyday activities, such as hobbies or social events. In an attempt to capture the full body of informal learning experiences in people's everyday lives, we asked the participants to focus on places and activities where they work, play, and learn. Work, play, and learning places are not mutually exclusive, but can overlap. We, for example, introduced "work," not only as one's business office and workplace activities,

but rather any environment and activity where one feels as being productive or creative. Similarly, we introduced "play" for people to reflect on places and activities where they have fun, socialise, enjoy themselves, or are entertained. "Learn" relates to any places or activities where people feel inspired, acquire or modify knowledge and skills.

The same process was employed with both groups. The participants were given a series of six instructions directing their reflection process during the drawing phase. First, participants were asked to think about the work, play, and learning places, which are part of their daily lives. They were asked to draw these places on a piece of paper and then notate and label the places with keywords indicating the nature of the place. On a sheet of trace paper participants were asked to draw activities that are not attached to a particular place. Then, participants used between 1 and 3 coloured dots to indicate levels of intensity of work, play, and learning that related to the places and activities that they had drawn on their papers (1 dot = low, 2 dots = medium, 3 dots = high intensity). The drawing exercise was followed by a focus group where participants discussed their drawings. Each phase, drawing and the focus group discussion took approximately 30 min. The following guidelines were used to assist the execution of the participatory design exercise.

A. **Drawing Activity (30 min):** Let participants draw on an A3 sheet of paper guided by the following instructions:

1) Starting with the place you are in now, draw a diagram of places where you engage in working, playing or learning activities [use colour 1].

2) Write down keywords of your activities / interests that you pursue at these places [use colour 2].

3) Grab a trace paper, write down keywords of any other activities/interests/social networks (that are not necessarily fixed at a particular physical place) [use colour 3].

4) Place between 1-3 dots depending on how productive (work: blue dot), how much fun (play: yellow dot) or how much you learn (learn: green dot) at the different places / activities.

5) Place between 1-3 red dots depending on how relevant physically co-located people are for your work, play, learn experience at the different places / activities.

6) Add anything else to your drawing that seems important to you as part of your work, play, learn experience.

B. **Focus Group Questions (30 min):** Discuss with fellow study participants the following aspects of the drawings:

   1) Explain your drawing and what you did in order to communicate your relevant places and activities.
   2) Explain the relationship between work, play, and learn at different places.
   3) Explain the role of co-located people at your relevant places and activities.

Findings

The participatory design intervention provided rich data and insight into the way that people perceive and communicate a wide range of physical and digital places that are a part of their everyday lives. The findings are broken down into two main sections. The first one discusses how the participants represent places for work, play, and learning through the act of drawing. The second section examines the relationships of places for working, playing, learning, and the informal learning environments, which participants choose to occupy.

Analysis of Drawings

Through the making of a drawing it is possible to observe how people visualise and communicate their understanding of places for work, play, and learning. When examining the drawing of places, four common trends emerged: the use of objects, symbols, shapes, and plans, all of which can be seen in Figure 23.

Figure 23: This drawing shows a combination of drawing techniques to communicate different places

Common attributes of drawing approaches are categorised into four groups: hierarchy of place, geographical relationships, sub-location, and time. The hierarchy of place is communicated in the drawings by a range of approaches including size, position, and order. Placement on the paper in order of importance is evident with some of the drawings, where the most significant place is at the top of the page followed by lesser important places. The size of the place drawn also indicates hierarchy, for example Figure 24 shows how one participant drew home as a large circle in the middle of his paper indicating it is central to his everyday life.

> "I drew my home in the centre as a big circle, because that's the centre of everywhere, I am either going to or from home," (J1).

Figure 24: Drawing of home as central to everyday places

Geographical relationships are communicated in some of the drawings by including major geographical features such as a river. Places are drawn and positioned on the paper in relation to the river, therefore indicating the geographical relationship of places with one another and their location within the city.

> "I draw a map essentially, it's not (to) scale. I have a river in the middle, that's that line. Well, Brisbane river… because I live on the south side, but mostly places I go to are on the north side as well," (JN1).

By combining drawing techniques some participants began to draw sub-locations or smaller parts of larger places. Different activities occur in different sites within home or work (Figure 25).
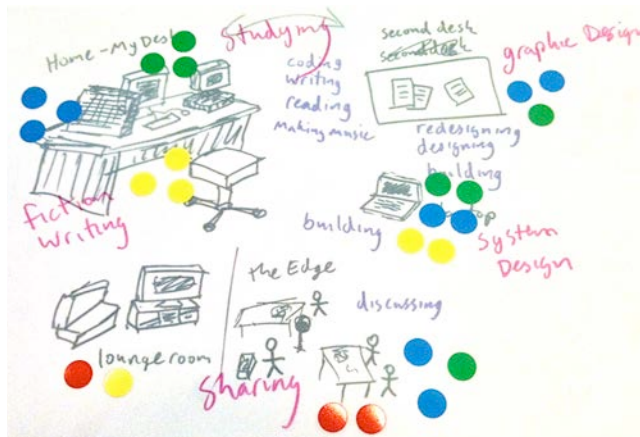
Figure 25: This drawing shows different desks with different activities occurring in the sub-locations

Often participants drew computers and TV screens acting as portholes to digital media and the Internet. The Internet itself is sometimes drawn as a separate place or cloud, indicated through a description of online activities such as "gaming," "reading," or "blogs." One participant organised his drawing based on time. Examining Figure 26, it can be seen that the positions of places on the paper were drawn in a cyclical manner based on a typical day.
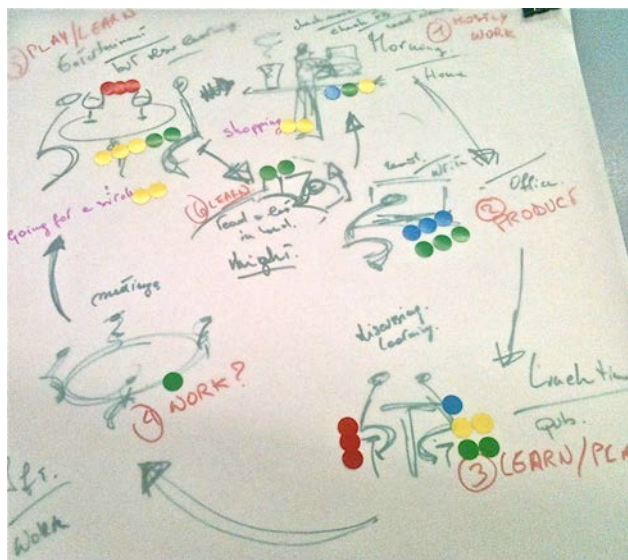
Figure 26: A drawing of work, play, and learning places based on time

The top of the cycle began with the morning where the participant drew himself at the breakfast table reading the newspaper and checking his phone. This is followed by the morning at a desk at work. Midday or lunchtime is positioned at the bottom of the paper. The afternoon shows a meeting room where work meetings take place and the cycle ends with dinner followed by the participant in bed reading. In the focus group

this participant described how he negotiates the amount of play in his day based on how productive he has been during the day. He allows himself to read a fun book at night if he has been productive at work, if not he reads a heavy book that is work related and therefore ending the day with increased productivity.

Relationship among Work, Play, Learn

Examining the drawings gives an overview of the sorts of activities each participant engages in at the places they have drawn. The intensity of work, play, and learning associated with these activities is indicated by the participants' use of coloured dots. Typically places are characterised by a range of one or more activities associated with work, play, and learning. Rarely would a place have only a dot of one colour. This reveals a cross-correlation of such activities within multiple places.

The drawing from one of the participants in Figure 27 shows that he drew the coffee shop with associated blue dots (work) and yellow dots (play). The participant did not include any red dots meaning there is no importance of co-located people to his experience at the coffee shop. His experience of that place is purely personal. This same participant drew a pub, which did include red dots (co-located people) indicating there is an importance of co-located people to his experience at that place. Although both the pub and the café are public spaces typically associated with social activities, it can be noted that these places have different meanings for different people.
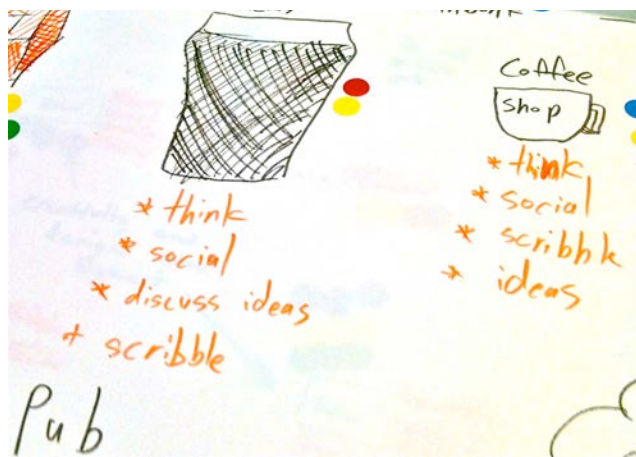
Figure 27: The importance of co-located people

Another example of this is highlighted when examining how participants represent their home. For one participant home is the central and largest place on his drawing (Figure 24) indicating it is very important in his life. His home has elements of play as well as

socialising, revealing it as a fun place dependent on the other family members who are at home.

One of the participants dedicated a large portion of her drawing to home (Figure 28). She seems to do everything at home including crafts, gaming, reading, and daydreaming. She spends a lot of time playing and learning at home, indicated by yellow and green dots. Home appears to be a creative place for this participant as many activities are described by key words such as making interactive dolls and 3D printing. Her home has a sub-location represented by the drawing of her bed, a place for other activities such as reading, web browsing, sewing, learning, playing iPad games, and listening to music.

> "I've got my studio at home which is where I do the most stuff, and I have the
> most fun and I do a lot of learning. I drew a lot of stuff that is in that room and
> it's the biggest," (A1).

Figure 28: Home is drawn to show where a lot of different work, play and learning activities take place

Conversely, for another participant home was not even drawn on his paper.

> "I haven't mapped out home, because even though I am there outside of work
> it's not really anywhere I do anything specific in…" (B1).

When examining the participants' drawings and looking at the workplace, the intensity of work indicated by blue dots varies from one person to the other. Some of the workplaces include elements of play (yellow), some include learning (green), and some include the importance of co-located people (red). For one of the participants the workplace can be understood as a fun place with high amounts of play (yellow) and learning (green). However, play and learning are not dependent on other people as there

are no red dots. The actual work itself is fun for the participant without needing to interact with anyone else.

> "…because I love going to work, it's a great place... I ahm... don't like all the people at work. Basically I go there to work, and I sort of keep to myself. Cuz I am the only one who does what I do at work, so I don't need to interact with anyone," (J2).

The intensity and range of dots tended to correspond to how much people liked their place of work. Places of work with high levels of play and social elements seemed to be more enjoyable places than those with only elements of work (blue) and learning (green). For some of the participants the workplace is purely about producing or conducting a service (Figure 29).

> "…I've defined my work as the 'grind house' because it really is… you get a task, you do a task, consistently, repeatedly, so yes you are being productive, but not in a way that actually feels to me as being productive…" (B2).
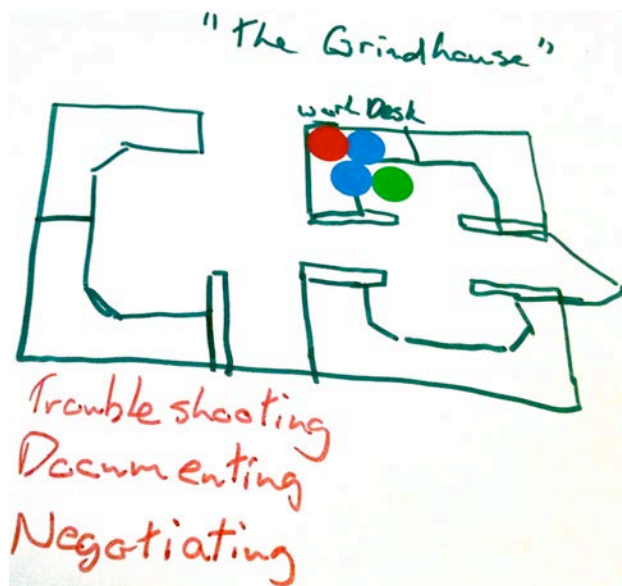
Figure 29: Drawing of work as the "Grindhouse"

Places that are marked with all colours are associated with work (blue), play (yellow), and learning (green). Per definition, those places provide an experience to users where they feel creative, entertained, and have a social experience all at the same time.

> "…there is band practice which I have been doing lately with my friends, that is interesting because it's a bit of learning and also equal parts learning equal parts play, there is a bit of work there because, um, writing songs are being constructed…" (K).

We are interested in what such personal "buzzing" places have in common, and filtered them accordingly. The criteria for a "buzzing" place are a minimum of two dots of each colour. The resulting locations turn out to be places such as friend's houses, the library, public urban places, particular suburbs, the internet, as well as hobbies, leisure activities, community places or meetup groups such as a dance performance group, local board games / cards club, where people come together and interact based on their common interests. The common factor amongst these places is that they are places where people can meet face-to-face and rely on these encounters to be productive, to learn from one another, and to enjoy the company and knowledge of others.

> "I was going to say about The Edge, I am not sure I would come here if there was no one else here, because… if I wanted to work on something that didn't need anyone else's help, I would do it at home, but you come here because you want to talk to other people because you want to or because you need their help, their opinion," (K1).

Figure 30 shows a drawing that depicts a "buzzing" place, the Hackerspace Brisbane (HSBNE), a workshop space for like-minded people interested in DIY technology, tinkering and hacking.

> "…the space [Hackerspace Brisbane] is probably where I spend a lot of my efforts. I get a lot of work done there, a lot of play done there, I get a lot of learning done there, because there is a lot of like minded people that know a lot more about some things than I do and I know a lot more about some things than they do so it's very much a collaborative environment…"(B3).

Figure 30: This drawing highlights places with dots from each category highlighting "buzzing" places

Discussion

The drawings illustrate how informal learning occurs across a network of online and offline learning environments that are particular to each user. In contrast to the separation in research literature, informal learning is not a purely online or purely offline experience. It is shaped by an individual's participation in activities and social networks across virtual, as well as physical environments.

Furthermore, informal learning does not exclusively take place at dedicated informal learning environments (e.g. library, museum, etc.) or during dedicated learning activities (e.g. reading a book), but rather embodied in everyday activities and places that involve social interaction, productivity, and fun. Every individual is involved in a range of physical places, online spaces, activities, community groups, social networks and technologies that facilitate access to, interaction with, and across those networks. Individual needs and interests shape the choice and intensity of involvement in such networks. Hence, each person's informal learning experience is a personalised patchwork of online and offline networks that facilitate learning in one-way or another. Previous literature has used the term 'communicative ecologies' (Foth & Hearn, 2007; Hearn & Foth, 2007) to describe social communication and interaction patterns as experiences that are formed, shaped and maintained across different media, technologies and physical environments. Similarly, the findings in this paper give rise to the assumption that informal learning is formed, shaped, and maintained as learner-specific ecologies of hybrid personal learning environments.

These findings provide a starting point to understand how people experience, create, and maintain their personal ecologies of learning networks and environments. Figure 31 is a diagram of the nature of people's ecology of hybrid personal learning environments (HPLE) as personal selections of networks across three different layers (HPLE 1-3): Technology, place, and people (Foth, Choi, et al., 2011). Each layer and the connections between the layers differ from person to person, as these connections create HPLE networks particular to the individual. This initial study provides empirical grounding for the theoretical concept of HPLEs.
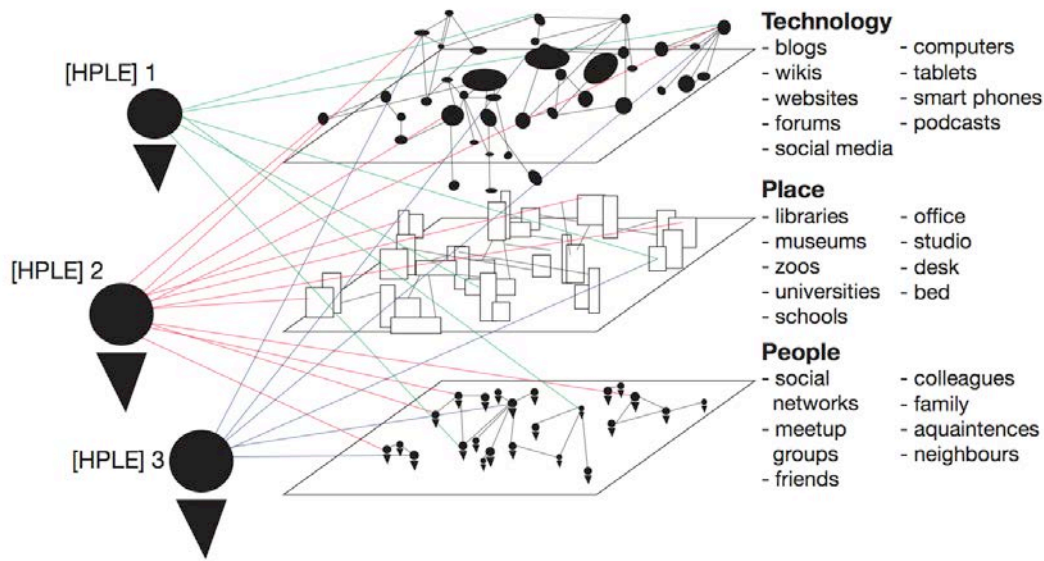
Figure 31: Hybrid Personal Learning Environments are personal selections of networks across different technologies, places and people

What do these findings mean for the design of ambient media architecture in libraries? Our participants, for example, outlined interests and hobbies such as interactive doll making through microcontrollers, circus performance practices, the making of laser light shows, or strategy card games. Each of those activities is bound to particular places, community groups, or other networks.

Ambient media architecture that reflects such ecologies of HPLEs, for example, through representations of people's places, social networks, hobbies, activities, communities, subcultures, special interests groups, tools, media and technologies, may provide valuable insights, inspiration and serendipitous discoveries of new topics and interests to other library users. Such ambient media architecture would provide an interface to the social capital within the community of co-located library users. An example would be a digital wallpaper that tells all users "who knows what" to facilitate connections to people with similar interests or complementary skillsets. However, how can the individual networks of learning environments be visualised and fed back to the user community? What design language can or should be used for communication? The findings from the participatory design exercise reveal ways that participants intuitively represent their own learning environments and networks. Through the process of making a drawing, participants had to reflect upon their personal learning experiences in order to visually communicate their work, play, and learning places.

These drawings – similar to a rich picture (Monk & Howard, 1998) – provide insights into the ways in which non-designers visually communicate. From the drawings it can be seen that many of the participants rely on the use of symbols and objects to signify place. Written words were also used to describe the places and activities they drew. The use of different fonts and graphics helped participants communicate a hierarchy of importance and emotion. From this we can begin to derive a design language that is in direct response to the stakeholders' perceptions. The design language used to create ambient media architecture should speak in a language that is understood by the stakeholders to encourage their interest and participation. This design language will develop as a result of the design process and the input from the participants. The opportunity for ambient media architecture in the library space will be to visualise the urban ecology of personal learning environments and feed it back to the community. Furthermore, the drawings and follow-up focus groups identify personal "buzzing" places where people learn, but also feel they are creative, entertained, and having a rich social experience all at the same time. The Hackerspace for example appears to be one such place for some people. Three of our participants report the Hackerspace as a regular hotspot for them to socialise, be creative, and learn new things through copious interactions, collaboration, and exposure to other likeminded members with complementary skillsets. The identification of such buzzing places provides a step towards further research about what happens when people engage in work, play, and learning activities at the same time.

Further in-depth ethnographic research at different "buzzing" learning environments (e.g. Hackerspaces) will provide insights about people's interactions and learning experiences at these places. Why do some people perceive such environments as "buzzing"? What makes those people feel creative, entertained, and having a social experience all at the same time, and others do not? What is the nature of the physical and digital infrastructure at such places? What do the interactions at such places look like, and how do work, play, and learning activities combine and potentially cross-fertilise each other? Shedding light on these questions will help inform ambient media architecture as well as general design interventions towards making libraries more attractive environments to engage in informal learning activities.

Finally, the drawings also provide an understanding for how people organise their personal learning spaces. Our participants for example have different desks at home to pursue different activities, such as fiction writing, graphic design, coding, or 3D printing.

Beds are used to surf the web and read blogs on iPads while relaxing at the same time. Such insights inform how the library as a learning space can be organised towards better accommodating people's learning styles, needs, and habits. Designers might for example consider creating different zones for different activities, such as noisy areas for socialisation; small desks for focused individual work, and day beds to accommodate relaxed learning activities.

Conclusion

This paper presents a participatory design research method that asks participants to reflect on their personal learning environments. The participants reveal personal places, activities, and social networks where they work (being productive, being creative), play (having fun, socialising, enjoying, being entertained) or learn (being inspired, acquiring or modifying knowledge and skills). The findings give rise to the assumption that informal learning is formed, shaped and maintained as learner-specific ecologies of hybrid personal learning environments (HPLEs). Informal learning is embodied in everyday activities and places that involve social interaction, productivity, and fun. The results discuss opportunities for ambient media architecture to augment public library spaces by reflecting representations of people's HPLEs, hence provide affordances for divergent information behaviour, serendipitous encounters, and inspirations between fellow library users, which would otherwise remain invisible. This research will inform our further work. We plan the development of two design interventions, which sit within the domain of ambient media architecture: *Gelatine* and *Fraggle Rock.*

Gelatine is a check-in system that allows public library users to "check-in" with a personal HPLE profile confirming their presence at the library. Public screens and 3D projections will reflect a collective representation of all checked-in library users' HPLEs. Observations about user interactions and perceptions of the installation will provide further insight and feedback about the value of such ambient media architecture in library buildings.

Fraggle Rock uses digital fabrication for participatory media architecture in order to produce an interactive installation in a library. The installation will incorporate digital fabrication methods to translate social media data into physical artifacts to be used and combined by participants to represent their hybrid personal learning environments and networks. The artifacts are inspired by the crystal structures made by the humanoid

'Doozers' in the *Fraggle Rock* TV series. The purpose of the installation is to expose the interests and activities from each participant to each other by collectively building a physical construct. Once the networks are revealed and made public, participants can make connections with one another based on common interests. Based on the findings in this paper that people's learning experiences benefit from social interaction in physical places, the research aim of *Fraggle Rock* will be to examine how ambient media architecture crossing digital and physical representations can facilitate face-to-face encounters and social interactions in public places.

Chapter 9:

Social, Spatial and Technological Aspects for Designing Effective Coworking Spaces

Bilandzic, M., & Foth, M. (2013, under review). Social, Spatial and Technological Aspects for Designing Effective Coworking Spaces. Learning, Culture and Social Interaction

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Statement of Contribution

This paper has been co-authored with my principal supervisor Assoc. Prof. Marcus Foth. Marcus' contributions are limited to editorial comments and minor revisions.

Preamble

Based on the research findings in Chapters 6, 7 and 8, I developed an understanding of the challenges, as well as factors that contribute to rich connected learning experiences (intrinsic motivation, opportunity for exploration and experimentation through self-directed activities as well as inspiration, motivation and support from peers, etc.). The user study in Chapter 8 reveals everyday social environments where people feel they have such connected learning experiences. This paper explores three of these environments (coworking spaces, meetup groups and hackerspaces) and focuses on the social, spatial and technological aspects where such groups meet, and why they meet where they meet. Exploring such organically grown aspects within such environments, the aim was to derive design guidelines for space makers to better accommodate and facilitate collaboration and connected learning. The paper is written for an evolving audience of researchers and practitioners that are interested in design aspects that can improve collaboration, connected learning and networking among people who share the same physical space.

Abstract

Collaboration, social learning and networking are essential success factors in today's knowledge economy. However, there is also an increasing number of independent, self-employed, and project based workers, who, on the one hand, enjoy the flexibility of being able to decide when and where to work, but, on the other hand, struggle with a new set of issues such as isolation, lack of social contact and networking opportunities. Coworking spaces, as an increasingly popular work configuration, promise these workers collaboration, social learning and networking opportunities across organisational and disciplinary boundaries. They strive to nourish a culture of learning, sharing and peer interaction. This paper identifies relevant socio-spatial aspects and design factors that contribute to the creation of successful coworking spaces. It reports findings from observations and interviews with users and managers of organically grown meetup groups and hackerspaces with a coworking mentality, as well as professionally curated coworking spaces across Australia. The findings reveal social, spatial and technological design interventions that these spaces apply to facilitate effective coworking, in particular social learning, collaboration, networking, and serendipitous cross-fertilisation of knowledge and ideas among their users.

Introduction

The increasing ubiquity of Internet connectivity, digital technology, web applications, and mobile services led to shifting trends in how people work, collaborate and learn. Today's increasingly independent, self-employed, project based and flexible types of work allows some work activities – especially in information, service, knowledge, creative, design, and experience professions – to be easily detached from the office premises and be performed "anytime or anywhere." As a result, we witnessed some shifting trends in workspace configurations over the past two decades. *Teleworking,* enabling people to work from home, evolved as a popular work configuration, in particular to save expensive urban office desk space. However, teleworkers experienced a set of issues as a result of teleworking, such as social isolation, lack of networking opportunities and dissolving boundaries between work and home spaces (de Jong & Mante-Meijer, 2008; Ellison, 2004). *Nomadicity* (Kleinrock, 1996; de Carvalho, 2012) evolved as a trend of office workers occupying, negotiating, and appropriating the city as their office to avoid the monotony in office spaces, as well as the lack of social

contact when working from home. Hampton and Gupta (2008) found an increasing number of workers that leave their traditional office cubicles and nomadically appropriate 'third places' (R. Oldenburg, 2001) such as cafés, parks, and libraries, as their office space, enabled by the provision of desk space, views and ambience, social patronage, electricity, wireless Internet access, and – coffee. An important aspect that is lost in both *nomadic* and *telework* is what Grebow (2002) describes as learning that happens at the water cooler. Only 25% of skills that people need for their jobs are acquired through formal learning, whereas *"…the other 75 percent of learning happens as we creatively adopt and adapt to ever changing circumstances. It happens when we ask someone a question at the water cooler – and get an answer"* (p. 57). Serendipitous social interactions with colleagues at work account for a significant amount of learning. Bingham and Connor's (2010) definition describes such effects as *social learning*, i.e.,

> "…[the] result in people becoming more informed, gaining a wider perspective, and being able to make better decisions by engaging with others. It acknowledges that learning happens with and through other people, as a matter of participating in a community, not just by acquiring knowledge."

Social learning is often a tacit or incidental (Bennett, 2012; Schugurensky, 2000) by-product of participation in particular socio-cultural environments.

Over the past decade, professionally curated *coworking spaces* have emerged fostering social learning and networking opportunities among their members. The coworking model has gained much popularity, and referred to as a sustainable work space configuration for the future of work (Butcher, in press). 71% of coworkers report that their creativity has increased, and 62% said that their standard of work has improved as a result of joining a coworking space (Deskmag, 2012). The global number of coworking spaces has grown exponentially since 2006 (Deskmag, 2011a).

The success and rising trend of coworking spaces have triggered the attention of parties outside the coworking industry (e.g., governments, public libraries, universities, organisations) that hope to provide better social learning opportunities for their stakeholders, clients and users. The South Australian government, for example, recently announced that it will provide AUD 1 million to help establish a coworking space in Adelaide in order to boost entrepreneurship and innovation in the region (adelaidenow.com.au, 2013). Public libraries – in their quest to adapt their services to the digital information age – have been increasingly removing bookshelves in order to provide more floorspace for infrastructure and interior design elements that invite for

coworking, peer-to-peer learning, and collaboration (LaPointe, 2006; Martin & Kenney, 2004; McDonald, 2006; Shill & Tonner, 2003). Innovative organisations as well as the lessors of office spaces have started to experiment with different configurations of amenities that not only make employees feel at ease, comfortable, and more productive, but also increase opportunities for networking and serendipitous cross-fertilisation of knowledge and ideas among colleagues.

However, actionable knowledge and academic literature on effective design and management of coworking spaces are still limited. The few existing studies that focus on users of coworking spaces (Bilandzic & Foth, 2013b; Spinuzzi, 2012) indicate that there is a lack of design knowledge in relation to socio-spatial aspects of coworking. Addressing this gap, this paper aims to identify relevant socio-spatial aspects and design factors that contribute to the creation of a successful coworking space; in particular, design factors that facilitate social networking, peer-to-peer learning and collaboration, and serendipitous cross-fertilisation of knowledge and ideas which individual users benefit from as a result of coworking from the space.

We first introduce the nature and perceived benefits of coworking as discussed in previous literature. Based on these insights, we formulate a research question that is of contemporary interest to practitioners as well as researchers on coworking. We then describe our methodology, present the findings, and discuss their implications for management and design as well as further research in relation to coworking.

Coworking – Between Creative Distractions and Getting Things Done

From a work configuration point of view, coworking means managing the tensions between rich opportunities for social learning, networking and interactions with other workers, and getting things done. Spinuzzi (2012) found two main attitudes towards coworking that he describes as *good-neighbours* and *good-partners*. Users with a good-neighbours attitude are mainly interested in working with other coworkers in parallel (on their own, individual projects) rather than in collaboration, good-partner coworkers recognise and utilise their coworkers as potential business partners and collaborators. They utilise the coworking space to team up with other freelance coworkers to tackle collaborative projects. Spinuzzi describes such configurations in coworking spaces as a *"nexus of transient work teams composed of specialists"* (p. 32). Those two distinct attitudes

towards coworking can cause conflicts about the object and socially accepted behavioural norm of coworking. The messiness on desks and workspaces that resulted from collaborative efforts between good-partners, for example, clashed with the desire of good-neighbours to invite clients for business meetings in a space that represents professionalism. However, the diversity and fuzziness of people's attitudes, activities, project foci and areas of expertise is a core ingredient to stimulate productivity, creativity and social learning. In accordance, users across various studies in coworking as well as library spaces (Aabo et al., 2010; Björneborn, 2010; Hurry, 2012; Spinuzzi, 2012) point out that the mixed exposure to *homogeneous* as well as *heterogeneous* people is a crucial quality of these spaces.

In Hurry's study (2012) on coworking, participants described 'creative collisions' being the most important aspect of coworking. As one of his participants describes, *"…people float in and out and that is why the meeting space is really interesting […] it brings in a different group of people [into the Hub] and we like to mix it up as much as possible"* (p.42). As a result the coworking space is perceived as *"…a space that is different every time you walk in"* (p. 6). As an interviewee in Spinuzzi's study put it, *"I can get really different views, because I have individuals across the spectrum in their jobs and what they do. You can get a better idea of what people think outside of the industry that you're in"* (Spinuzzi, 2012, p.20). Aabo et al. (Aabo & Audunson, 2012; Aabo et al., 2010) identify libraries as places for *high-intensive* and *low-intensive* meetings, i.e. people live out and interact around their primary interests in life (e.g., student study group, language learning group, photography meetup), as well as are exposed to diversity and otherness, e.g., through encounters with people with social and cultural beliefs, values or interests that are different to their own. One of their interviewees, for example, would choose to work from the public library rather than the university library, due to the rewarding experience of being exposed to a wider age range of people, and their activities (playing game consoles, reading newspaper, surfing the net, etc.). Similarly, Björneborn (2010) found that people value the library for its affordance of *convergent* as well as *divergent* information behaviour, i.e. as a space to find particular books on their core interests, as well as where they can stroll around and randomly stumble upon new information that they were not necessarily looking for (e.g., books, magazines, community event brochures, etc.).

Based on these insights on the core ideas and perceived benefits of coworking, the remainder of this paper strives to provide answers to the following research question – *What are relevant design aspects to facilitate serendipitous encounters, inspiration, and cross-fertilisation*

of ideas and knowledge among homogeneous as well as heterogeneous groups of people who share the same workspace?

Methodology

This study follows a two-sided approach. First, it investigates organically grown social settings, interaction formats and spatial environments of meetup groups and hackerspaces, as instances of groups that naturally engage in collaboration, social learning and co-creation of knowledge. Second, it explores current experiences and best practices of commercial coworking spaces in relation to facilitating social learning, networking and collaboration between their members.

Investigating the Socio-Spatial Context of Meetup Groups and Hackerspaces

Meetup Groups and Hackerspaces were selected as case studies of what Thomas and Seely-Brown refer to as *collectives* (Thomas & Seely-Brown, 2011, p.52), i.e. groups of likeminded people who regularly meet based on a *shared passion* or *intrinsic interest*, in particular to collaborate, teach and learn from each other. Interested and passionate individuals form such collectives to share experiences, exchange tips, tricks and skills, celebrate their shared interest, advance knowledge and progress their subculture on a local and global level; for example, groups of web developers, hobby gardeners, photographers, digital artists, music consumers, wind surfers, hip-hop dancers, skateboarders, etc. While collectives on a global level often interact in virtual environments (e.g. connect via forums, wikis, mailinglists, social networks, etc.), this study investigates collectives that meet locally in face-to-face settings. In such settings, knowledge is created through interaction and collaboration between physically co-present people. The co-location and face-to-face interaction with other people is a crucial factor for the experience of the individual. This study focused on the *socio-spatial aspects* that are organically grown by and through the interactions in collectives:

- What do people in collectives do when they meet for social learning purposes? What structures and formats do their interactions follow?

- Where do they meet for social learning purposes, and why do they meet where they meet?

- What (social, spatial, technological) interventions do collectives employ to facilitate social learning?

We interviewed 13 organisers of Brisbane based meetup groups from Meetup.com, and participated in 7 of these meetup groups for one or two of their sessions beforehand in order to make observations and notes that informed the interview questions. Some of the interviewees turned out to be organisers or members of other meetups, too, which were included as part of the interview conversation, if they suited the research focus. Some of the meetups are based on small groups of up to 20 people, others have more open settings that regularly attract 200+ people for their events. 11 of the 13 meetups are non-profits. 9 of those 11 are free to attend, and two charge a nominal attendance fee (AUD 2-5) to cover their basic costs. The other two groups were labeled as "conferences" with a focus on education of professionals in web design and digital marketing. The organisers run these conferences as their full-time job.

In addition, this study covers interviews with the founding members or acting presidents of 5 *Hackerspaces* across Australia (hackerspaces.org/wiki/Australia), i.e. Hackerspace Brisbane ("HSBNE"), Hackerspace Sydney ("Robots and Dinosaurs"), Hackerspace Adelaide, Gold Coast Techspace ("GCTS"), and Hackerspace Melbourne ("CCHS – Connected Community HackerSpace"). The first author has been an active member of HSBNE and participated in their weekly meetups for six months prior to the interviews. Hackerspaces represent a particular type of meetup group that usually require a communal space with special tools, equipment and infrastructure for their activities.

Investigating Socio-Cultural Interventions and Best Practices in Coworking Spaces

To explore the best practices in curating coworking spaces, we conducted in-depth interviews with the proprietors or general managers of four different coworking spaces in Australia. The focus was on their interventions to facilitate community building and cross-pollination of skills and knowledge between their members. The study includes three coworking spaces. *Thought Fort* (thoughtfort.com.au) and *Salt House* (salthouse.bris.biz) have about 20 permanent coworkers each, while *River City Labs* (rivercitylabs.net) and *Hub Melbourne* (hubmelbourne.com) represent bigger coworking spaces with a few hundred members each that come in more or less regularly depending on their membership plan (ranging from every day to a few hours a month).

All interviews were conducted in face-to-face settings or via phone, according to each interviewee's availability and preference. The interviews were semi-structured and audio-recorded for follow-up transcription purposes. For the data analysis we followed a Grounded Theory approach (Strauss & Corbin, 1997) and mapped (re-) emerging patterns as presented and discussed below.

Findings

Meetups and Hackerspaces are Social rather than Physical Destinations

The meetup groups and hackerspaces in this study show examples of collectives in physical environments where knowledge is being created and shared in a peer-to-peer fashion. People become part of these larger collectives to feed their need for learning, progressing as well as expanding their skills, knowledge and expertise in particular domains. The organiser of the local IxDA Brisbane group, for example, reports that the goal was to establish a platform for professional "User Interface and User Experience Designers" to network and connect with each other across organisational boundaries.

> "…the core motivation of running a local IxDA group is to provide a space for interaction design and user experience design professionals in Brisbane to get together, share and learn from each other, giving professionals the opportunity to have contact with other likeminded and similarly skilled people outside of their workplace."

Other meetups are formed based on their desire to connect with similar people within a larger subculture. Girls who work in IT for example, share the same interest, but – as a minority in the industry – struggle with particular issues. "Girl Geek" was formed as a meetup group for girls that are interested in IT to support and help each other, share tips and experiences and build networks among women in IT. As one interviewee explains,

> "…you want to connect to someone who has not only the same interest to you, but also is similar to you; being a girl in this [IT] industry can be quite hard."

People's participation and learning is not reinforced or directed by a third instance such as a teacher or instructor, nor is it rewarded by a certificate, diploma or degree.

Participation in these social environments is intrinsically motivated by personal interest and curiosity. Learning happens as a result of a more or less unstructured social gathering of people in a shared physical space, and interactions that take place at those gatherings. As the founder of Hackerspace Adelaide reports:

> "Something magic happens just by getting people together. When they are all together in one room, you work on your thing and just mention your idea or problem and someone else randomly picks up on that idea and comments on it and all of a sudden you have these ideas coming from different people. That's something bigger than everyone working on individual stuff."

Unlike in *formal* (schools, universities) and many *informal* learning environments (workshops, driving lessons, cooking class), there tend to be no set agendas or learning goals. Rather, peer-to-peer learning and the exchange of experiences and knowledge are practiced through informal conversations and interactions with others. As a member from Hackerspace Melbourne puts it,

> "…turning up at a Hackerspace meeting, you never quite know who is gonna be there on a given night. Some night there are people just doing research on their project, but you know, you'll turn up another night and some dude who has never turned up before has arrived with some bizarre thing they've created. It's fun to just go and hear these stories and see what they've built."

As such, the Hackerspace and meetup groups provide an environment for intrinsically motivated, *self-directed* activities. At the same time, sharing the same space with a community of likeminded, creative other user users, individuals are exposed to what Schugurensky (2000) refers to as incidental learning and learning through socialisation. The function of the actual space is important (as described in the next section), but secondary. Similarly, the philosophy of coworking spaces is to create benefit through knowledge spillovers and inspirations among coworkers. As one of the coworking space managers summarised,

> "The real asset, I suppose, is not the lease or the desks or any of that stuff, it's the relationships of people within the space. And I mean that's why people come back. That's why people work here."

A core aspect across all meetup groups, hackerspaces and coworking spaces in this study is that they are perceived as *social environments*, rather than purely *physical destinations*. The groups are founded and maintained as forums for social gathering, collaboration and knowledge sharing with likeminded others. As such, they are different from the

traditional notion of communities, as they are generally not based on a sense of belonging to a geographic location (Foth, Choi, Bilandzic, & Satchell, 2008; Gusfield, 1975) or to a group of emotionally close ones, but rather on a sense of shared beliefs, values, interests, as well as passion and participation around those with others.

Selection Criteria for Meeting Spaces: Accessibility, Infrastructure and Social Atmosphere

Space is *built*, *selected* or *re-appropriated* according to the group and their activities. The hackerspaces in this study all started as meetups of interested enthusiasts without having their own dedicated space. Hackerspace Sydney was started in a random Sydney café, which was soon overcrowded by more than a hundred participants. As the group became too big, they had to leave the café and continue their meetup on a close-by parking lot. One participant offered his vacant house as a gathering place, where soon after, people started bringing along tools and equipment to work with and share with the community. A couple of years later, the community became big and strong enough to afford and rent out a proper hackerspace. A similar evolution is reported by the founders of Hackerspace Brisbane, Adelaide and Melbourne.

Other (in particular smaller) meetup groups, who do not have their own fixed community spaces, gather in public places in the city, such as bars, cafés or restaurants. Such places have usually not been designed for collaborative or creative activities in mind, but rather as places for socialisation or consumption. The groups carefully select their meetup place based on particular criteria, and apply tactical practices to re-appropriate such spaces according to their needs.

They tend to gravitate towards places that are easily accessible (central location in the city, closeby public transport, etc.), provide the required infrastructure for their group specific activities (e.g., desks for work on laptops, projectors for presentations, WiFi, etc.), and have a social environment that suits their needs. As different groups have different requirements, some of which contradict each other, they gather in different places in the city. The games engines and IxDA group, for example, seek quiet environments to film their presentations or work on collaborative tasks with little external disruptions. The Silicon Beach meetup, on the other hand, aims to facilitate connections between people that have mutual or complementary interests (technology developers / entrepreneurs, entrepreneurs / investors). They hold their meetups in local bars or restaurants to facilitate sociality.

Meetups continuously evaluate and re-negotiate their meetup space as their groups evolve. The Brisbane Jelly group, for example, started as a coworking meetup in the public library, but was not happy with the "no food," and "no backpacks" policy. They migrated to a closeby community centre, which allowed food and backpacks, however, as their work was mainly laptop based and involved intense internet usage, they found the lounge areas with no desks uncomfortable to work from, and the WiFi too slow for their purposes. Eventually, group members started to move desks from adjacent rooms to the communal lounge areas, and set up 4G WiFi routers to create their own wireless Internet networks, which provided faster internet access than the public one shared by all other visitors.

Other meetups, when they realise that they cannot appropriate public third spaces according to their needs, escape to private homes or office spaces that group participants volunteer for the group after-work hours. The Brisbane IxDA meetup group, for example, started their meetings at a local Brisbane bar, but soon moved to an office space of the group organiser's employer, where they could use office facilities, the stationary cupboard, projector and speakers to engage in collaborative workshop activities, or participate in interactive online workshops together. The office also provides a controlled, closed environment in the CBD, so the group does not have to worry about external interruptions.

However, a space that only provides optimal work conditions is often not sufficient. The SNAP architect meetup group, for example, is familiar with the recently launched local library space that provides dedicated meeting spaces and cutting edge technology infrastructure. However, the group does not use it for their meetings, because it does not cater for the social apects of the group very well. As the founder of SNAP architects reported,

> "… you can't get a glass of wine there or a beer [laughs]. Which I think, you know, you're asking people to come along after a full day's work and you're trying to create a setting that's overlapping, you wanna feel like you're going to something relaxing with friends yet at the same time you're really having like a meeting. So I don't know, being able to get a drink there is really one of the prerequisites I think."

On the other hand, if the atmosphere at a place is too social, the group does not feel comfortable with engaging in activities that are obviously work related.

> "If you went to a lot of bars and you had, you know, several people there with like you know notepads and drawings, in most bars you'd probably feel like an idiot I think [laughing]. You've got all these people partying and yelling, and you know you'd feel a bit silly."
>
> <div align="right">(Founder of "SNAP Architects")</div>

As a tradeoff, the group specifically seeks places with an atmosphere that provide a healthy trade-off between formal work and sociality. An optimal place should accommodate what the interviewee refers to as *"half-social, half-information meeting type situations."* SNAP found two spots that cater for these specific needs, a café close to the library and a restaurant bar in the CBD. The founder describes the social atmosphere at these places as follows:

> "[The café] at the State Library, there is WiFi and there are people there who you're competing for tables with, who have their laptop and they're skyping someone, they're drinking their coffee or having their wine. It's got that sort of overlap from the social and the sort of information transfer. And the same with [the restaurant bar] in the city, because it's like a bar in the city, business people would go there and meet there and it's open enough; it's not so noisy, so it's always people who've come down from the offices around 'cause you know it's in the base, the podium around this office tower.... so there is always those sort of people having little business meetings."
>
> <div align="right">(Founder of "SNAP Architects")</div>

Hackerspace members, on their way back from work, often bring pizzas, fast food and drinks to eat while 'hanging out,' discussing current projects, ideas and experiences, or simply watching other members 'getting their hands dirty' and working on their projects. Hackerspace Melbourne reports that when they were looking for a space, it was important that it not only allows for *"noisy, dirty and smelly activities without the fear of damaging good flooring,"* but can also host separate soft work areas (software programming and laptop activities) and social areas (kitchen, couches, TV and game console area for chilling out, chatting and relaxing). These were also mentioned as core elements that Hackerspace Brisbane was looking for, when they recently moved to their new premises.

The bigger meetup groups in our study recognised this need and provide catering service ranging from finger food and drinks to organised dinners. The BrisScience group – organised by the University of Queensland – has an invited guest speaker for each of their monthly events, who gives a talk on a science and technology related

topics. Rather providing a usual lecture series on campus, the organisers provide a free glass of wine and cheese snacks for all participants.

> "You know, you would go and watch the ballet, or go to an art gallery and you would get enjoyment out of watching those things. I don't think there is any... shouldn't be any difference between those sorts of leisure persuits and going to see a really stimulating science talk. The only difference is that you don't usually go to a science lecture and sip your wine while you discuss dinosaurs or cosmology."

The popularity of the meetup is significantly based on the fact that it is perceived as a social outing that is fun, enjoyable and informative, rather than a traditional science lecture. In addition, the organisers deliberately picked a venue off-campus in the city centre, and close to the main train station. In doing so, the meetup is easily accessible and attracts over 200 participants per event mostly from the general public, not just academics. Similar setups and motivations were described by the organisers of Pecha Kucha Brisbane (a lightning talk series around design, arts and other creative fields), Barcamp (an un-conference around digital technology), and Silicon Beach (a meetup group for entrepreneurs, founders and investors). In all these meetups, the actual core purpose of meeting up (e.g. peer-to-peer learning, inspiration, exchanging knowledge and experiences, discussion about latest developments in the field, networking, etc.) is embodied in practices of socialisation, such as having drinks, snacks and informal conversations.

Social Learning and Interactions in Larger Groups Requires Facilitation

The different groups in this study follow different formats (structured, semi-structured, unstructured), require different levels of interaction between participants, and consequently provide different learning experiences.

	Group Interactions		
	Structured	**Semi-structured**	**Unstructured**
Format	Strictly structured and fixed	semi-structured with room for co-curation by participants	unstructured, self-directed
Participation	passive	active or passive	active
Learning Experience	curated, predictable	semi-curated, unpredictable	Not curated, self-driven, social, serendipitous, unpredictable
Significance of Interactivity with collocated participants	low	medium to high	high
Example	Pecha Kucha, Public Lecture Series	Barcamp, Unconferences	Co-working Spaces, Meetup Groups, Hackerspaces

Table 2: Meetups differ in the structure of interaction between participants, and learning experiences they provide.

The smaller **meetup groups** in this study (*Jelly, Games Engines, SNAP, Shut-up and Write*) and Hackerspaces mostly have no structured elements that guide interactions and learning experiences among peers (Table 2); group activities are often defined spontaneously, or are self-initiated and driven as individual projects, while co-present group members function as facilitators of each other's individual progress and learning experience. The learning outcome of these unstructured "hangouts" with the group is unpredictable and serendipitous. However, as Hackerspace Melbourne reports, the success of having a collaborative culture in the space depends on having

> "…a few key personalities who are actually doing a couple of things: drive enthusiasm, be willing and open to share their time and skill, to get other people involved or help them with their projects and so on […] You kind of need almost these catalysing elements that will help it become a vibrant community, and partly there is leading by example."

In **hackerspaces**, this is usually the role of the president, however, this common ethos is also understood and promoted among all hackerspace members. The learning experience is heavily based on one's individual level of activity and openness to engage in interactions. Lazy and passive users usually have no or very poor (social) learning experiences (Figure 32).

Figure 32: Hackerspace meetings usually do not have a learning agenda. Learning experiences are serendipitous and unpredictable, and based on active participation and self-driven interactions with other members.

Bigger meetup groups (*Pecha Kucha, BrisScience*) provide fixed timeslots for talks or presentations by pre-defined and promoted speakers. As such, the participation level of the audience is rather passive, and the learning experience quite predictable. The collective intelligence of participants is not leveraged as a learning resource during the talks; however, the social gatherings, conversations and discussions around drinks and snacks after the talks, provide a forum for richer social learning experiences. *Barcamp*, in contrast, is set up as an *unconference,* i.e. organised, curated and driven by the participants themselves, rather than an official host. There is *"no spectators – only participants,"* as our interviewee reported. All attendees are encouraged to contribute to the conference; either as a presenter or facilitator, e.g., through documenting the event via blog posts and sharing comments, pictures, links and other relevant content via social media. The format of the event is semi-structured. It leaves plenty of opportunities for serendipitous encounters, conversations, discussions and unpredictable (social) learning experiences, however, provides a rough framework for particular user-driven activities. Those are for example short "lightning talks" for attendees to share their projects, ideas, products or any themes that they find interesting, or "show and tell" sessions to present work-in progress or prototypes of current project to inspire, discuss and gather feedback from others. These elements are not only perceived as the core attraction of

the event, but more so as a means to spark interest and provide ice-breakers for follow-up conversations and connections among participants.

Coworking spaces mostly aim at providing unstructured environments. Similar to the behavioural norm in Hackerspaces, people are focused on their individual, self-directed activities, but seek to gain social learning experiences as a result of sharing the same physical space with other coworkers. Based on a comparison between coworking spaces, hackerspaces and meetup groups in this study, we made the following observation.

The bigger a social environment, the more opportunities for social learning there are; however, the bigger and more heterogeneous the people in the group are, the more facilitation is required to nurture social learning and interactions (Figure 33).
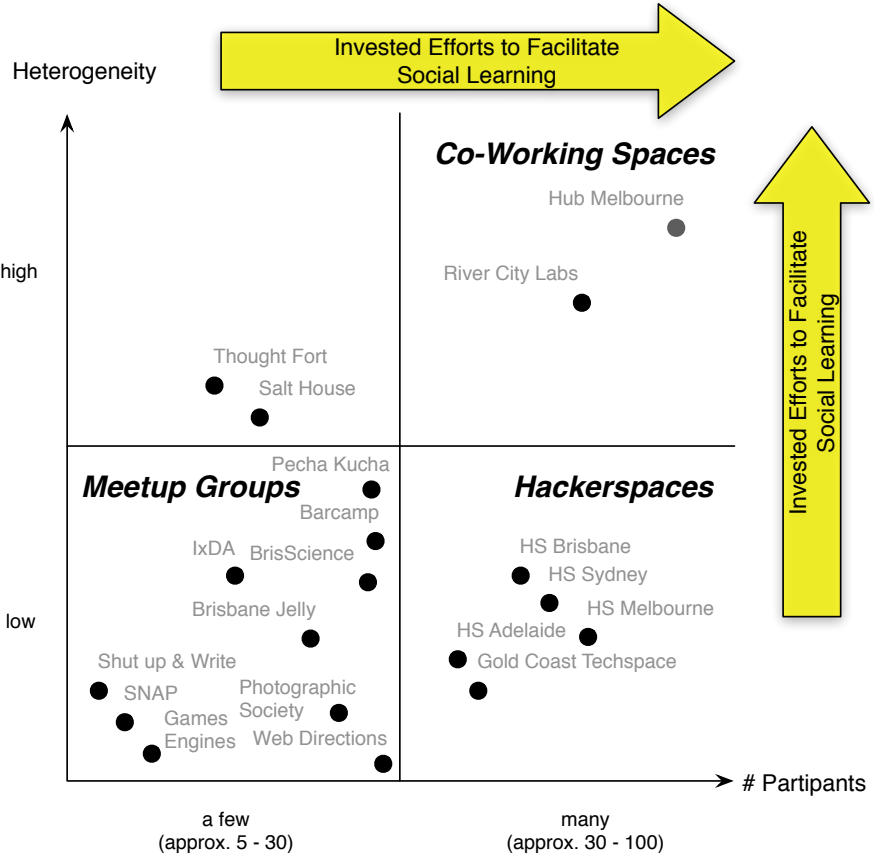
Figure 33: The higher the size and heterogeneity of a group, the more facilitation is required to nurture social learning, collaboration and networking.

In the smaller coworking spaces in this study (*Thought Fort* and *Salt House*) with around 20 mid to long terms members who work in the same or related industries (online marketing, web development, graphic design, etc.), social interaction between coworkers

occurs almost naturally as a result of a small number frequently sharing the same physical space and interests. According to the *Thought Fort* manager,

> "…there is surely ways that we can make it better […], but I guess we just don't have such a big necessity for that."

At bigger coworking spaces (*Hub Melbourne, River City Labs*), on the other hand, a few hundred members regularly go in and out. In addition, they work across a wider variety of industry sectors (government, corporate businesses, small to medium enterprises, non-profits, social enterprises, academia) and disciplines (sustainability, technology and web, change management, organisation development, arts and entertainment, innovation processes, journalism). As a consequence, there is no obvious connection between two random coworkers, and the space being regularly traversed by hundreds of people counteracts the natural bonding of small place-based communities. In accordance, bigger coworking spaces tend to invest more effort and resources in facilitating social learning experiences among their coworkers. We identified three major types of interventions: social, technological, and spatial facilitation.

Social Facilitation

Hub Melbourne, for instance, hired a full-time person to catalyse connections between members – the "Space Host."

> "Her role, full time, is to connect people. Which means that every single person who walks into Hub Melbourne knows her. She is everyone's friend, and it is through that friend, the Host, who will introduce you to someone else, that trust is built. We trust our peers, so she is now your peer and is able to build a connection with you, and that's how collaboration happens."

The Space Host is carefully recruited as a person who understands work across different sectors, industries, disciplines and cultures; she is a generalist, rather than a specialist, being able to understand the value of each individual member and their background, profession and areas of expertise, to catalyse connections where there is a potential for collaboration. The Host also needs to have a *"social touch"* that allows her to not only match people based on their passion and skillsets, but also their personalities, attitudes and beliefs – crucial factors for fruitful collaboration. Due to exponentially growing memberships, *Hub Melbourne* makes an active effort to crowd-source the role of the Host by encouraging all coworkers to catalyse connections, and reinforce a culture of networking and collaboration:

> "We often also make it very, very clear and obvious to everyone that you have the permission and you should connect people and be the Host yourself. […] we think it's very natural for people to do certain things, but a lot of times even ourselves, we often need permission before we do anything… So we always make it very clear, and always tell people you have the permission to be the Host and you should be the Host as well."

Further, established members can volunteer for a buddy system that helps new members to feel welcome, get connected and settle in the space during the first three months of their membership. *Hub Melbourne* also supports their members to initiate or join what are called "Hub Clubs" – member-driven groups that gather around a particular interest or passion (e.g. the "runners club" meets every Tuesday for a run through the city, and the "business club" is around the exchange of ideas and concepts to improve businesses) – this initiative nourishes little, tightly knit sub-communities within its larger community of coworkers. Informal social events such as brown bag lunches, shared dinners or "Social Beer Fridays," also create new cross-links between coworkers, creating a more and more connected, and tightly knit community. *River City Labs* as well as *Hub Melbourne* regularly invite industry experts to give a talk or workshop about a topic relevant to the coworkers' businesses. This provides another opportunity for likeminded coworkers to meet and "rub shoulders" before, in, and after such events.

Technological Facilitation

The different groups in this study, in particular the bigger meetup groups, hackerspaces and coworking spaces, apply various technologies to connect and stay connected with other group members.

Hackerspace members are connected via IRC (an instant messaging system) and different e-mail mailinglists (which connect each Hackerspace locally as well as all Hackerspaces across Australia) all of which are logged, openly accessible and browsable in history. The number of subscribers to the email lists are often tenfold to the number of active members (e.g. Hackerspace Adelaide has 10-12 members and approx. 150 mailinglist subscribers, Hackerspace Sydney 30-40 members and over 400 mailinglist subscribers), which hints at the fact that the conversational topics within the spaces are of interest to a broader community, of which the majority appear to be 'lurkers' (Ebner, Holzinger, & Catarci, 2005). In addition, many Hackerspaces have websites or Wikis listing tutorials of previous projects, instructions for particular tools and machinery or lists of members with their particular areas of expertise. Such digital sources make it easy

for members to identify other members with complementary skills or previous experiences.

Coworking spaces use different social media platforms to provide a virtual backchannel for their members. *River City Labs* has a Facebook group, Google Plus and Google Groups. At *Hub Melbourne*, every member is automatically assigned with a Yammer account, which is used as a continuous backchannel to share news, seek collaborators, ask for tips and recommendations and announce or organise social after-work events. Recording and analysing the number of visits and amount of Yammer messages per day over a period of one year, *Hub Melbourne* found that the amount of Yammer messages significantly correlates with the number of people who visit the space per day. These use patterns underscore the significance of Yammer as a simultaneous background channel between co-present coworkers. At the same time, members who do not work in-situ regularly participate in such conversations. *Hub Melbourne* manually selects the core discussion themes and topics from members across different social media networks (Yammer, Facebook and Twitter) and cross-pollinates the conversations by aggregating content into their weekly e-mail newsletter.

Spatial Facilitation

The spatial infrastructure and interior design of all coworking spaces was designed with collaboration and social interaction in mind. An active effort is for example made to keep the space open and furniture mostly arranged in a way that does not constrain eye-sight, but rather facilitates mutual awareness among coworkers. The *Thought Fort* manager reports that they

> "…managed to find quite unusual desks, almost like triangle desks but with a curve edge, so three of those would fit together to form like a circle of desks […], so people weren't looking into the wall, but you could see sort of half the room. Not looking directly at anyone, but you're in an easy talking range."

Different *zones* are created to accommodate different types of work, activities and moods. The main coworking area at *Hub Melbourne*, for example, provides different styles and sizes of desks (round, rectangle, small, large) to accommodate individual as well as team work (Figure 34). The interior is purposefully separated into meeting areas with whiteboards, a boardroom with video conferencing and presentation facilities, an idea room for brainstorming, silent areas for individual focused tasks, couches for

informal conversations, a relaxation area with beach chairs and a hammock, and a large kitchen to prepare coffee and meals.

Figure 34: Coworking space at Hub Melbourne. The interior suits to individual as well as collaborative work, and accommodates different activities and moods of work. (Screenshot from http://hubmelbourne.com/coworking-space)

Spaces for socialisation have a particularly important role for bonding. According to Deskmag, for the majority of coworkers (81%) it is highly important that the coworking space is close to food options such as snack bars or restaurants, or even come with a café or kitchen as part of the space (Deskmag, 2011c). All coworking spaces in this study have a kitchen that allows members to store and prepare their own drinks and food. In the interviews, the kitchen was often described as a place where conversations between random individuals are easily initiated, as there is a mutual understanding that the other person is not being interrupted at work. Kitchens are perceived as what Goffman refers to as "open regions" (Goffman, 1966, p.132), i.e. environments where it is socially acceptable to initiate a face-to-face conversation with a stranger. They are also designed similar to what our earlier meetup group interviewee referred to as *"half-social, half-information meeting type situations." Hub Melbourne* has a large dinning table, a small library and comfortable chairs, which invite activities in the kitchen that blend socialisation and work. In fact, in the six days of observations, the kitchen at *Hub Melbourne* was almost continuously populated with people having breakfast, preparing lunch or brewing tea or coffee while discussing work related matters.

Discussion

The insights from meetup groups, hackerspaces and coworking spaces in this study show how they function as social environments for likeminded people to meet, interact and collaborate around a shared passion, profession or interest.

As such, it appears, they not only form a new type of work configuration, but more significantly, provide precious locales for social capital, trust and strong interpersonal relationships to evolve – an increasingly important function in today's globalised and networked society. Wellman (2002) describes how interpersonal relationships in communities have changed as a result of globalisation and the introduction of ICT. The prevalence of door-to-door relationships ("Little Boxes") in pre-industrial times when the radius of social interaction was limited to people in the spatial proximity, has been increasingly weakened by place-to-place relationships ("Glocalised Networks"). Rather than being forced to interact, work and socialise with people in the same neighbourhood, urban dwellers can select their workplace and every day social environments beyond the physical boundaries of the local neighbourhood. The nodes in such glocalised networks represent communities of shared interest, such as workplaces or households. However, they tend to interact in private, place-based and homogeneous silos. As Wellman points out

> "…there is little social or physical intersection with the intervening spaces between households […] People often get on an expressway near their home and get off near their friend or colleague's home with little sense of what is in-between. Airplane travel and email are even more context-less." (p. 4).

The same phenomenon translates to many contemporary work configurations. Medical doctors work with medical doctors, academics work with academics, biologists with biologists, computer scientists with computer scientists. They operate in their respective work places (hospitals, universities, research laboratories, etc.) mostly in isolation from other fields and disciplines; telecommunication and transport networks are used to connect and interact with a global community of people and organisations with shared interests. However, the nature of these interactions tends to be trapped within the individual disciplinary silos without much room for serendipitous encounters and inspiration from 'outside.' In today's knowledge economy, where disruptive innovation and creativity is based at the intersection of fields, disciplines and cultures (Johansson, 2004), such work configurations can often be counter-productive.

Meetup groups, hackerspaces and coworking spaces represent grass-root initiatives to provide local forums for social interaction, collaboration and encounters with other people around a shared interest. In contrast to the traditionally fairly isolated organisational workspaces, they are open locales that continuously attract new people from various backgrounds, fields, disciplines and interests. In doing so, they take better leverage of the social pluralism and diversity of urban environments. In accordance, the exposure to people from other backgrounds, interests and professional domains, as well as the opportunity to collaborate and interact on shared interests were perceived as the main benefit of the meetup groups, hackerspaces and coworking spaces in this study. This finding is in line with the global Deskmag study (2011c) which found that 86% of coworkers regard the opportunity for social interactions as an important aspect of coworking, as well as the ability to share knowledge (82%), and the *"random opportunities and discoveries made through such interaction"* (79%). Theoretically, this would mean that the bigger the coworking space the more attractive it should be for coworkers, as it provides more diversity and opportunities for interactions, serendipitous encounters and knowledge sharing. However, Deskmag's global survey also found that if coworking spaces get too big, they become less attractive; only 4% of coworkers prefer environments with more than 50 users (Deskmag, 2011c). While bigger coworking spaces provide a wider network of potential ties to other people, these ties are thinner and more loosely connected than in smaller spaces (Deskmag, 2011b).

Public libraries – providing free and open work and collaboration spaces to the general public – are the probably biggest coworking spaces in terms of both number of users and their diversity. In our previous study on a coworking space that was launched by a public library and frequented by a few hundred people every day – we found that the social atmosphere and behavioural norm between users was similar to other public places, such as a bus stop or shopping mall (cf. Goffman, 1961, 1966). Collocated unacquainted users regarded each other as strangers, and usually only engage in direct interactions if there is an obvious reason, such as helping someone in need. Users mostly worked individually and in isolation from other users, or collaborated within groups that they pre-negotiated a meeting with, but usually did not make new connections, interact or get inspired by coworkers. These interactional patterns have been found in other user observations in public libraries (Aabo & Audunson, 2012; McKechnie et al., 2004). What do the findings from this study mean for the design of coworking spaces?

Co-Working: Local Knowledge Communities require Dedicated Spaces

Despite functioning as successful hubs for innovation, creativity and peer-to-peer learning, as well as social interaction and growth of social capital within a local community, there is little support from government or the private sector interest-driven knowledge communities such as meetup groups, or hackerspaces. There seems to be an unfulfilled need for appropriate spaces where local creative groups and knowledge communities can flourish.

The insights from meetup groups illustrate their struggle to find and (re-) appropriate public places that meet their needs. Many bars, restaurants or cafés are ruled out, because they lack the minimum required infrastructure for their work activities (WiFi, powerplugs, whiteboards, projectors, ergonomic seats and tables, etc.), or because they embody a social environment that disrupts or clashes with the users' desire to engage in creative activities.

Public libraries, on the other hand, have been deliberately built and funded by governments to facilitate access to information, social learning, co-creation of knowledge and social capital among the general public. They provide better (physical) work conditions, but are often dismissed, because of their lack of hospitality and support of community and sociality. Recent trends in library design embrace places of socialisation such as coffee kiosks, and lounge areas (LaPointe, 2006; McKechnie et al., 2004; Shill & Tonner, 2003; Waxman et al., 2007), but, in contrast to the intrinsic motivations of group members observed in this study, libraries tend to cater mainly for the physical and infrastructural needs of learning, and not so much for the social aspects of it. It is not surprising to observe interactions between strangers and people from different backgrounds in libraries as *"…in most cases indirect and nonverbal"* (Aabo & Audunson, 2012, p.146). Varheim suggests, the library as a place to meet others and build social capital, appears to be no more significant than other public places such as shopping malls or bus stops (Varheim et al., 2008, p.889).

Butcher (in press), on the other hand, identifies coworking to nourish a sense of community, cooperation, belonging, collaboration, co-creation, and social capital between local people – qualities of and within local communities that have increasingly suffered from the effects of urbanisation and globalisation. He acknowledges coworking spaces to *"foster an appealing habitus that fills a void in urban society"* (Butcher, in press, p.5). According to Figure 33, libraries share similar work configurations as coworking spaces – many people from heterogeneous backgrounds share the same physical space. The

findings in this study suggest that such social assets and benefits in coworking spaces do not come naturally, but need to be facilitated. The insights from meetup groups, hackerspaces and coworking spaces suggest some core (social, technological and spatial) design factors (see "co-curating" further below) that facilitate healthy and fruitful interactions to nurture communities of knowledge, collaboration and learning. Those are relevant for designers, managers and decision makers that have an interest in nourishing a place-based knowledge community, e.g. libraries, corporate office buildings, research laboratories, coworking spaces, etc.

Co-Designing: Design Space "with" and "by" Users, not "for" Users

The study's insights indicate that there is no "one size fits all" solution. Every knowledge community has their own spatial requirements and employ group interaction formats (structured, semi-structured, unstructured) according to the group's evolving needs and motivations. Space proprietors need to do research about their target knowledge community, and shape their space and infrastructure to accommodate their particular activities, practices and spatial needs, rather than adopting generic solutions. In fact, the evolution of meetup groups and hackerspaces shows that these local knowledge communities evolve even before there is a dedicated space that facilitates their interactions. Space is built and continuously shaped, or selected and continuously evaluated and re-negotiated according to the group's activities and evolving needs – not the other way around. Space proprietors need to be sensitive and afford such organic, bottom-up appropriation of space. The community should be embraced as co-creators, co-designers and co-owners of the space, rather than just "tenants" or "users." They need to be able to take *ownership* and continuously adjust and re-appropriate spatial arrangements according to their needs. However, such user-led spaces can cause tensions with traditionally imposed top-down regulations such as health and safety policies or facility management. Those need to be re-evaluated towards allowing more flexibility, but at the same time, keeping order.

Co-Curating: Social, Spatial and Technological Means to Facilitate Connections

The findings also suggest that the design and planning of successful coworking spaces should not only be concerned with spatial and architectural arrangements, but more so with social facilitation and community building. Meetup groups, hackerspaces and

coworking spaces are usually not only perceived as physical destinations, but more importantly, places to meet new people, network as well as engage in social learning and collaborative activities. The bigger a social environment is, the harder it is to maintain such an open and social atmosphere. The bigger coworking spaces in this study provide insights into how they facilitate the creation of strong ties among their 600+ members, despite being large communities. Bonding is facilitated through *social*, *technological*, and *spatial* interventions.

In terms of **social facilitation**, Space proprietors need to think how they can attract "key personalities" as they exist in hackerspaces and meetup groups, and encourage them to share their enthusiasm and passion with other users. Mechanisms such as reward, reciprocity or reputation are often applied to motivate people to share knowledge and contribute to online platforms (forums, wikis, content sharing, etc.). Further research needs to investigate how equivalent programs can increase user engagement in real-world spaces that host knowledge communities, and possibly, how they can be linked back and cross-pollinated with equivalent digital spaces. Further, public libraries, for example, employ librarians who catalyse connections between people and information resources (books, collections, digital archives, etc.). However, what knowledge communities also need, are the equivalent of a librarian who catalyses connections between people and people (with similar or complementary skills).

Technology can be applied to complement the physical space with digital backchannels that make invisible social aspects of space visible, thus enabling users to better identify likeminded others. As Bullinger et al. (1998, p.17/18) found, the *lack of awareness that one's skills might be useful* for someone else, and the *lack of awareness which skills are in demand* are the main barriers of knowledge transfer between colleagues in organisational settings. Yet, most organisational systems are based on groupware, i.e. systems that assume that participants know each other (email, teleconferencing systems, etc.). In this context, Wellman (2002) suggests to rather think of technology as "networkware," i.e. systems that facilitate connections with new people through *"search for information and the selective disclosure of one's own information"* (p. 8). Elsewhere we provide an overview of locative and mobile media (Bilandzic & Foth, 2012) and ambient media architecture (Caldwell et al., 2012) that facilitate such connections between physically collocated people. Space proprietors need to think about how such technologies can be applied to facilitate social interaction and contribute to community building within the space.

Spatial arrangements, such as a central location in the city or accessibility through public transport, ergonomic desk spaces, and supportive infrastructure for individual and collaborative work are crucial elements to attract users. At the same time, different knowledge communities and coworkers might have contradicting or competing motivations and spatial requirements. Space proprietors need to think about the core target groups that they are trying to attract and how the space can accommodate all their activities. Different zones can be dedicated for different activities (meetings and discussions, silent laptop work, socialisation, etc.). Falk (2009) found contradicting motivations and needs among museum visitors, and suggests dedicated opening hours for particular visitor preferences, e.g. silent visiting hours vs general visiting hours where parents can bring kids to engage in noisier activities. Varying the purpose of space zones at different times for particular activities could increase the number of activities that a space can accommodate.

Goffman refers to *"open regions"* (Goffman, 1966, p.132) as physically bounded places where initiating face-to-face contacts with unacquainted others is socially acceptable. Two unacquainted people who meet at a social party at someone's private home, for example, have a right to *"initiate face engagement with self-introductions"* (p. 135) based on a mutual understanding that they have the host as a shared friend. Creating "open regions," such as a shared kitchen, provides opportunities for coworkers to initiating face-to-face conversations without the fear to interrupt the other person in a work related activity. Previous initiatives have developed design concepts for creating dedicated open sub-regions in public transport (Trinh, 2011) or urban public places (Harrington, 2012) to encourage interactions between random strangers. Further research needs to investigate how such design concepts could be adapted to coworking environments.

While it might be counterintuitive for places such as public libraries to get a license for serving beverages, in meetup groups and coworking spaces it appears to be crucial for facilitating social interactions, discussions and ultimately the co-creation of knowledge. According to a coworking space manager, *"the most inspirational conversations and discussions between coworkers occur on Fridays, after a couple of glasses of wine."*

Conclusion

This paper presents socio-spatial insights from meetup groups, hackerspaces and coworking spaces. The findings show that these environments serve as successful and –

in the context of today's knowledge-economy – increasingly important venues to meet and interact with likeminded people. They embrace the pluralism and diversity of society by providing open and inviting locales for networked individuals to meet around their work, interests and passion outside of the isolated barriers of work and home. The findings illustrate tactical practices of such groups to find and re-appropriate public places for their meetups, and underscore their need for dedicated spaces that support their activities. The paper explores and discusses a number of organically established patterns and best practices found in meetup groups, hackerspaces and coworking spaces that not only contribute to accommodate spatial arrangements, but also to shape, nourish and maintain a supportive community. These facilitations embrace spatial, social and technological interventions.

Chapter 10:

Learning Beyond Books – Strategies for Ambient Media to Improve Libraries and Collaboration Spaces as Interfaces for Social Learning

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Preamble

This paper introduces the design rationale and design concept of a technology intervention that aims at bridging some barriers of connected learning that were identified in Chapter 6 (in particular as embodied by the Personas *What-can-I-do-here Sophia*, *Learning-Freak Fred*, *I-wanna-share-it Garrett* and *Coworking Chris*). The design was further informed by the findings in Chapters 8 and 9. The first half of the paper introduces some themes that were already discussed in previous chapters; in particular, a summary of findings from the case study at The Edge (Chapter 6), and a summary of previous literature on *locative media* (Chapter 2) and *sense of place* (Chapter 4).

Abstract

With the advent of digital media and online information resources, public libraries as physical destinations for information access are being increasingly challenged. As a response, many libraries follow the trend of removing bookshelves in order to provide more floorspace for social interaction and collaboration. Such spaces follow a Commons 2.0 model: they are designed to support collaborative work and social learning. The acquisition of skills and knowledge is facilitated as a result of being surrounded by and interacting with a community of likeminded others.

Based on the results of a case study on a Commons 2.0 library space, this paper describes several issues of collaboration and social learning in public library settings. Acknowledging the significance of the architectural characteristics of the physical space, we discuss opportunities for ambient media to better reflect the social attributes of the library as a place; i.e. amplify the sense of other co-present library visitors and provide opportunities for shared encounters and conversations, which would remain invisible otherwise. We present the design of a user check-in system for improving the library as a physical destination for social learning, sharing, and inspiration for and by the community.

Introduction

In the digital information age of the 21st century, the significance of library buildings as a physical storage for books and archives is decreasing. Instead, libraries place a stronger focus on providing an information commons place: i.e. an informal learning place that encourages its users to contribute, participate, and engage with the library, its services as well as other library visitors towards a collaborative, social construction, and dissemination of knowledge.

Commons 2.0 (B. Sinclair, 2007) refers to a trend that puts a strong emphasis on designing library spaces that accommodate collaborations, meetings, social hangouts, and comfortable work. It suggests spaces that are open, free, convenient, inspiring, and practical; i.e. designed in ways that facilitate open sharing, collaboration, and human interaction, thus fostering the learning principles of social constructivism (cf. Vygotsky, 1978; Wertsch, 1997). Contemporary trends in library building design embrace open architecture approaches such as no walls or only glass between different work spaces, in order to facilitate serendipitous cross-disciplinary discoveries from people who work

side-by-side; or reconfigurable furnishing and continuous connectivity through free WiFi to allow flexible formations that suit different modes of interaction and learning, such as individual study, group work, or presentations (McDonald, 2006; Niegaard et al., 2009).

However, the vision of the library as a public place for collaboration and the co-construction of knowledge is subject to social barriers such as naturally limited interactions between strangers, or simply not knowing "who knows what". The goal of this paper is to investigate how ambient media can augment the library's physical manifestation to facilitate shared encounters between library users who could potentially benefit from meeting each other due to shared interests or complementary knowledge. Over the last couple of decades, an established body of research has been concerned with e-library services, i.e. opportunities by information and communication technologies (ICT) to make library services more efficient (e.g. digital indexing and catalogues) as well as being accessible to anyone at anytime (e.g. e-services, digital archives, e-book loan systems) independent of a user's location and the library's opening hours. Other studies show how social learning can be enriched through extended interactions by means of virtual channels (Ebner et al., 2005; Motschnig-Pitrik & Holzinger, 2002). However, there is only limited research into how digital technologies can facilitate the sharing, collaboration, and social construction of knowledge in and through a physical place.

This paper aims to fill this gap by identifying untapped potential for ambient media in physical library spaces, in particular "embodied hybrid media" that takes advantage of both digital ICT and the physical architecture of the library. The remainder of the paper is structured as following:

We first present our insights derived from a case study on The Edge at the State Library of Queensland in Brisbane, Australia – a bookless library that was designed with Commons 2.0 in mind. We identify two main challenges for collaboration and social learning as perceived during users' everyday visits in our case study. In our theoretical framework section, we discuss relevant theories in the domains of place, people, and technology, and shed light on several challenges and barriers for social learning in libraries and collaboration spaces. Based on a discussion of Web 2.0 technologies and locative media, we suggest four design strategies for ambient media to improve library and collaboration spaces as interfaces for social learning. An example scenario is presented to illustrate how ambient media design can bridge social and spatial barriers

and enable users to engage in social learning activities, in particular with the ideas of sharing, collaboration, and social constructivism in mind.

The Challenges of Collaboration and Social Learning in a Public Library

The paper presents a design idea that is both theoretically informed and driven by the analysis of empirical data gathered in a previous study at The Edge (http://edgeqld.org.au/), an initiative of the State Library of Queensland (SLQ) in Brisbane, Australia. In order to illustrate the issues addressed by this paper, we briefly outline several core findings of our study at The Edge.

The Edge represents a tangible example and prototype of a new engagement concept as part of SLQ's evolution in the digital information age. Officially labelled as a '*Digital Culture Centre'*, The Edge maintains the library's traditional values as a physical hub for knowledge and information, not through books and information archives but as a "*hub for both planned and incidental collaboration – people stumble upon each other and create new possibilities that wouldn't have existed otherwise*" (Unconventionbrisbane, 2010). As such, it aims to foster co-creation and the social construction of knowledge.

Much of The Edge's physical environment was designed according to Commons 2.0 principles (B. Sinclair, 2007). The Edge's designers explicitly envisioned and designed its environment, services, and programming to facilitate an interactive and collaborative culture with and among its visitors. It provides an open and pleasing physical environment that accommodates group work, meetings, presentations, and social gatherings. In fact, the technical as well as architectural setup and interior furnishings at The Edge were explicitly designed with collaboration and open sharing in mind (Figure 35). The physical space aims to facilitate social interaction, discussion, and collaboration; e.g. lounges and couches, a presentation hall, a coffee and snack bar, and technical infrastructure including networked computers, projectors and projection screens, and free Wi-Fi.

The goal of this carefully-designed place and cutting-edge technical infrastructure is to attract, support, and nourish a community of primarily young people (the target group is 15-25) to meet, explore, experience, learn, and teach each other creative practices in various areas related to digital technology and the arts. The Edge was launched in February 2010 as the first institution of its kind in Australia.

Figure 35: The Edge was designed with collaboration and open sharing in mind. The physical architecture and interior design invite for the collaborative activities and coworking of users.

For our case study at The Edge, we engaged in five months of ethnographic research, resulting in more than 70 informal conversations as well as 30 audio-recorded interviews with selected visitors during their informal everyday visits and activities. The observations and interviews were made at different times and days during the week. Our aim was to understand how people make use of The Edge as a public space that is

explicitly dedicated to collaboration and peer-to-peer learning. The findings indicate that The Edge, following a Commons 2.0 concept towards a community-driven *centre* for digital culture, struggles with two issues: (1) The Edge's physical environment does not communicate its purpose particularly well; it has a lack of perceived affordances (Norman, 1999) for users to retrieve, access, and benefit from the community of other users as an information resource; and (2) unlike the access to information from a book or Internet resource, approaching co-present library users for conversation or collaboration is subject to social barriers. Table 3 and the following two sections describe those issues in more detail.

	Information Resource	Information Retrieval		Information Access	Learning Paradigm
		convergent (goal-directed, explicit information need)	divergent (explorative, implicit information need)		
Traditional library	physical or digital document (e.g. book, journal, digital archive, web page)	find catalogue, index, key word search, etc.	browse bookshelf, serendipitous discoveries, etc.	low barriers (e.g. pick a book from the shelf)	Constructivism (e.g. reading a book, isolated study)
Commons 2.0 space	human (user community, co-present users)	Design Question 1 ?	?	Design Question 2 high barriers (social barrier of talking to a stranger, availability, mood)	Social Constructivism (e.g. collaboration, discussion, peer-to-peer learning)

Table 3: Human library interfaces: How can design interventions enable library users to retrieve and access information from the wider user community?

Lack of Perceived Affordances to Gather Information From the User Community

At the beginning of the 20th century, libraries adopted an open access model that allowed users to freely walk around and browse shelves for books according to their interests. As Dahlkild points out, "… the users could find and read the books they were looking for, but they could also stumble upon something unexpected. These possibilities were important aspects of a new type of library and a new library identity that the room itself both expressed and contributed to create" [2, p. 20]. The books, as integral parts of the interior design, communicated the function of and conceived activities within the library as a place. Catalogues and themed signs reveal what digital and physical resources are available, and what topics and domains they cover. Such affordances, as Björneborg observed, enable visitors to engage in convergent (goal-directed) and divergent (exploratory) information behaviour (Björneborn, 2010).

In contrast, the conceived value of new library approaches around Commons 2.0 spaces is primarily in social interactions within the user community, in human rather than physical or digital resources. The emphasis is on social learning, collaboration, and interaction rather then isolated study. However, in contrast to pointers and affordances that direct users to physical and digital resources (Björneborn, 2008), the physical environment of most libraries does not communicate much about the user community and the resources it has to offer. Library spaces that went entirely bookless such as The Edge struggle to convey the Commons 2.0 vision. In our study we found that users, in particular first time visitors, are often confused about what The Edge is and what one can do there. Some of the visitors, as we observed, do not even enter the space, but leave half way in. That issue may partly be a PR and marketing problem; the public needs time to understand the concept of information commons being embodied into a physical place, as opposed to the common, traditional perception of the library as a place to grab a book and read, or engage in self-study.

However, similar to books, signs, and catalogues in traditional libraries, we argue that the physical environment of future library and collaboration spaces must provide perceived affordances that enable users to retrieve and access information from the community of other library users. It needs to promote and facilitate access to its user base as a social interface for gathering new information and knowledge.

The Edge, even though its physical architecture, interior design, and infrastructure are perfectly set up to host collaborations, discussions, presentations, and other forms of peer-to-peer learning interactions, is rather poor with communicating available human resources (e.g. skills, knowledge, experiences, etc.) to the user through other co-present users (i.e. goal-directed behaviour) or providing inspirations (i.e. exploratory behaviour) on a discursive layer; e.g. insights into themes, topics, and ideas through co-present users' practices and activities in relation to digital technologies and culture. Such information might be partly available through the website and dedicated user groups on social platforms such as local Wikis or Facebook, but is not apparent for users who visit The Edge in its physical building. The space appears to be rather generic, and other than during occasional events, exhibitions, and presentations, it does not provide much food for thought or encourage exploration, like themed bookshelves do in a traditional library.

This gives rise to our first design question (DQ1): *How can the physical environment of a collaboration space better reflect the community of co-present users as a resource for information?*

Interaction Between Unacquainted Users is Subject to Social Barriers

Our observations indicate that, even though the interior of the building is open with no walls or physical barriers between different workspaces, a social barrier remains for interaction between visitors. As a space that is open to the general public, hundreds of people walk in and out of The Edge on a daily basis. Hence, the social atmosphere is similar to a public place, where most of the co-located users are unknown to each other or 'familiar strangers' (Milgram, 1992; Paulos & Goodman, 2004), with little or no history of interactions. Users tend to work next to each other, rather than with each other. People that collaborate in groups have mostly met each other before and visit The Edge together as a group. Serendipitous encounters and connections between unacquainted Edge visitors, on the other hand, are rare. Our argument is not that every visitor has to engage in social interaction and collaboration, or that books and other information resources should be neglected. However, when many like-minded, creative individuals from various backgrounds and disciplines share a physical space such as The Edge, there is a lot of untapped potential for each individual to be inspired and enriched by the community of fellow users. A Commons 2.0 space that builds on the ideas of social learning and co-construction of knowledge should allow users to bridge natural social barriers. We believe that animating the socio-cultural space with ambient media design interventions must foster direct and indirect social interactions between users that could ultimately lead to a learning experience. This forms our second design question (DQ2): *How can collaboration spaces facilitate shared encounters and conversations, hence nourish an interactive, engaging, and collaborative culture amongst its users?*

Theoretical Framework

The following sections describe relevant theories for our design questions from three different viewpoints: place, people, and technology. The theories in the first two sections (place and people) shed light on the potential spatial and social roots of the challenges described in our case study above.

Informed by those theories, the third section (technology) provides insight into opportunities created by ICT and ambient media to address our two design questions, and suggests design strategies presented in the next chapter.

Place: Architecture for a Sense of Place

Our spatial experiences are shaped by both the geometrical characteristics of the spatiality as well as the socio-cultural context of a place.

The goal of architects, when designing buildings and spatial infrastructure, is to facilitate activities, practices, and social interactions particular to the vision and function of a place. Churches and temples communicate a sense of spirituality, facilitating an engagement in spiritual activities and praying; offices facilitate efficient work; and people often arrange their homes to facilitate relaxation. In this context, Lawson discusses architecture and urban spaces as "containers to accommodate, separate, structure and organize, facilitate, heighten and even celebrate human spatial behaviour" (B. Lawson, 2001, p.4). John Ruskin (1849) emphasises the "eloquence of architecture." He suggests that there are more abstract things we want from buildings beyond just providing shelter in a physical sense; we want buildings to speak to us. Architecture, from this point of view, can be regarded as an object of design with a goal to communicate a message or, in De Button's words, to provide "an impression of the psychological and moral attitudes it supports" (De Botton, 2006, p. 76). Alexander et al. (1977) proposed patterns guiding the design of physical infrastructure towards supporting particular social activities, such as a city plaza for a relaxing walk or serendipitous social encounters.

Social and cultural theorists on the other hand remind us that people's perceptions of a 'place' are not only about location, and the spatial infrastructure and characteristics as laid out and designed by architects and other people in 'power', but more so socially produced (Certeau & Rendall, 1984; Gordon & de Souza e Silva, 2011; Lefebvre, 1991; Tuan, 1977). The practices, activities, memories, and meanings that people collectively attach to a *space* turn it into a *place* (Harrison & Dourish, 1996; Tuan, 1977). Such social and cultural traditions that define a place establish behavioural norms that are considered appropriate for that place (Harrison & Dourish, 1996), and eventually shape a particular 'sense of place' (Tuan, 1977).

The infrastructure and characteristics of 'space', and the notions of 'place' that are socially produced within that space, are often intertwined and impact each other. Brand (1994) provides examples of how the physical appearance of houses, as well as the socio-cultural circumstances and inherent everyday life practices of different generations of people who occupy these houses, affect and shape each other over time.

"First we shape our buildings, then they shape us, then we shape them again – ad infinitum" (p. 3). Over time, culture is embodied in the architecture of a place and vice versa.

In contrast to Brand's observation of how buildings naturally evolve and carry clues about their inhabitants over different generations, in our case study at The Edge, the conceived culture and practices that the building was designed for are not being morphed into the physical environment. Edge users can book dedicated working areas for a designated time, and, as per the house rules, need to tidy the areas afterwards. They take their projects, materials, and tools with them when they leave. Hence, the physical environment at The Edge is always tidy and does not reveal any interaction history or social cues of other people's previous activities in the space. For visitors it may feel like a sterile, tidy, clinical-like environment, which can create uncertainties about the purpose of the space and what one can do in it – they lack a 'sense of place'. There are few opportunities to get inspired, curious, and interested through the physical environment or people's previous activities (Figure 36).

Figure 36: The house rules in public libraries dictate that users to tidy up before they leave the space – users take their projects, materials, and tools with them, leaving no interaction history or social cues of their activities for other people in the space.

For example, if people could book a working area in which to work on particular projects over a couple of weeks or months rather than hours, the physical environment

would presumably look more messy with tools, materials, and project sketches lying around, hence revealing social signifiers (Norman, 2010) about people's domains of practices and creative activities. Rather than looking sterile, such social signifiers would endow the space with opportunities for inspiration, discovery, and learning, similar to how themed bookshelves and catalogues reveal physical and digital information resources in the library. Allowing the user to take ownership of the space and leave marks of their interactions, activities, skills, and areas of interest would enable others to gain insights into the community of users at The Edge, hence facilitating practices of mutual inspiration, sharing, and social learning.

People: Social Behaviour in Public Places

Social behaviour in public places, especially when it comes to social encounters between strangers, follows established social rules (Goffman, 1966). The transition from people merely being co-present in the same physical space to actually engaging in a face-to-face interaction is a complex social process influenced by preconditions such as acquaintanceship, accessibility, or cognitive and social recognition (pp. 131). The general norm, as Goffman states, is that "acquainted persons in a social situation require a reason not to enter into a face engagement with each other, while unacquainted persons require a reason to do so" (p. 124). Similarly, studies that have explored the spatial behaviour of unacquainted people who share the same physical space, such as in a train (B. Lawson, 2001, p.136) or public library setting (Sommer, 1969), have found that people spread out as much as possible, usually occupying the space in a way to maximise distance and minimise eye-contact. Given The Edge is a public place that is open to all members of the general public, it cannot be expected that spontaneous and serendipitous face-to-face collaboration among strangers will naturally become a behavioural norm.

Goffman presents different modes of interaction between strangers in public spaces, i.e. unfocused and focused interaction. Unfocused interaction is "the kind of communication that occurs when one gleans information about another person present by glancing at him, if only momentarily, as he passes into and then out of one's view." (Goffman, 1966, p.24). Focused interaction on the other hand involves forms of communication where two people have a "single focus of cognitive and visual attention," such as a conversation, discussion, or playing a board-game. Such situations,

in which two or more people engage in a focused interaction, Goffman refers to as face engagements or encounters (p. 89).

Both focused and unfocused interactions facilitate the building of a perceived sense of place, and a sense of the community that populates that place. An architecturally open environment with little physical barriers for visual contact between strangers facilitates unfocused interactions. However, unfocused interactions between strangers do not naturally evolve into face-to-face encounters. Unacquainted people in public places need a reason to start a focused interaction. For example, a mutual sense of connectivity to a particular group provides a socially accepted reason to start a conversation. A person who recognises a fellow compatriot at a distant holiday destination would be in such a situation, or two random strangers that meet at a house party, where it is a mutual understanding that everyone is somehow connected to the host. Another basis for mutual accessibility (Goffman, 1966, p.104), such as a person being exposed to a potential encounter with a stranger, is enabled by what Goffman refers to as "open regions" (p. 132); i.e. a physically bounded place (e.g. a bar or discotheque), where the initiation of a face-to-face conversation with strangers is part of the behavioural norm. The architectural infrastructure of a place can minimise physical barriers and hence encourage open sharing, interaction, and collaboration, but is insufficient to nurture a socio-cultural environment where users feel comfortable starting interactions, collaboration, or even informal chats with co-located others. Similar to the way in which people's selections of clothes can reveal their social status (expensive brands) or particular interests and preferences (e.g. a music fan shirts or motorcycle jacket), a physical intervention could reveal cues about people's interests and backgrounds in relation to digital culture, hence providing an 'ice-breaker' for conversation with like-minded others.

Gordon and de Souza e Silva (2011) illustrate how both the physical and digital space (e.g. geo-tagged content, location-based mobile services, location-based social networks, etc.) contribute to how people make sense of, negotiate their everyday activities and practices in, and attach meaning to a place. How can these two powerful means – architecture and social media – be combined to better facilitate shared encounters that lead to collaboration and peer-to-peer learning activities in library spaces? The goal of a design intervention at a Commons 2.0 place would contribute to it being perceived as an "open region" for finding collaboration and peer-to-peer learning partners.

Technology: Ambient, Embodied and Hybrid Media

This section discusses a set of technologies that promises effective tools to tackle several spatial and social challenges of social learning in collaboration spaces, as presented above.

Web 2.0 and Collaboration

The term Web 2.0 stands for a second-generation of web services that facilitate collaboration and sharing between users. Web 2.0 platforms and social networks such as blogs, Wikipedia, YouTube, Flickr, and Facebook are more open, collaborative, personalisable, and therefore participatory than the previous Internet experience (Foth, Forlano, Satchell, & Gibbs, 2011). Web 2.0 services provide means for users to engage in a participatory culture that is no longer limited to the technically versed or the civically inclined. This has meant that the strict borderline between information providers and consumers is blurred, which has triggered a trend of entirely community-driven web services (Lindahl & Blount, 2003).

Scholars such as Jenkins (Jenkins, 2006) and Burgess et al. (Burgess, Foth, & Klaebe, 2006) identified socio-technical trends towards a wider ('vernacular') ability of people to participate in digital culture through personal expressions of creativity. According to Kolbitsch & Maurer (Kolbitsch & Maurer, 2006), such participatory qualities of Web 2.0 encourage ordinary users to make their knowledge explicit and develop a collective intelligence (C. Anderson, 2006). Such participatory design principles that have shaped Web 2.0 as a 'Social Web' (O'Reilly, 2005) have been combined with location-based services and translated for mobile user scenarios (Jaokar & Fish, 2006). Elsewhere (Bilandzic & Foth, 2012; Foth, Forlano, et al., 2011), we provide an overview of studies about people's use and practices of such mobile and locative media in their everyday lives. Foth et al. (Foth, Odendaal, & Hearn, 2007) argue that such capabilities present diverse possibilities for a profound urban epistemology to evolve in an urban context. For example, mobile users collectively tag, rate, and recommend restaurants, cafés, and other public places, crafting and nourishing a digital information layer that augments the urban physical infrastructure in real-time. The ubiquitous connectivity to this collective intelligence through mobile devices informs and affects people's socio-spatial practices and interaction patterns in urban environments. People are enabled to connect, interact, and share knowledge in a local context beyond physical and temporal barriers. In doing so they form what is referred to as 'net localities' (cf. Gordon & de Souza e Silva, 2011).

Previous research illustrates the potential of social media to enrich collective place-based social interactions (Foth et al., 2008), animate place-based engagement among general members of the public (Schroeter & Houghton, 2011a), or facilitate encounters between people with complementary interests in various contexts; e.g. business (Eagle, 2004), dating (Wired, 1998), socialisation (Kjeldskov & Paay, 2005), conferences (Eagle & Pentland, 2005), or car pooling (Hartwig, 2006).

In terms of social interaction, such locative media create a digital layer on top of the physical world affording new practices for social interaction that would not be possible otherwise; they bridge spatial, temporal, and social barriers, and hence render the physical world to a more socially translucent space.

Information about co-present people gathered through unfocused interactions is not limited to physical appearance or clothes, but also revealed through location-annotated data from social networks. People can for example identify other co-present people with mutual interests, complementary skills, or shared affiliation with particular social groups or community. Mobile social network applications (Humphreys, 2010) enable users to 'check-in,' i.e. digitally confirm their physical presence at a particular place. People can see where their friends have checked-in as well as any background information of those that have checked-in in their immediate proximity. In relation to Goffman's theory of encounters in public space, the presentation of such data in the physical space provides a design space to facilitate unfocused interactions between co-located people which, in turn, can lead to focused interactions and potential discoveries of collaboration and peer-to-peer learning opportunities.

Ambient and Embodied Media

According to Lugmayr, ambient media are media that "convey knowledge distributed in time and space throughout the natural environment of consumers through a digital overlay morphing with physical daily objects" (Lugmayr et al., 2009, p.338). He further distinguishes between different ambient media *forms*, depending on how an ambient medium is manifested in the real world, the ways its digital and physical components are morphed, and how they interplay with the user.

In the context of augmenting the library as a physical place, ambient media that materialise digital information as observable and sometimes interactive parts of the physical environment seem particularly relevant. Informed by previous research on embodied interaction (Dourish, 2001), we refer to such ambient media forms as *embodied*

media. Embodied media convey a meaning relevant to the situated context of the particular place. Similar to augmented reality (e.g. Nischelwitzer et al., 2007), embodied media enrich the real through the digital, but do this so that the digital layer is made visible and accessible as a shared property of the space itself, rather than rendered through a head-mounted display or other personal mobile device. As such, embodied media are visible and accessible to everyone who is physically present (Falk et al., 1999), thus having the potential to enrich the *collective* situated experience of people at that place (e.g. Veerasawmy & Ludvigsen, 2010).
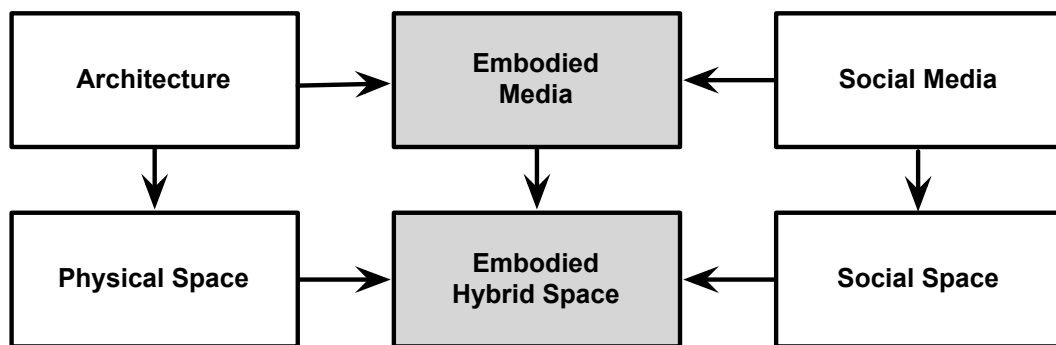
Figure 37: Embodied media combine physical and digital affordances towards an embodied hybrid space. They render digital information as part of the physical environment, and in the Commons 2.0 context, can display opportunities for shared encounters between users that would remain invisible otherwise.

Combining assets and affordances of the physical as well as digital space, we see embodied media creating an *embodied hybrid space* (Figure 37). The embodied hybrid space is manifested in the physical environment, but uses digital assets to enable people to bridge spatial, temporal and social barriers for social interaction. By means of 'making the invisible visible,' they can communicate relevant social information (potentially leading to valuable situated interactions) in the real world that would remain invisible otherwise. Social navigation (Bilandzic et al., 2008; Dieberger, 1995, 1997; Dourish & Chalmers, 1994; Höök et al., 2003), serendipity (Eagle & Pentland, 2005), or shared encounters (Willis, 2010) are examples of social interactions that have previously been successfully mediated in virtual and mobile information spaces.

In terms of ambient media, previous research on public display has shown that it can trigger informal conversations (E. Churchill, Nelson, Denoue, Murphy, & Helfman, 2003) and a sense of community in organisational settings (J. F. McCarthy, 2003). However, research that informs the design of ambient media to facilitate shared encounters in an informal learning context is still rare. We collaborate with a colleague

from architecture to inform such ways of designing 'hybrid' learning spaces; i.e. spaces that facilitate learning experiences through physical as well as digital means (Caldwell et al., 2012).

Design Strategy

By way of morphing the digital and the physical space, embodied media can leverage both: (1) the power of social media to provide an asynchronous channel for discourse, and build up and store a collective intelligence within the community of users; and (2) the power of its ambient visibility in the physical world to not only emphasise the user community as the core function and resource for information gathering and the acquisition of new skills and knowledge, but also provide inspiration about relevant themes, topics, and discussions. For example, it can achieve this by displaying social hints, interaction histories, or the interest profiles of other users in the space. Informed by the above theories and discussion, we suggest the following design strategies (DS) for ambient media towards enriching the human interfaces with libraries and other collaboration places:

- DS 1) Provide means that enable users to share and make their skills, knowledge, and expertise available to fellow users.
- DS 2) Provide means that enable users to retrieve the skills, interests, experiences, and areas of expertise of fellow users (convergent information behaviour).
- DS 3) Provide means that allow users to browse, discover, and serendipitously stumble upon the interest domains, activities and practices of fellow users (divergent information behaviour).
- DS 4) Provide means that lower the social barriers for unacquainted library users to facilitate conversations with each other.

In the following we outline a first draft of an ambient information system that embodies these strategies. We expect this plan to be further shaped or even changed through the iterative process of action planning, action taking, and evaluation on site.[2]

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[2] We describe the process and nuances of combining such iterative participatory design and action research cycles in the context of designing for members of the general public in a

The system enables visitors to virtually 'check-in' at The Edge and a network of different working areas at The Edge (e.g. using their swipe-card ID or a mobile phone application). Visitor can complete an online form with their interests, skills, areas of expertise, and other profile information that they would like to share (DS 1). Keeping track of 'checked-in' visitors, the system displays a visual patchwork of aggregated information: for example, who are the people who currently hang out at The Edge? What are their backgrounds, interests, and key areas of expertise? What projects are they working on and what questions are they currently struggling with? Who of the users is busy, and who is happy to be approached with a question? Public screens and projections feed such social information from the check-in system, and dynamically display the available knowledge and social capital at The Edge in real-time (Figure 38).
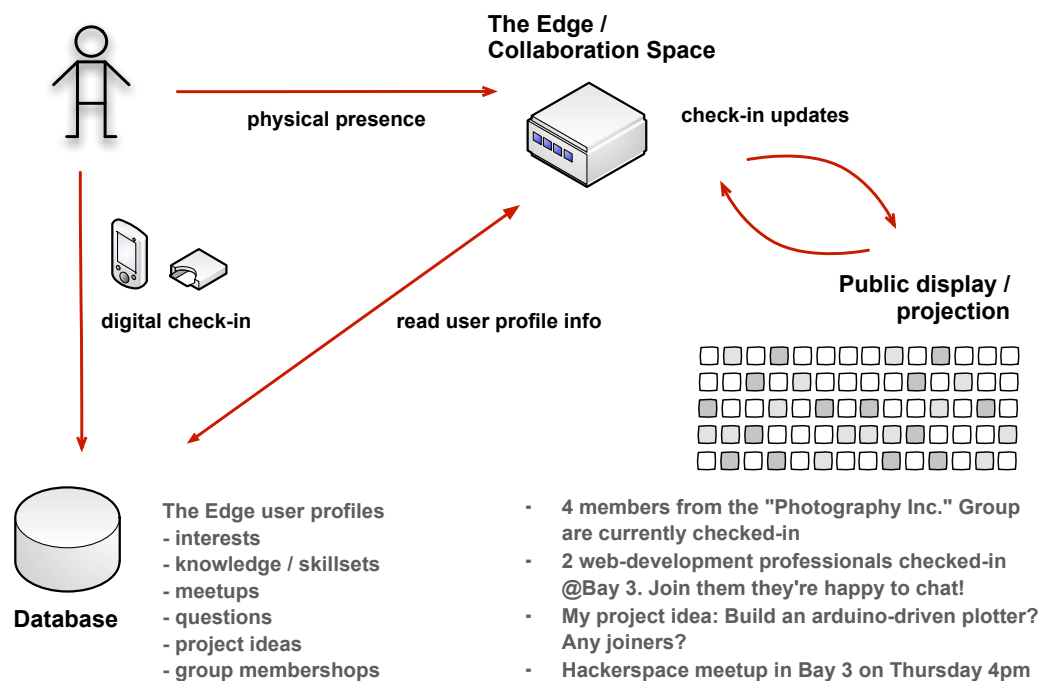
Figure 38: A "check-in" system feeds ambient displays and projectors with information about currently co-present users, using their profile information such as skills or areas of expertise.

Every time a new user checks-in, the visualisations update according to the knowledge and assets that the particular user possesses (DS 2). Interactive visualisations aggregate the areas of expertise, knowledge, skills, and current projects by all users and adapt to the interests of the particular user who approaches the display, allowing for

methodology framework that we call Participatory Action Design Research (Bilandzic & Venable, 2011)

serendipitous discoveries and in-situ encounters (DS 3). Visitors who check-in at The Edge can specify whether they are happy to be approached or if they prefer to work alone. Ambient façades (Scherr, 2006; Villareal, 2004) installed in the user's work area or wearable displays (e.g. Hansen, 2011; Holgar, Foth, & Ferrero-Regis, 2009) worn by users glow in green or red, depending on the option that was selected. This helps fellow users to identify fellow users with complementary interests, skills, or knowledge, and ice-break conversations according to the users' availability (DS 4).

Figure 39: Ambient and public displays mediate a sense of co-present users at The Edge and facilitate shared social encounters and serendipitous discoveries

The focus is set on the visitor base, promoting The Edge as a hub of creative people and their knowledge and expertise in topics relevant to any form of digital culture. Rather than highlighting the infrastructure and technical equipment, it promotes The Edge as a space that is socially produced by and through visitors (Lefebvre, 1991). New visitors who enter The Edge get a glimpse of the profiles and knowledge of other visitors who are or who have recently been at The Edge (Figure 39). The items can, for example, be presented in a tag-cloud while the size of keywords is determined by the number of people and level of expertise these people have in their given fields (Figure 39). Such visualisations give visitors a sense of the dormant capabilities available at the place in the form of people's skills, experiences, know-how, and other intangible assets and resources. They also strengthen the identity of The Edge as a place defined through

the diversity of its visitors and their activities, illustrating new opportunities that originate from this diversity.

In contrast to most previous work on digital projections onto physical buildings (e.g. Scheible & Ojala, 2009), the focus of this study is not simply on digitally augmenting the building in an artistic way, but rather enlivening it to convey relevant information about its current status, activities, people, social encounters, and the like which are happening inside the building. The design of the installation would follow the paradigms of public and ambient displays (Greenberg & Rounding, 2001; Guzman, Yau, Gagliano, Park, & Dey, 2004; Hazlewood, Connelly, Makice, & Lim, 2008; Mankoff et al., 2003; Rogers, Hazlewood, Marshall, Dalton, & Hertrich, 2010; Wisneski et al., 1998), conveying information in an unobtrusive, non-distracting, yet visually appealing way. Combining the in-situ advantages of the physical space with the benefits and 'social translucence' of digital ICT and social media, the overall aim is to explore how ambient media can augment the notion of The Edge as a place-based knowledge community. The aim is to increase the advantage of being physically present at The Edge by visually articulating the diversity of what has so far only been an imagined community (B. Anderson, 2006): i.e. increasing exposure to a variety of topics embodied in the community, affording links to particular individuals within this community, and highlighting points of commonality and difference (Figure 40).
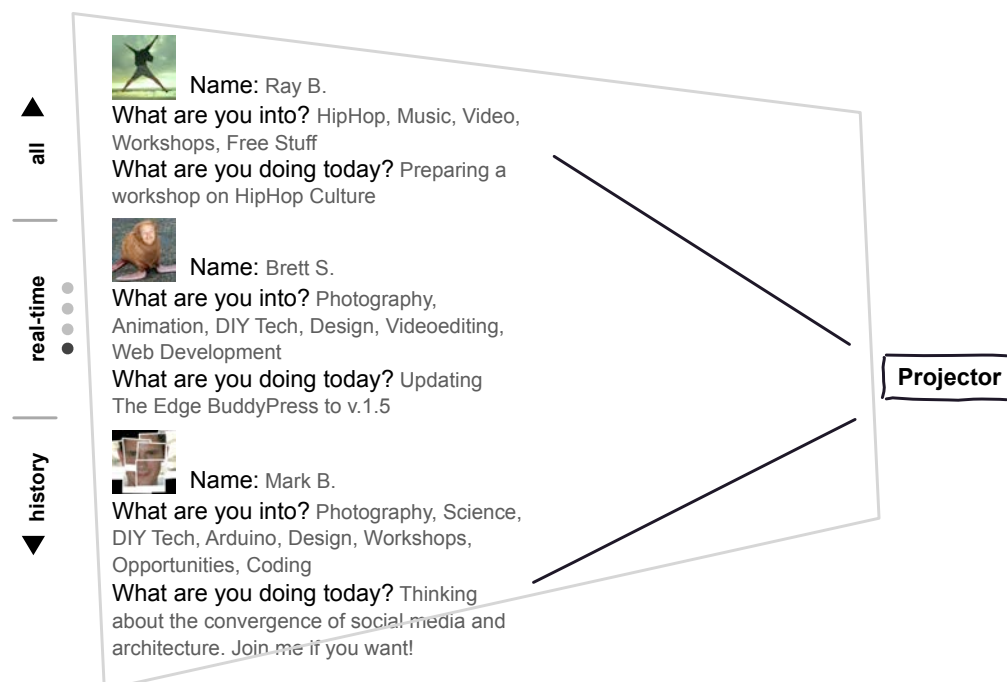
Figure 40: A projector displays background information about currently checked-in visitors at The Edge. The visualisations present the in-situ social capital available in real-time.

Use Scenario

As Johnny enters The Edge, he briefly touches the check-in terminal with his membership card at the entrance. The RFID chip inside the card transfers his ID to the check-in system, confirming his presence at The Edge.

Digital wallpapers and public displays within The Edge update their content with Johnny's profile information, showing for example that he has expertise in digital photography, especially high dynamic range (HDR) and Photoshop (DS1). As he walks through the corridors, he proudly checks the wallpapers that now display several example shots that he uploaded last week onto his Flickr profile page, as well as links to his blog and YouTube videos describing the basics of the techniques used in each shot. His entry on the digital wallpaper is among a patchwork of pictures, videos, descriptions, and links posted by other visitors of The Edge. As he browses through the posts, he discovers an entry by someone about a project with Arduino microcontrollers (DS3). Johnny has heard of Arduino, and the new possibilities that this open-source hardware platform provides to high-speed photography. In one of Johnny's projects as a freelancer he is working for a still water distributer, and for a poster advertisement he imagined taking a shot of a water drop hitting a still water surface. Such fast movements cannot be captured manually, and that is where an Arduino microcontroller can help trigger an automatic flash. He has read tutorials and descriptions in online forums, but as a photographer without previous programming experience, it has been hard for him to fully grasp the required knowledge. Tapping the Arduino post on the digital wallpaper opens additional information about Angie, the author of the post (DS2). It indicates that Angie usually visits The Edge every Tuesday around 5pm. Through the contact form he writes Angie a message describing his interest in Arduino, and if it is okay to catch up next Tuesday for a chat (DS4). Johnny also subscribes to Angie's blog and Twitter feed to obtain her latest updates.

Later, Johnny discovers a check-in system post on the wall saying that there are two people currently checked-in from the HDR photography fan group on Facebook (DS3). Being a member of this group himself, he wonders who the other person is. Tapping on the group's name, a little green light indicates that Ana is currently checked-in at work desk 5 (DS4). Johnny decides to approach desk 5 and ask Ana about her software of choice for creating HDR photos. He has worked with Photoshop but is interested to

see what alternatives people use these days. The fact that Ana's light was green and not red gives him confidence that he will not disturb her in an important task.

After talking to Ana, Johnny moves on to another work desk to work on his assignment for university. After a while he receives an instant chat message from The Edge check-in system which notifies him of an incoming call through the conference system at his desk: *"Someone would like to talk to you in regards to your expertise in Photoshop. Would you like to receive the call?"* Johnny remembers that he has ticked the box on his Edge profile that he is happy to be tracked when at The Edge and provide help for others in relation to his areas of expertise (DS2). The check-in system logged the check-in at his desk and published his areas of expertise live on The Edge website. Visitors of The Edge website can, if they are interested, click the *"Call now"* button to establish a live conference call to the respective work area. Johnny, always happy to share his knowledge and nurture the Photoshop community, clicks on *"Yes"*. It is Andy, a high-school student on the other end of the line, who has a question about a Photoshop assignment for school. Johnny gives him a quick introduction to the layering system to help him complete the assignment. He also gives him a reference to a good Photoshop introductory book and a couple of links to introductory Photoshop videos on YouTube (DS1).

Conclusion and Further Work

Public libraries in their traditional role as public living rooms, i.e. open, free, and shared physical spaces for people from various backgrounds, skills, and interests, have a huge potential to facilitate spill-over effects and the cross-fertilisation of ideas, knowledge, and creativity between their users.

The point of departure for this research was to investigate how ambient media can facilitate shared encounters between users of public libraries. Based on a case study environment, we outline two main barriers for users in library spaces to engage in collaborative practices along the vision of Commons 2.0. Firstly, the physical environment has a lack of perceived affordances for users to retrieve and access skills, knowledge, and experiences that other co-present users might possess. Secondly, approaching co-present library users for conversation or collaboration is subject to social barriers.

Based on Goffman's theory of social behaviour in public places, and theories on the role of architecture as part of what people perceive as a 'place', we suggest four design strategies for ambient media designers to tackle those barriers. We outline the system

overview and use the scenario of a user 'check-in system', incorporating the strategies and describing ways for ambient media to facilitate shared encounters and a better sense of the presence of other library visitors.

We will continue this work by implementing the check-in system and evaluating it 'in the wild' at our case study environment. We will attempt to answer several questions: how will the system impact interactions of unacquainted, co-located users in the library space? Will it trigger shared encounters, conversations, and interactions between people that would not happen otherwise? How will the system affect people's perceptions and awareness of the user community in the library? Is it capable of providing serendipitous discoveries and inspirations based on other users' interests and activities in the space? We also expect the evaluation to provide insights into new issues as a result of introducing such a system; e.g. users' privacy or distraction. Further work will require continuous participatory design and iterative cycles of action and design research to organically shape the system towards an embodied element of libraries' physical and social space.

Chapter 11:

Gelatine: Making Coworking Spaces Gel for Better Collaboration and Social Learning

Bilandzic, M., Schroeter, R., & Foth, M. (2013, forthcoming). Gelatine: Making Coworking Spaces Gel for Better Collaboration and Social Learning. Paper accepted for presentation at OzCHI 2013 - Australian Conference on Computer-Human Interaction

Statement of Contribution

This paper has been co-authored with my supervisors Dr Ronald Schroeter and Assoc. Prof. Marcus Foth. Ronald contributed to the first few paragraphs in relation to the literature review on public screens in the *"Related Work: Public Screens and Shared Encounters"* section. Both Ronald and Marcus edited and revised the manuscript. I am grateful for Ronald's comments and suggestions on (re-)structuring the *Discussion of Findings* section. It contributed to a much stronger analysis and presentation of findings.

Preamble

This paper presents results from an evaluation of *Gelatine* – an ambient media system that I implemented following the design concept outlined in Chapter 10. I installed *Gelatine* for a pilot study at The Edge, and evaluated it against its impact on connected learning as encountered by users 'in the wild' during their everyday visits at The Edge. The evaluation reveals how *Gelatine* affects Edge users that match different Personas from the initial user study discussed in Chapter 6. The paper was submitted to *OzCHI 2013 – Australian Conference on Computer-Human Interaction*. It reports relevant contributions to the *ubiquitous computing* and *human-computer interaction* community; however, it also provides empirical evidence and insights on the potential of ambient media, which is relevant to designers and decision makers of coworking spaces.

Abstract

Public libraries and coworking spaces seek for means to facilitate peer collaboration, peer inspiration and cross-pollination of skills and creativity. However, social learning, inspiration and collaboration between coworkers do not come naturally. In particular in (semi-) public spaces, the behavioural norm among unacquainted coworkers is to work in individual silos without taking advantage of social learning or collaboration opportunities. This paper presents results from a pilot study of 'Gelatine' – a system that facilitates shared encounters between coworkers by allowing them to digitally 'check in' at a work space. Gelatine displays skills, areas of interest, and needs of currently present coworkers on a public screen. The results indicate that the system amplifies users' sense of place and awareness of other coworkers, and serves as an interface for social learning through exploratory, opportunistic and serendipitous inspirations, as well as through helping users identify like-minded peers for follow-up face-to-face encounters. We discuss how Gelatine is perceived by users with different pre-entry motivations, and discuss users' challenges as well as non-use of the system.

Introduction

The knowledge economy of the 21st century requires skills such as creativity, critical thinking, problem solving, communication and collaboration (Partnership for 21st century skills, 2011) – skills that cannot easily be learnt from books, but rather through learning-by-doing and social interaction. Big ideas and disruptive innovation often result from collaboration between individuals from diverse backgrounds and areas of expertise. Public libraries, organisations and coworking spaces have been continuously seeking for means to facilitate social encounters and peer collaboration to nurture cross-pollination of skills, creativity and innovation. The more diverse the people that an institution hosts, the more potential there is for social and collaborative learning – however, the social atmosphere appears to be more public and less familial.

This controversy is illustrated by the social space and user interactions usually found in public libraries. The library is one of the few remaining "truly" public places (Leckie & Hopkins, 2002) that is frequented by people from a broad cross-section of society with a high diversity of socio-cultural backgrounds and areas of expertise. As such it has a high potential for mutual inspiration and cross-pollination of skills, knowledge and experiences among library users.

However, the library also appears to be perceived as a typical "third place" (R. Oldenburg, 2001) in the public realm where users usually regard each other as strangers. People mostly work within their "individual bubbles" (Aabo & Audunson, 2012, p.143), many even weaving "an individual net around themselves that does not invite communication with others" (2012, p.143), for example, by marking their work space with coats, bags, notebooks, and other possessions (McKechnie et al., 2004, p.44). In general, library users perform their individual activities next to each other, without taking advantage of the social capital and knowledge networks within the community of other users. Whilst isolated work should not be discouraged – in fact, the library as a place for individual study and rejuvenation is highly appreciated by users and needs to be preserved as such (Waxman et al., 2007) – there is untapped potential for serendipitous social learning, inspirations and the creation of social capital (Aabo & Audunson, 2012; Aabo et al., 2010). Especially in today's new economy with an increasing amount of independent, self-employed, and project based workers, the role of public libraries, as socially inclusive spaces for coworking, is more important than ever before. How can public libraries cater for the social needs of coworkers (Deskmag, 2011c), such as opportunities through social interactions and ability to share knowledge with other coworkers?

This paper contributes new insights and knowledge to the question how digital technology can support the design of collaborative interactive spaces. We present the design and evaluation of 'Gelatine,' an ambient media system we developed in the context of a case study at The Edge – a dedicated space for social and collaborative learning at the State Library of Queensland. Gelatine is a real-time user checkin-system that makes visible the invisible social aspects of the library as a 'place,' in particular, by displaying currently physically present users' backgrounds, skills, and interests, on a public screen inside The Edge. We created the system to overcome challenges and barriers for social learning that we identified in our previous field research at The Edge. As a result, the design targeted three goals: (1) Amplifying people's 'sense of place' at The Edge as a place that is dedicated to the purpose of social learning, i.e. promote peer interaction, collaboration and networking as 'appropriate' behaviour between users in the space. This goal was targeted in particular at first time visitors who are often confused about the purpose of the space. The second and third goals aimed at tapping into the wisdom of the user community at The Edge to support both, (2) serendipitous explorations and peer inspirations by raising mutual awareness of skills and areas of

interests in the user community, and (3) identifying and localising particular coworkers for direct face-to-face interactions.

The remainder of this paper is structured as follows. First, we discuss theories and perspectives on space and place, and related previous work on public screen applications and mediating shared encounters. We then discuss the anticipated role of Gelatine as a hybrid instrument (embracing digital and physical aspects of space) for placemaking. Acknowledging that place cannot be *created* by design but only *socially constructed* through use of space (Dourish, 2006b; Harrison & Dourish, 1996), we hypothesise that hybrid social media such as Gelatine can, by reflecting social aspects and use patterns of space, re-inforce and amplify a 'sense of place' that users would not be able to perceive otherwise. Finally we report and discuss results from our evaluation of Gelatine 'in the wild,' real world user context through impressions and follow-up reactions of users who encountered the system during their everyday work at The Edge.

Theoretical Framework: Space, Place, and Sense of Place

Scholars distinguish between the concepts of *space* and *place* (Dourish, 2006b; Harrison & Dourish, 1996; Tuan, 1977). While the term 'space' primarily refers to geometrical and physical configurations of infrastructure, 'place' covers a broader concept embracing a social layer of meanings that people attach to a space. People attach social attributes such as meanings, memories and experiences through their everyday practices, activities and interactions with and in a space, thus render space into 'place.' The same location might have a different meaning to different people, depending on their subjective and emotional relationship to a place. A house, for instance, is not necessarily a home.

Space is designed and built by architects and spatial designers, while place is a social construct – created by the way people make sense and use of it. Placemaking, then, as practiced for example by urban planners or architects, is an attempt to design spaces that accommodate and invite particular activities and spatial behaviours. However, as Harrison and Dourish point out, the question *if* and *how* a place is actually produced, is not in the hands of a designer, but subject to how users appropriate and make use of that space. "Placeness can be designed *for,* but it can't be designed *in […]* The best that the designers can do is to put the tools into their hands. Trying to do more – trying to

build places – is not our job." De Certeau's concept of 'tactical practices' (Certeau & Rendall, 1984), Levebvre's (1991) distinction between *perceived*, *conceived* and *lived* space, and Soja's notion of *counterspaces* (1996, p.68) further describe the gulf between how designers often imagine a space being utilised and perceived, and how people actually interpret, make sense of and use space. The different interpretations and meanings that people attach to a place collectively shape a *sense of place* (Tuan, 1977), and shape the behavioural norm of people at this place.

What does this mean for the design of collaboration and learning spaces? Library designers, for example, put much effort into the physical design of lounge areas, meeting rooms, cafés and other 'open' spaces that invite social interaction, collaborative work, peer-to-peer learning, meetings and social hangouts (LaPointe, 2006; Ludwig & Starr, 2005; Shill & Tonner, 2003; Talve, 2011). However, in practice, there seems to remain a social barrier to peer interactions and focused encounters (Goffman, 1966) between most (unacquainted) library users. The behavioural norm is to work in isolation from other users (Aabo & Audunson, 2012; McKechnie et al., 2004). Physical infrastructure that accommodates and invites social learning is not sufficient to turn a social learning *space* into a *place* where social learning is actually being practiced and experienced.

We identified such a gulf between *designed* space and *lived* place in our previous fieldwork at The Edge (Bilandzic & Foth, 2013b). The motivation to bridge this gulf marked the point of departure for this study. Can a public screen application that highlights particular social aspects and use patterns of a place, re-inforce and amplify a particular 'sense of place' that users would not be able to perceive otherwise? The following section discusses previous work on public screens, before we discuss the design rationale for Gelatine.

Related Work: Public Screens and Shared Encounters

Struppek (2006) provides a summary of projects demonstrating the 'social potential' of urban screens, i.e. screens that display cultural content and support the development of a local community around those screens. The common denominator of most such public screen applications is their aim to foster social behaviour between people with

weak ties or no ties, in order to counteract the natural behavioural patterns of 'civil inattention' (Goffman, 1966) between unacquainted people.

A case study undertaken by Churchill et al. (2004) examined the potential of plasma posters (large plasma screens situated in public places that enable direct touch interaction) as interaction hubs to support sociality within an organisation. Employees could post URLs, text, images or movies via an internally advertised web interface or email address to the screen. The authors observed that reading items on the posters frequently led to conversations and therefore served as an icebreaker. Although most people only posted a few times, most of them were at least passively interested in reading and browsing the content. Overall, these posters were seen as a positive contribution to the culture and working atmosphere of the organisation. Similarly, IBM's internal social network application 'Beehive' was reported to increase social capital and participation among IBM coworkers (DiMicco, Millen, Geyer, & Dugan, 2008; IBM Research, 2011).

McCarthy et al. (2008) deployed *C3C*, a proactive display application at a research lab to increase awareness amongst colleagues. Participants had to register their Bluetooth phone name and associate it with their Flickr account. Eight large LCD touchscreen situated within the lab then displayed a collage of images retrieved from the Flickr accounts of staff whose presence was sensed through Bluetooth. Their findings showed increased interactions and improved personal relationships among coworkers.

In the public screen project *CoCollage*, McCarthy et al. (2009) aimed at enriching the social experience within a café. Visitors confirm their presence to the system by swiping their customer loyalty card, and an ambient public screen application visualises images, greeting messages, comments and ratings from the profile accounts of currently present visitors. The study showed that people develop a stronger sense of community and place attachment through the use of *CoCollage*. The authors conclude that, in contrast to other social networking systems that foster relationships between people with already existing strong ties (e.g. friends on Facebook), *situated* social software applications, such as *CoCollage*, help create links between co-located people in the same space, i.e. "*help people who are in the same physical context become friends, or at least become more familiar strangers.*" (p.8)

Such links do not necessarily have to involve direct face-to-face interactions, but can be indirect, or what Goffman refers to as 'unfocused interactions' (Goffman, 1972). Willis et al. (2010) introduces 'shared encounters' as a term to describe interactions between

people who share the same physical context, i.e. interactions "between two people or within a group where a sense of performative co-presence is experienced and which is characterised by a mutual recognition of spatial or social proximity" (p.4). 'Digital encounters' as defined by Fatah et al. (2010), then, are shared encounters that are mediated by digital technology, such as a mobile phone or public display. Fatah et al. show that digital encounters can create new forms of situated interactions that would not evolve without the use of technology.

However, digital systems that are designed to facilitate shared encounters need to be sensitive to the socio-cultural peculiarities and function of the particular place of installation. As Konomi et al. (2010) state, "digitally augmented settings may not effectively support encounters, unless it is integrated with human interaction processes and social conventions (p. 54)," therefore they regard it as an important design challenge "to blend the 'right' information in the 'right' spaces in the 'right' way, and thereby increase the 'right' encounters in our everyday lives" (p. 48).

Previous studies have explored the impact of public screens in various settings, e.g., organisation and workplaces (E. F. Churchill et al., 2004; J. F. McCarthy et al., 2008), third places (J. F. McCarthy et al., 2009) or urban outdoor places (Morrison, Jacucci, & Peltonen, 2008; Schroeter et al., 2012; Struppek, 2006). However, little is known about the social impact of situated social software applications displayed on public screens in library environments.

Previous work on interactive public screens in libraries focused on facilitating serendipitous discoveries by providing an alternative, digital access point to the library's book archives, e.g. visualising the circulation of checked out books (Legrady, 2005), or providing flexible, artistic, animated and playful interfaces (Groenbaek et al., 2006; Thudt et al., 2012) to explore library archives.

In contrast, Gelatine does not facilitate connections between users and books, but rather connections among the user community. It aims to enhance and reinforce the vision of contemporary libraries as places for social learning, participation, interaction and collaboration. The following section describes the background and design rationale behind Gelatine.

Gelatine: System Design

The design of Gelatine follows the idea of Commons 2.0 (B. Sinclair, 2007). Whilst libraries have long been perceived as 'gatekeepers' for information and knowledge (with

a clear distinction between the library as an information *provider* and the user as an information *consumer*), Commons 2.0 puts a strong emphasis on social constructivism (cf. Vygotsky, 1978), collaboration and co-creation of knowledge. Commons 2.0 recognises and promotes the library user themself as an asset and resource for information, inspiration and social learning to other, co-present users.

The design rationale behind Gelatine is based on extensive previous ethnographic field research at our case study site at The Edge (Bilandzic & Foth, 2013b), and identification of five user personas with different pre-entry motivations, perceived barriers and needs. The results reveal a mismatch between the vision of the State Library of Queensland for The Edge as a place for social learning and collaboration, and users' actual pre-dominant patterns of isolated work and rare interactions with other coworkers.

In contrast to related projects discussed in the previous section (E. F. Churchill et al., 2004; J. F. McCarthy et al., 2008; J. F. McCarthy et al., 2009), the Gelatine public screen does not enable users to share general social information and media content (greeting messages, birthday, leisure activity pictures, videos, etc.), but rather focuses exclusively on content that is likely to trigger social learning or collaboration. The design specifically aims at bridging barriers for social learning that were identified in our previous ethnographic observations and user interviews at The Edge: (1) We found that users lack a perceived affordance to identify other users as potential information resources. Whilst library catalogues, themed bookshelves and the labels on book covers provide easily perceivable affordances to search, browse and find printed information material, the physical environment of most libraries (despite the rising trend towards Commons 2.0) does not communicate much about their user community and the collective intelligence it has to offer. (2) As a consequence, users of The Edge, as a Commons 2.0 library space that went entirely bookless, are often puzzled about what the space is for and what one can do there to begin with – they lack a sense for The Edge being a place for social learning and collaboration. Instead, perceiving many other visitors working in isolated silos reinforces a sense of place that counteracts its intended purpose. As one user stated, *"when I go in there, I don't really talk to anyone that I don't know, just because they are kind of already doing stuff mostly individually, but I don't know… it feels like the wrong type of people are there."*

Aiming to bridge these two barriers, Gelatine was designed as a combination of a checkin-system and a real-time public screen installation that highlights the *skills*, *interests* and *help requests* of currently present users in the space (Figure 41). Rendering such

invisible social resources visible, the two design goals were (1) to enhance people's perception of other users in the space as a source for incidental as well as goal-directed social learning, and (2) promote The Edge as a place for social learning and collaboration.
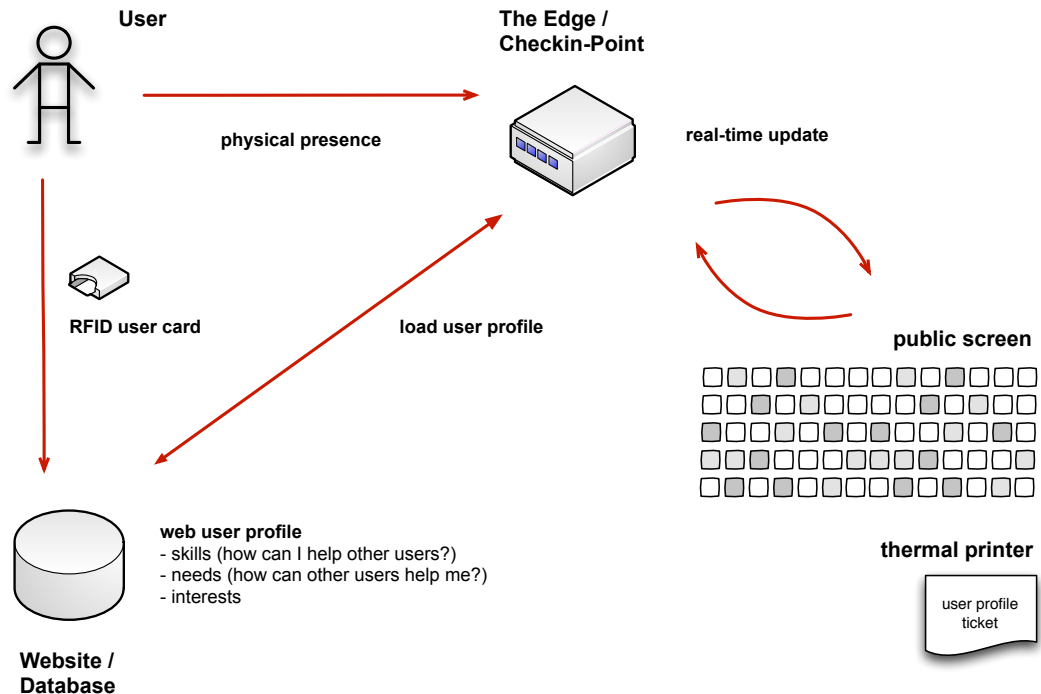
Figure 41: System overview of Gelatine – users can leave a digital footprint of their skills and needs on a public screen by swiping their RFID user card at the entrance or workspace in the library building.

Gelatine provides an online / mobile website for users to create a personal profile with keywords ('tags') that describe their skills, areas of interests, as well as areas that they have a problem in or want to learn more about. This profile information is linked to their RFID membership card, which they can swipe at one of the 'checkin-points' (Figure 42) at the entrance of The Edge or sub locations such as individual workspaces, computer lab or coffee kiosk to confirm their presence in the space. RFID cards, as a method for a seamless user checkin process, were selected in respect of the library's institutional mission as a socially inclusive space (Leckie & Hopkins, 2002). Smart phones or other 'personal' devices could discriminate against users who do not own and cannot afford them.

Figure 42: A networked thermal printer prints a personal user profile ticket with their skills, interest and workspace location for each user that has checked-in by touching a checkin-point (bottom pictures) with their library user card. The design is based on open source hardware and software (http://arduino.cc), and digital fabrication methods such as CAD and laser cutting.

Each checkin point (Figure 42) is made up of a network controlled RFID / NFC reader box, that, every time a user checks in, attaches a timestamp to the user's ID and saves it to the Gelatine system database. A custom designed visualisation on each of two public screens (Figure 43) is updated in real-time according to the profiles of those users who checked in. The two screens are designed to answer three basic questions:

- How can other users help me?
- How can I help other users?
- What areas of interests can I engage in with other users?

Each of the two screens displays a tag cloud visualisation of keywords that describe the skills (areas a user can provide help with) and needs (areas a user seeks help with) of all

currently checked-in library users. Tag clouds were selected as a visualisation technique in order to facilitate browsing and serendipitous ('non-specific') information discovery (J. Sinclair & Cardew-Hall, 2008). Further, in contrast to explicit search interfaces, tag clouds are better suited for the presentation of ambient information that can be perceived in the periphery of people's attention. Figure 43 shows an installed prototype of the Gelatine screens, as well as their location in the floorplan as installed at The Edge.

In order to avoid the 'screen blindness' phenomenon often found with people passing by public screens (Müller et al., 2009), and to represent available skills and knowledge grouped by individual users rather than in an aggregated tag-cloud form, we added an additional 'low-tech' display next to the two public screens: We installed a small, networked thermal printer (similar to the point of sale printers at the local supermarket or gas station) that prints out a user profile ticket for each user that checks in (Figure 42). The user can then decide to pin his ticket on a blackboard to make their skills apparent and available to other users in the space. The two screens and the ticket blackboard provided a central display of engagement opportunities with currently co-present users (Figure 43).
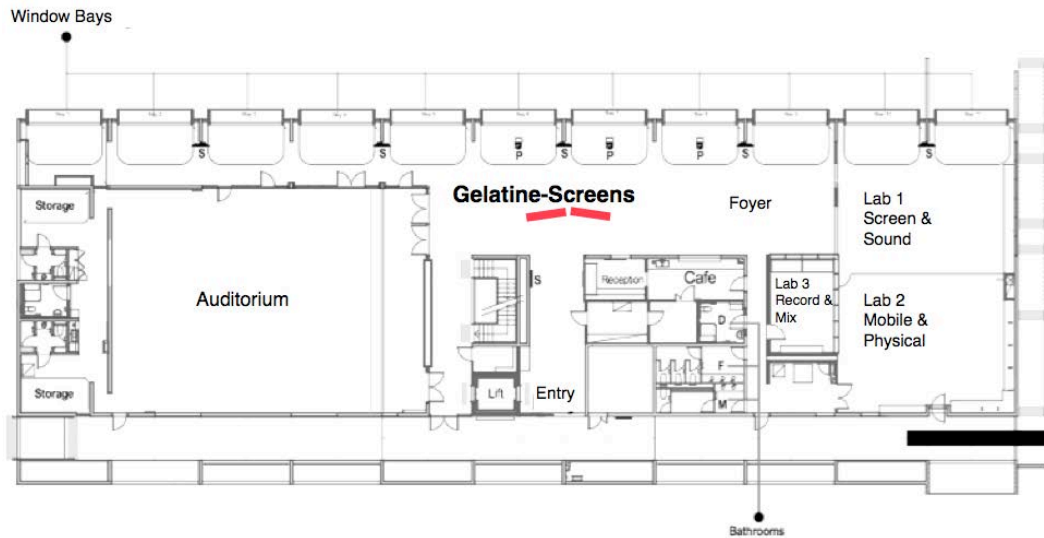
Figure 43: Prototype of the 'Gelatine' checkin-system and its location at The Edge – two public screens display a tag cloud with keywords that describe domains all currently checked-in users that can provide help with or seek help in the space.
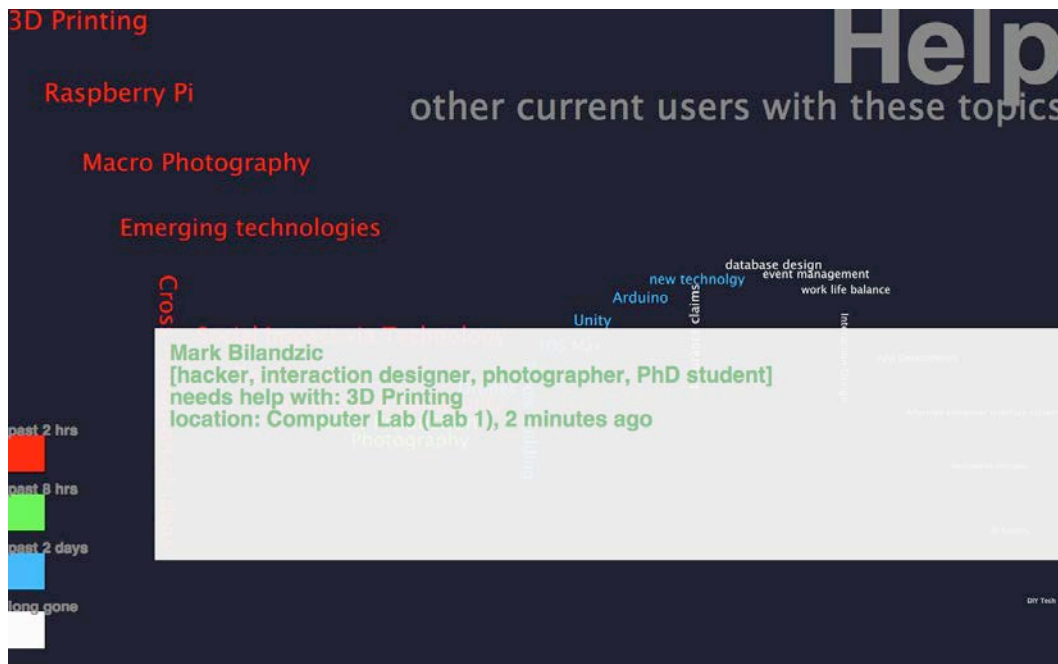
Figure 44: Tapping on a keyword pops-up a window with the current location of the person who has volunteered to share skills from, or who needs assistance with a particular knowledge domain.

In order to encourage face-to-face encounters, users can click / tap on the respective tag to find the user behind that tag (Figure 44) if they are curious about a particular skill. The associated user information and location are polled from the checkin-system database in real-time and displayed in a pop-up window.

To provide a sense of currency, the different tags in the clouds are colour-coded according to the respective checkin-timestamp. Tags of users that checked in most recently (past 2 hours) are displayed in bigger font-size and red colour. Keywords of check-ins further in the past are coloured in green (up to 8 hours), blue (up to 2 days) and white (longer than 2 days ago).

Methodology

In our evaluation, we were interested in what social impact Gelatine had on users, i.e. how it impacted users' perception of and relationship to the social environment at our case study site. Previous studies that discuss the social impact of public screens predominantly employ long-term, longitudinal evaluations over a period of a few months or years (E. F. Churchill et al., 2004; J. F. McCarthy et al., 2008; J. F. McCarthy et al., 2009; Struppek, 2006). However, in order for a public screen to have a social impact, it

needs to embody a satisfying standard of usability, as well as attract awareness to start with. Such questions require thorough, site-specific trial and error testing of different human-computer interaction specific aspects of public screens, e.g., their position and orientation (Huang, Koster, & Borchers, 2008; Schroeter et al., 2012) or means to raise by-passers' attention and motivation for use (Müller, Alt, Michelis, & Schmidt, 2010). Conducting the evaluation from an early stage of the development came with a tradeoff: In order to identify socio-cultural barriers and challenges relevant to the system design, thus be able to inform the re-design process from an early stage, it was crucial to evaluate the system in the 'wild' (i.e. how users perceive and adopt the screen in the context of their everyday life messiness). On the other hand, a pre-mature user interface and usability issues (as usual in early prototypes) might not attract users to naturally use the system in their everyday context. We applied a mixed methodology to tackle this challenge:

As the system was yet to be approved by the State Library of Queensland for an official launch, we were only allowed to recruit a number of selected pilot study users who would create personal profiles in the system that we used as valid 'user generated' content for the evaluation of the public screens to be installed in the main visitor area at The Edge. We recruited 21 pilot study users who all form part of "Hack The Evening" – a group of technology enthusiasts who meet at The Edge every Thursday night to discuss and collaborate on projects around hacking and making things with hardware and electronics, and do-it-yourself technology. We selected "Hack The Evening" as a representative user group who uses The Edge for collaboration and social learning purposes, while remaining open to new members. The pilot study users checked in during their weekly "Hack the Evening" meetups at The Edge, as well as their casual visits at The Edge.

The Gelatine screens and profile printouts were set up at the main foyer of The Edge (Figure 43) and evaluated in a user study for a total of six days. In the user study we not only observed the 21 pilot study users who had a user card to actually perform a check-in, but were actually even more focused on other visitors who came to The Edge and encountered the screen during their everyday visits. We did observations for a period of 3 hours every day, and varied the timeslots between afternoon, late-afternoon and evening (The Edge is closed in the mornings). We engaged 24 users in follow-up interviews (none of whom were part of the 21 pilot study users), who we selected according to different interaction patters (Michelis & Müller, 2011) with the screens.

Michelis and Müller (2011) identify six different phases of user interactions with a public screen, i.e. *passing by, viewing and reacting, subtle interaction, direct interaction, multiple interactions,* and *follow-up action.* They provide empirical data showing that these phases form an 'audience funnel' – only a certain percentage of users transitions from one phase to another, and eventually, only a fraction of users ends up engaging in direct or multiple interactions with the public screen.

Our approach was to sit in a distant corner with a clear line of sight on the screens and covertly observe users ignoring, or going through and/or dropping out of these six phases in the audience funnel. We then approached the users after they finished their interaction, or passed by the screens, and asked them for a follow-up interview where we would ask them to reflect on their experience of viewing or interacting with the screen. Users who had only passed by ignoring the screen, we later 'took by hand' to the screen and asked them to 'think aloud' as they interacted with it.

In total, we interviewed 13 users who ignored and *passed by*, 7 users who *viewed and reacted*, and 4 users who *directly interacted* with the screens (clicked on the tag clouds) or printouts (came close to read or touched the printout). Interviewing users who engaged in *viewing and reacting*, we focused on how the screen affected them as an ambient information display (i.e. with the user simply perceiving the information without taking any follow-up action). With users who directly interacted with the screen, we focused on the results and motivations behind them initiating a face-to-face encounter as a *follow-up action* to their *interaction* with the screen.

Each user interview involved a 3-step process: (1) We first asked questions about the user's general visiting and use patterns as well as their perceptions of The Edge. How often do they visit? What activities do they normally engage in when they visit? What are their relationship, perception and usual interaction patterns with other users? This first phase was to help us match the interviewee to one of the five use personas that we identified in previous extensive field work at the same case study site (Bilandzic & Foth, 2013b), and evaluate how Gelatine impacted different user groups. (2) We then revisited the Gelatine screens with the user, and asked them to reflect on their earlier interactions as they went through the audience funnel and 'think aloud'. The questions were open ended, and targeted at shedding light on their impressions and perceived usefulness of the system and information on the screen. (3) The third step included an open discussion about concerns and suggestions for future versions of Gelatine.

Each interview (hereinafter referred to as I1-I24) went for an average of 20-30 minutes, and every user was offered a coffee voucher as a compensation for their time. All interviews were audio-recorded and transcribed. For the data analysis we borrowed grounded theory techniques, and categorised the user comments according to emerging and reoccurring reactions to Gelatine, and how it has or has not impacted their sense of place in comparison to their previous use patterns at The Edge.

Discussion of Findings

The following sections discuss our interviewees' thoughts, impressions and reasons for use or non-use of the screen throughout the different phases of the audience funnel (Michelis & Müller, 2011) (Figure 45).
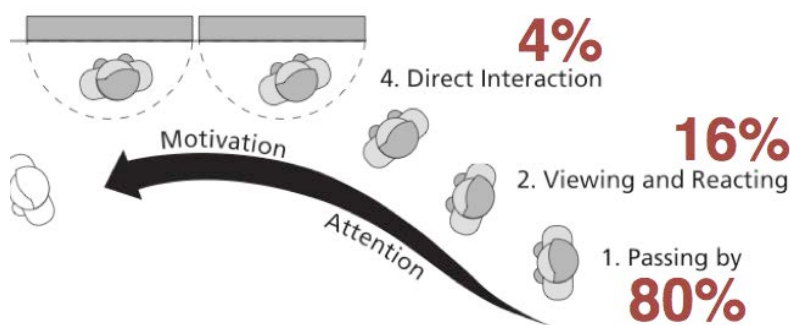
Figure 45: Observation along the 'audience funnel.' Illustration adopted from (Michelis & Müller, 2011)

Passing by

Even though the screens were placed in the middle of the foyer (i.e. everyone who entered the space had to pass them), most people who entered during our 3 hour observation slots (25 people on average) either completely ignored (80%) or only took short notice of them (16%). Only 4% actually interacted with the screen.
We followed-up with 13 users who ignored the screen and interviewed them on their pre-entry motivations, use patterns and attitudes towards the space.
12 out of those 13 interviewees reported to be regular users, who had been visiting The Edge for at least three months on a weekly or sometimes daily basis. They all come to The Edge with a particular pre-entry motivation, i.e. a purpose of completing a set of pre-defined tasks. Upon entering The Edge, these users follow established routines without paying much attention to signs, posters or installations in general. Their main focus of attention is to occupy a space and work on the tasks they came in for. For

example, we encountered a backpacker (I1) who, for the past two months would come in every day to access a computer and search for jobs on the Internet; an Indian student (I10) and her tutor would use a work lounge to study English three times a week; another daily visitor (I4) – a young man – would come in to read online news, watch YouTube videos and download online e-lectures to avoid stressing the download limit of his Internet plan at home; a self-employed programmer (I19) uses The Edge between two to five times a week to work on his free-lancing projects and avoid the distractions from home.

In contrast, the few users who actually *viewed and reacted* (16%) or *directly interacted* (4%) with the screen were mostly people who were new to The Edge. We usually observed such users wandering around the space, looking at posters, brochures and signage in an attempt to find out what this place is about. Eventually, they would stumble upon the public screens and visitor profile printouts and spend a few minutes browsing through them. Some regular users would *view and react* to the screen during short work breaks, e.g., on their way back from getting a coffee at the internal café or the toilet.

In summary, these observations show that people, who have more open and exploratory attitudes towards the space, are more likely to *naturally* push through the 'audience funnel' than others who follow established routines and tasks in the space. To those, who actually noticed and interacted with the screen, its nature as an ambient information display (i.e. information is presented in a way that is perceivable in the physical manifestation of space) turns out to be crucial for them to perceive the displayed information in the first place. Had the information been hidden behind a website, none of these users would have actively sought or become aware of it.

Viewing and Reacting

The impressions and reactions upon *viewing and reacting* to the screens were mixed, and depended highly on the individual user's pre-entry motivations and attitudes towards the space and other people in the space.

Non-Use

Four interviewees, after recognising the social intentions of the system, reported that they do not have any interest in socialising or meeting other users. This matched our observations of tactical practices (cf. Lefebvre, 1991) these interviewees and many other users apply to isolate themselves from the social environment in the space; they, for

example, put on headphones or close the curtains around their workspace, signaling their desire not to be disturbed or interrupted in their activity. These following statements represent typical responses we heard in the follow-up interviews:

> "I am here to find a job, not interested in much else to be honest." (I1)
>
> "I am here to prepare for my English test, why would I bother talking to anyone else?" (I10)
>
> "I don't normally communicate with people. I don't come here for social purposes […] I don't think I would use [Gelatine]. I can see how it's a good service, and how a lot of people might benefit from it, but I am more of an individual user. I have my own interests and stuff that I look at." (I4)

For such users – with their own pre-defined work agenda that involves isolated work, and without intrinsic motivation for social learning or shared encounters with others – a system like Gelatine does not make a difference; they choose to remain non-users (Satchell & Dourish, 2009).

Amplified Sense of Place

For first-time visitors, who, upon entering are generally curious (and often confused) about the purpose of the space (Bilandzic & Foth, 2013b), the screens and user tickets provide a lens that 'amplifies' their perception of the socio-cultural environment that is embodied, but underrepresented in the place. In contrast to many posters, brochures and signs that were put up to promote library offers, such as workshops or events, the screens provided a real-time glimpse into other users' activities and interests. By making visible these invisible socio-cultural aspects of a place, new people to the space perceive a sense of place that would be invisible or hard to grasp otherwise. The invitation of the screens to approach other users for providing or seeking help frames their notion of the purpose and function of The Edge as a place for collaboration and learning with others. As a first-time visitor couple, who stumbled upon the screen, stated in their follow-up interview:

> "We were trying to figure out what this place is […] to be honest, I am still not 100% sure what it is all about. I imagine if you come here and look at these people they are busy doing whatever they are doing. This [the printouts] sort of indicates that people are here sort of wanting other interesting people to come and chat to them? […] at the moment I am working on a website and I am having… you know if I run into a problem that I just can't quite figure out, I

would come here, I think. If there was somebody here that I could say hey you know, can you check my code, what is the problem." (I16/17)

They were able to construct an idea of the purpose of The Edge as a space for collaboration and social learning, which they – prior to the installation – would struggle with if not explained by a staff member.

Further, the nature of the screen content is perceived as constructed bottom-up, i.e. socially constructed by people, rather than imposed top-down the library. For example, in contrast to a billboard at the entrance of the space, the public screen does not tell *what the space is built for* from the space designers' and planners' point of view, but rather *how it is actually being used* by other users (Figure 46).

> "When you read you see someone is offering [...] you realise it's made by people; this is not like just made up by someone, you know, you kind of recognise this is sort of a social thing. Somehow you do, I don't even know how I do. You just kinda get it…" (I12).

Figure 46: Gelatine user ticket printouts vs a library billboard: While library billboards tells the the space designers' and makers' perspective what the space has been built for, Gelatine displays *how* the space is actually being used by its users. It gives power to the user to promote their activities and interests in the space, hence shape the overall sense of place.

As one interviewee pointed out, the screen provides an 'implied consent' that the users who signed up for Gelatine are happy to be approached and open to conversations:

> "… I guess the fact is that there is this sort of implied consent to have that happen, because they've put their stuff up there; you know it's not just I've come here to work in the space privately and now I'm gonna have ten people who are interested into what I am interested in and come and harass me" (I9)

This implied consent further strengthens the notion of a place where meeting and interacting with strangers is socially accepted. Some first-time visitors that we interviewed have marked The Edge as a future destination for serendipitously meeting likeminded and skillful people.

> "It [looking at the screen] definitely makes me think that I should come down here to do some of my work. Just the idea of being in the same space is kind of cool […] I don't know, the potential that I could end up having a conversation instead of doing my work, that's always nice… yeah like, there's all sorts of strange people here." (I14)

They remember The Edge as a place where they are likely to meet people that have the skills and interests that are displayed on the screen..

Amplified Sense of Coworkers

In our previous user study at The Edge (Bilandzic & Foth, 2013b), we identified that one of the core motivations for regular users coming to the Edge is the ability to work in a social environment among other users, and away from the distractions of home. The exponential rise of professional for-profit coworking spaces since 2006 (Deskmag, 2011a) underlines the desire of independent workers to work amongst others, as well as most coworkers' desire for social interactions (86%), the ability to share knowledge (82%), and the serendipitous opportunities facilitated through such interactions (79%) (Deskmag, 2011c).

In contrast to the isolated work attitudes of non-users' discussed above, users with coworking attitudes at The Edge are generally open and glad for serendipitous discoveries in their environment. They appreciate Gelatine as a virtual window that triggers curiosity, and provides inspiration and stimulation by other users.

> "Even if I wouldn't actually go and chat to anyone there, but it still looks nice; friendly; even if you don't do anything about it, if you just read it then I think it's good for you. It gives you an idea about what are the people using this space for. I think that's interesting […] Probably I am a curious person, so I just like to know these things. I don't know, it's just interesting to know what people use this space for" (I15).

Whilst our interviewees reported that they were obviously aware of their coworkers' presence, the profile information on the screens and printouts revealed new facts about their skills and backgrounds. One regular coworker that has been coming to The Edge

almost every day for over a year, was surprised by the amount and diversity of skills he found in the tag cloud. After having scanned different keywords in the tag cloud, he stated:

> "I am actually learning new things about this place that I didn't know. I thought there was much less than what's there [on the screen]. To be honest, I really only thought it was design, video and music. I didn't think there was anything more than that […] I thought everybody who is in here is very like... sort of arty; it's interesting to see that there is a lot to offer here." (I3).

For another interviewee, who generally tends to work alone, the screen raised some awareness and thoughts of other coworkers that he did not have before.

> "I guess I hadn't thought about why other people come here. I am usually in my own headspace when I come here. So it's interesting to see that so many people use it for such a diverse range of uses." (I7).

This increased awareness of interests and skills of strangers in the same space, affords serendipitous encounters and inspiration. Another interviewee, for example, who saw *'scuba-diving'* in the tag cloud reported that

> "[scuba-diving] is something that's not even actually offered here [by the library], but you end up doing it because you were here […]"

He felt that, by incidentally sharing the same space with other users at the same time, he has got access to their interests and areas of expertise –

> "…now you can really say you are at the right place at the right time. I mean if you are here, and this person is here as well or you have got their email."(I3)

Direct Interaction and Follow-up Action

The goal in this phase was to evaluate the system against the opportunity it provided to identify the location of and ice-break face-to-face conversations with like-minded users or users with complementary skills. We regarded the *follow-up action* as a user initiating (or not initiating) a face-to-face conversation as a result of their screen interaction. Only 6 users of all people we observed during our observation timeslots (4%) made it naturally to the direct interaction phase. Out of those we experienced two successful face-to-face encounters as well as two unsuccessful attempts to initiate an encounter. We asked those users to reflect upon their experience, as well as gathering additional thoughts and feelings from other users who we manually guided through the direct interaction phase.

One successful face-to-face encounter was initiated by I12 – a university student of IT and digital media, and regular user at The Edge for three years. He reported a frequent issue he faces when working on his university assignments: *"…sometimes I am stuck, so I have to go and search, and search, and search, and try find specific things. If you're learning a new program, you need to go on the Internet, but I wish someone just tells you what to do" (I22)*. During our pilot study, he stumbled upon a profile printout from a user at the "Hack The Evening" group who had specified skills in 3ds-Max – a software tool for 3D modeling that I22 needed for a university assignment. That day, he deliberately stayed at The Edge for longer than usual in order to join "Hack The Evening" for their meetup at 5.30pm. Meeting his target user later on, they spent the following 2 hours discussing different techniques and alternative developer tools for 3D modeling. I22 was also given a list of web links, e-books and other free sources to learn about 3D Modeling. He decided to come back for the next "Hack The Evening" meetup, as reportedly, he has learned more, and in an easier way than he would have by himself. This example shows a successful face-to-face encounter that was mediated by Gelatine, and more so, resulted in a social learning experience (Figure 47).

Figure 47: An example of a face-to-face, collaborative learning experience that was initiated as a result of a serendipitous encounter with the Gelatine public screen – a university student (at the right) identified and sought help from another user (at the left) with complementary skills in 3D modelling.

Users take Gelatine as an *'implied consent'* and invitation to initiate new face-to-face encounters. I14, for example, approached an electronics hobbyist who was offering his expertise on 'Arduino' (a microcontroller platform), and had a chat to him about how he could apply Arduino for his hobby in creating new interfaces for electronic music instruments. Reflecting upon his follow up action, he stated:

> "…so what's the worst, like, they just think I am idiot and I just have to leave. I could probably deal with that, I just never come back again (laughing). I think it was doable." (I14).

For a user to initiate a conversation, a personal benefit has to arise from that conversation.

> "If it was particular to my exact interest, than yeah. I would go 'oh wow'; I would go and have a chat with them." (I9).

Initiating conversations just for the sake of socialising and personal chit chats without any deeper purpose does generally not appeal.

> "So if there is an actual thing where there's gonna be some sort of transaction then yes, but just for general chit chat probably not…"(I9)

Similarly*,* another interviewee stated his strict interest in professional skills, rather than personal details about other users

> "…I am more interested in his professional skills, not the colour of his hair. Like, if I want to get something done. Tell me what he is good in" (I19).

The decision to approach another user also appears to depend on someone's general personality and openness towards other people. In contrast to I14 and I22's example above, I15 and I7, both regular coworkers at The Edge, were a bit more hesitant when we asked them to 'think aloud' while they reviewed where particular users were located.

> "…I don't know if I'd feel comfortable just going to a booth and… well, maybe… to be honest, I didn't feel very hard about it and probably I was just on my way to grab the coffee. I don't know, I think it's nice. It looks friendly." (I15).

This example illustrates the significance of the situated context and a user's urge to gather a particular skill for them to initiate a face-to-face conversation.
Another strong motivation for use emerged by regular users who were keen to identify like-minded others in order to grow their community of interest. I3, even though he has been a daily visitor at The Edge for almost one year, works on music projects but finds

it hard to identify like-minded musicians and music producers at The Edge. He does not feel well connected;

> "…like there is not anything much that makes musicians here interact, to be honest. I heard of so many that use this space, but, to be honest, I have only met two. But I am pretty sure that there is so many more than them. Because some people actually go in the recording studio and leave, they don't stick around in the public areas…"

He perceives Gelatine as a welcomed tool that will help him find other musicians.

> "It will be so much easier you come and see 'oh that person is actually somewhere in here.' I will definitely be a user of this, I am signing up. To meet other musicians and music producers […] Honestly, I was trying to find a way how to put it, but I mean this is what's missing. It's very vital for people to interact…" (I3).

Limitations, Challenges and Future Work

Through the evaluation, a few challenges emerged to be considered by future versions of Gelatine or similar systems. Non tech-savvy interviewees had problems understanding the mental model behind the RFID check-in concept and the tag-cloud reflecting the profiles of all currently present people in real-time. McCarthy et al. (2009) report similar challenges in their study with users at third places, and suggest 'information flyers' as a fruitful solution. One user that interacted with the screen found a skill-tag ("C++" – a programming language) that he was interested in, and which pointed to a person at workspace 8. Wanting to initiate a conversation, he walked over to workspace 8, but found the person occupying the space was a homeless person (*"kind of old," "…had a lot of plastic bags").* He assumed that that person could not possibly be the person on the screen with the C++ skills. A profile image behind each tag might help match people in the space with their digital representations on the screen.
Another participant raised the issue that the turnaround time to find a facilitator for the (computer programming related) types of problems he usually faces might be too slow. *"…if you've a problem right now, I don't think that system will be fast enough to help you"* (I19). On the other hand, users reported that they are usually too busy working on their own things to actively go and browse through the tag cloud in order to provide help for someone else.

> "…it's not a problem of me willing to help, it's kinda willing to help without spending a lot of time on just kinda reading or searching for whom to help […] that'll be a waste of my time" (I19).

Future versions will integrate web and mobile application modules that 'helpers' can configure to be notified if someone in the space requests help with an issue in their particular areas of expertise.

A longitudinal study would need to shed light on how Gelatine would actually transform a space like The Edge in long-term. Placemaking requires providing users with a sense of ownership, and encouraging them to continuously shape and re-appropriate spatial infrastructure according to their needs and comfort. In contrast to the physical space in most libraries, Gelatine's infrastructure has been designed to embrace the user community to become co-designers and co-developers of the system. It is based on open-source software and hardware (e.g. wordpress.org, processing.org, apache.org, arduino.cc), the development code is made openly accessible on Github, and we provide an API to the Gelatine database for users to create their own visualisations of checkin-data and user profile information. Whilst the tag cloud visualisation showed its potential for serendipitous skill discoveries among users, it also triggered some alternative visualisation ideas among the interviewees, such categorisation of checked-in users according to their background (designers, artists, coders, etc.) or check-in timestamp (timeline). Further research needs to investigate the alternative visualisations through dedicated participatory design sessions and their respective impact on users' sense of place and ownership.

Further research also needs to investigate opportunities of other smart space applications and concepts that are enabled through the Gelatine infrastructure. Gamification elements, as we discuss elsewhere (Bilandzic & Johnson, 2013, forthcoming), could enable users to collect reward points or unlock "badges" through providing assistance to other users, which then can be exchanged for premium library services (multimedia equipment hire, extension of book loans, etc). The evaluation also highlighted the contradictory perceptions of "non-users" and "users with coworking attitudes" which raise cultural and political questions for the space managers, such as the installation of "quiet" and "social" spaces.

Conclusion

Designers and placemakers cannot create a 'sense of place' on their own. Place is created by people, their intrinsic motivations for particular activities, and patterns of use. This study shows that public screens such as Gelatine, by making invisible socio-cultural aspects of a place visible, have the potential to 'amplify' users' perceived sense of place as well as sense of situated people at a place. In contrast to personal displays (e.g., smartphones), Gelatine embodies digital footprints of situated users as part of the public space; hence serendipitously perceivable to all passers-by, most of whom would not actively retrieve or stumble upon such information otherwise. Further, the study shows that whether a user takes notice, ignores or interacts with the screen highly depends on that user's individual pre-entry motivations and attitudes towards the surrounding place and people at the place. In summary, Gelatine was used to fulfill needs that users have had before Gelatine was introduced (c.f. Bilandzic & Foth, 2013b), e.g., for divergent (exploratory, opportunistic, serendipitous) and convergent (goal-directed, focused, explicit search) information behaviour (Björneborn, 2010). *First-time users'* browsed the screens to get a better sense of purpose and function of the space, and *coworkers* identified likeminded or more knowledgeable users. On the other hand, users who were not interested in engaging with their fellow coworkers prior to the installation of Gelatine, showed no interest in using Gelatine either. This underlines the design of public screens not only being a matter of (human-computer) interaction design, but even more so a matter of a broader placemaking (Schneekloth & Shibley, 1995) strategy at the place of installation. The purpose and function of a public screen need to match with the prospective user's role and motivation of being at that place. Given such a match, public screens such as Gelatine can serve as a powerful *hybrid* tool for placemaking. Follow-up thoughts on *hybrid placemaking* are elaborated in (Bilandzic & Johnson, 2013, forthcoming).

Chapter 12:

Conclusions

This research study was aimed at *understanding* the nature and challenges of connected learning, as well as *informing, designing and evaluating* social and technological interventions that facilitate *connected learning* in *collaboration* and *coworking environments*. The results provide findings and actionable knowledge in relation to these aims.

Understanding and Informing – Connected Learning Requires Facilitation

Learning does not exclusively take place at a particular environment (e.g., school, university, library, museum, etc.) or during particular activities (e.g., studying for an exam, reading a book), but it is embodied in everyday life and social environments that involve participation, engagement, productivity, and fun. The study in Chapter 8 shows that people, in their leisure time, engage in a range of physical places, online spaces, community groups, social networks and technologies to learn and improve their skills in relation to their personal interests and passions. I summarise the nature of these networks as *Hybrid Personal Learning Environments (HPLE)* – they are personally selected, shaped and re-negotiated according to the learner's interests, and spread across physical spaces, nomadic socio-spatial environments such as friends and meetup groups, as well as online spaces and platforms.

Despite the increasing *online* opportunities for people to connect, interact and find inspiration from other likeminded people and groups, there remains a need and desire to meet, mingle and interact in face-to-face settings with likeminded people from the local area. Chapter 9 reports findings from observations and interviews of various *meetup groups* and *hackerspaces*. Those represent organically grown, community-driven locales that provide opportunities for such *social mingling* and *connected learning* around shared interests and hobbies. The insights show that the *learning* that members experience as a result of their participation in such groups is not perceived as an isolated 'learning' experience per se, but rather embodied into practices of socialisation, such as informal conversations over dinner or drinks. Ito et al. (2013) report similar findings about learning in the context of youth culture – significant learning experiences occur "out-of-school" and

are embodied in young people's everyday interactions and spaces that allow them to *hang out, mess around and geek out.*

Spaces that support personal, interest-driven activities as well as provide opportunities to do this within a supportive socio-cultural context are significant not only for the future of learning and education, but also for the knowledge economy we live in. We depend on locales that foster *cross-fertilisation* of knowledge, creativity, ideas and innovation. The selected case study environment of this research at The Edge at State Library of Queensland envisions providing such a space for people in Brisbane and Queensland. The insights from the case study (Chapter 6) show that people indeed use the free space and state of the art infrastructure (music studio, physical lab, computer lab, meeting spaces, multimedia authoring software, projectors, etc.) for interest-driven activities, which they would not necessarily be able to pursue elsewhere.

However, the study also reveals that there is a *lack of connected learning experiences*. In contrast to the organically grown, bottom-up community initiatives such as meetup groups or hackerspaces, users at The Edge usually perceive their fellow coworking users as *strangers*. The behavioural norm in the space is people working by themselves, or in isolated pre-negotiated groups. Serendipitous interaction and connections to unacquainted users were only rarely observed. People perceived a *social barrier* to ice-break conversations and connect to unacquainted coworkers. These findings are in line with previous studies on user behaviour in libraries. Aabo and Audunson (2012) observed users mostly working in *"individual bubbles"* (p. 143) and interactions being *"in most cases indirect and nonverbal"* (p. 146). Sommer (1969) found that library users spread out as much as possible, usually occupying the space in a way to maximise distance and minimise eye-contact. Goffman (1966) observed similar patterns observing interactions between unacquainted people in public places.

These findings reflect culturally established behavioural norms, and show that simply building a space and laying it out with connected learning and collaboration in mind, does not mean that people will necessarily use (or feel comfortable using) it for activities that involve connected learning or collaboration. Environmentally pleasing and accommodating physical spaces are *necessary*, but *not necessarily sufficient* to enable connected learning.

The investigations in this thesis on four professionally curated, commercial coworking spaces (Chapter 9) show practices of coworking space managers to counteract such social barriers. In particular the larger coworking spaces hire a full-time staff member

(*Space Host*) whose job it is to catalyse connections among coworkers. Through organised social events such as *brown bag lunches*, *Social-Beer Fridays* or the support of smaller, special-interest *clubs* of their coworkers, coworking spaces nourish a tightly knit community towards increasing opportunities for connected learning and collaboration. In addition they set up online social networks to encourage additional networking via digital channels.

While the significance of the socio-cultural context for the design of free-choice learning environments is well known (Falk & Dierking, 2002), most institutional spaces that facilitate self-directed and intrinsically motivated learning (e.g., galleries, libraries, archives, museums, etc.) do not cater for a social or collaborative learning experience per se. Their curation efforts are rather focused on spatial and infrastructural elements that visitors might or might not end up utilising as part of a collaborative learning journey (e.g., family in a museum, student study group in a library). They provide spaces for people to engage in self-directed learning in parallel to each other, but do not necessarily encourage people making new connections with collocated peers to facilitate cross-fertilisation of knowledge and connected learning effects. In quest to explore opportunities in relation to this gap, I designed, deployed and evaluated *two innovative design interventions* at The Edge: A social intervention (Chapter 7) and a technological intervention (Chapter 11). Those are described in the following section.

Designing and Evaluating – Two Interventions that Facilitate Connected Learning

Nurturing Organic Growth of Local Interest and Passion through a Social Intervention

As a **social intervention**, I initiated *Hack The Evening (HTE)* – a weekly meetup group around hacking, making and DIY (Do-It-Yourself) technology. The insights from 18 months of ethnographic observations and in-depth interviews with HTE group members show that it evolved into a locale that attracts people primarily for the purpose of *self-directed, social learning*. In contrast to top-down imposed programs and organised events (invited talks, workshops, exhibitions, etc.), HTE is *community-driven*, and as such, a *self-maintained* and *sustainable* mechanism. By the time of this writing (21 months after the group was started), I have been progressively making myself redundant as the socio-cultural animator of the group (Foth, 2006b). Despite my absence as the original

initiator and 'organiser' of HTE, the weekly meetings on Thursday nights are still heavily attended. It has become a messy, but self-sustained system. There is no particular agenda, program, hierarchy or organisational control. There are no obligations or particular directions; everyone comes and goes when they want, and do what they want. New people constantly join, and regular users drop out. Some do not attend for a couple of months, and then come back again. This loose setting and flexibility are perceived as the key points of attractions for HTE members. They are able to pursue self-driven activities, which they care and feel passionate about rather than following an externally imposed agenda or learning goals. At the same time, they enjoy doing this with and around a group of likeminded others, who provide a stimulative, inspirational socio-cultural context. HTE has become a locale for people to connect, socialise, have fun, explore, experiment, exchange, learn, teach and support each other.

The description and findings from the HTE experiment (Chapter 7), show how libraries in particular, and coworking spaces in general, can support and cooperate with *local special-interest meetup groups* as a mechanism to encourage and nourish connected learning, collaboration, creativity and innovation within the local community. In contrast to set workshops, agendas or programs, initiatives such as HTE cannot be designed or imposed top-down, but rather need to be nourished to *organically grow* and *evolve* bottom-up. Therefore, libraries and coworking spaces need to get a feeling for particular interests and passions within the local community. Their role should be then to support individuals or small special-interest groups to practise their passion and interest, and infect others towards growing enthusiasm in the wider community. Supporting multiple such local, special interest groups, libraries and coworking spaces can become *hubs for connected learning.* They facilitate connections within special-interest groups, but also across different groups and their particular activities, practices and knowledge bases. Previous research recognises the potential of libraries as (free, democratic, accessible and socially diverse) spaces for such *high-intensive* meetings or *low-intensive* meetings respectively (Aabo et al., 2010; Audunson, 2005; Audunson et al., 2007b). However, conversation, collaboration and face-to-face interaction do not come naturally, in particular, among unacquainted people (Goffman, 1966). Culturally established social barriers can be counteracted by means of *designing open regions*, i.e. situations where it is considered as socially acceptable to ice-break conversations with strangers. At HTE, we provided free pizza, which often broke the ice for a long term transition of HTE members being *familiar strangers* in the beginning, towards becoming acquaintances,

friends and in one instance even romantic partners. In particular libraries need to recognise *hospitality* and *social facilitation* as an important means of enabling connected learning. They should be considered into their budget similar to investments on physical arrangements, such as open architecture, whiteboards or meeting rooms.

Amplifying Awareness and Connections Between Coworkers through a Digital Intervention

Gelatine, the **technology intervention** in this research has been designed through an iterative, user-centred approach to further facilitate connected learning on a more scalable level. Gelatine is an ambient media system that augments shared encounters between coworkers by allowing them to digitally 'check-in' at a work space, and displaying skills, areas of interest, and needs of currently checked-in users on a set of public screens (Chapter 10). It was evaluated (Chapter 11) over a period of six days 'in the wild,' real-world context as encountered by users during their everyday work at The Edge. The study illustrates the potential of Gelatine *as a tool for hybrid placemaking*. Coworkers with similar or complementary skills and interests often worked from The Edge without being aware of each other's activities. Gelatine made such invisible, social aspects of currently co-present people visible, and succeeded in *amplifying* users' *perceived sense of place* at The Edge. The users started to recognise The Edge as a destination not only to work on their individual projects, but also to *meet* and *connect* with interesting other people. Some users' changed their perception of The Edge as being merely a *location* towards being a *locale*. People used the displayed skills and interests to identify likeminded users and initiated serendipitous conversations that were unlikely to happen otherwise. Gelatine's form factor as an ambient medium (as opposed to, e.g., a mobile phone application) was significant to attract the attention first-time visitors, most of whom would not have stumbled upon it otherwise. Gelatine caused different reactions according to a particular user's pre-entry motivation at The Edge. Some people who used The Edge primarily for concentrated, isolated activities towards 'getting things done' showed no interest in the system; other people, who were more open and keen to meet likeminded people in their domains of interest, embraced Gelatine wholeheartedly. Spinuzzi (2012) found similar tensions (*inward facing vs outward facing*) between coworkers based on their different activities, motivations, and attitudes in the shared space. The design of future ambient media systems such as Gelatine needs to account for such different user attitudes; in fact, ambient media provide means to address such tensions

in new ways. Further research needs to address how individual coworkers' moods and attitudes can be captured in real-time and reflected in the space for notice to other coworkers. Contemporary ubiquitous computing technology and ambient media provide the means for seamless integration of such features in the physical space. However, the design matter of *hybrid spaces* is finding ways that their *physical* as well as *digital affordances* become culturally *embodied* elements of the space, and guide social interactions towards decreasing the tensions and amplifying the benefits of coworking. *Gelatine* was a first step towards thinking and designing in this direction.

Outlook

Skills, knowledge, creativity and innovation are increasingly important drivers of economic growth and wealth in the global economy of the 21st century. Collaboration and interaction in a supportive socio-cultural environment is a key driver for both, acquisition of skills and knowledge, as well as creativity and innovation. New skills and knowledge that lead to disruptive innovation and creativity are increasingly based at the intersection of fields, disciplines and cultures (Johansson, 2004). Governments, education and research institutions, as well as industry corporations have recognised the significance of locales for actors to mingle and interact with people from diverse and relevant other backgrounds, cultures and areas of expertise; over the past decade, we have witnessed more and more *innovation precincts, ideation stores, incubator labs, collaboration* and *coworking spaces* being designed and built to foster creativity and innovation. Companies such as Google, Facebook, Apple or Microsoft that continuously strive for technological innovation have been building campuses with dedicated spaces and infrastructure to facilitate cross-fertilisation of knowledge, projects ideas among their employees. Coworking spaces and public libraries seek to design and provide similar environments for the general public to co-create, collaborate and be inspired by likeminded peers. Governments build such collaborative spaces as part of their innovation systems (OECD, 1997) in quest boost their economy. The Australian Government, for example, has recently announced to spend more than AUD 500 million on the construction of up to ten Industry Innovation Precincts around Australia to foster collaboration between industry, companies, universities, research institutions and experts in technology and business (Australian Government, 2013).

However, an effective coworking space is an environment that not only provides facilities for people to work next to each other, but also nourishes the formation of a

knowledge network within the coworking community. The collective intelligence, knowledge and skills in such a network is greater than the sum of its parts, thus embodies a potential for creativity and innovation that is bigger than the potential of individuals working by themselves. The case study from this thesis shows that a top down-approach of building and providing a dedicated physical space and infrastructure is not sufficient to actually foster collaboration or innovation. Effective collaboration and innovation start with conversations, discussion and trusted connections between individual people. Those cannot be forced or imposed top-down, but need to be organically grown and nourished in a bottom-up fashion. Over the past eight years, the rise of Web 2.0 (O'Reilly, 2005) has revolutionised how people find likeminded peers to collaborate, exchange and cross-fertilise knowledge, skills and ideas. It is now time to think about ways to embody such means into physical spaces to better foster bottom-up connections and collaboration *within place-based knowledge communities*. As part of this research project, I have designed, implemented and evaluated a social and a technological intervention in an attempt to do so. The outcomes of both, the social and the digital intervention show their contribution through the creation of connections between individuals that would not have happened otherwise. However, the two interventions also reveal limitations and untapped potentials. Further research needs to explore the facets and dynamics of what I refer to as *hybrid placemaking*. Hybrid placemaking combines the opportunities of social, spatial and digital means to facilitate social interaction, and regards them as equally important, complementary elements for the design of interaction affordances in a space. Unlike the Web 2.0 and digital applications that live behind glass displays, physical space is ambient, tangible and a profound element of everyday life experiences. Designing and embodying digital interaction affordances as part of a hybrid place can unleash potential for collaboration, creativity and innovation in ways that would not be possible in purely physical or digital collaboration spaces. This quest forms a new, interdisciplinary research agenda across urban informatics, ubiquitous computing, architecture, computer-supported collaborative work and other relevant domains.

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