Teaching Urban Landscape Microclimate Design Using Digital Site Visits: A Mosaic Method of Embedding Data, Dynamics, and Experience

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Abstract: This paper presents a methodology for creating a multi-modal digital site visit as a tool for teaching urban microclimate design. The approach draws on traditional site visit methodologies including walking and data capture and positions these within a curated digital environment to produce a 'mosaic' of critical data, representations, design theory and research. The construction of the digital site visit further applies principles from game-design to promote students' engagement and creative exploration. By producing an exploratory interactive digital site, the tool seeks to engage students with the complexity of microclimates in the early stages of the design process.

Keywords: Site visit, simulation, design pedagogy, gamification, landscape architecture

1 Introduction

Prior to 2020, interest in creating digital sites and virtual field trips for teaching design highlighted the many potentials of digital tools but also reported hesitations in translating studio methods to an online environment (BENDER 2005, GEORGE 2017). However, with the COVID-19 global pandemic and the shift to more online delivery, design educators have had to rapidly overcome these uncertainties. While the abundance of online data and digital resources have been invaluable for communicating spatial information to students, the previous hesitancy in using digital site visits has left gaps between these resources and disciplinary-specific pedagogical methods. For landscape architecture, this is evident in how sites are introduced to students in the early stages of a design process.

Landscape site investigations have traditionally used physical site visits, experiential recordings, and data collection as part of the early stages of design. For example, exploring a site through walking, surveying and site-specific embodied practices are common methods for understanding the special qualities, topography, materials, usage, and spatial scale of a place. However, it is difficult to substitute such place-based investigations in an online environment (DE WIT 2016, SCHULTZ & VAN ETTEGER 2016, WINGREN 2019). The broad range of existing research into creating digital sites has largely focused on technical aspects of recreating space. For example, using virtual or augmented reality to reproduce an immersive visual experience or communicate design concepts (LI et al. 2018, PORTMAN et al. 2015, TOMKINS & LANGE 2020). These approaches do not explicitly connect digital spatial replication with teaching generative design. Within educational research, there is an acknowledged need for online tools that more directly connect with the pedagogy of design studio (DREAMSON 2020, FLOHR et al. 2020, GEORGE 2017, PIPAN 2019, MILOVANOVIC 2020).

These challenges are further highlighted when teaching generative methodologies for microclimate and atmospheric design. In addition to understanding stable physical spatial characteristics, students must learn to work with fluctuating environmental phenomena such as temperature, wind, and solar exposure (LENZHOLZER 2015, WALLISS & RAHMANN 2018). Static

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representations and numerical forms of environmental data can be difficult for students to interpret as dynamic conditions which operate in time as part of a designed space.

Although digital experiences are common, there are gaps in structuring these resources for learning outcomes specific to design teaching. Particularly for students who are learning to work with data and digital tools, who need strategies engaging with the content, alongside explicit connections to design techniques. This paper describes a methodology that was developed in the move to fully online studio teaching. The digital site visit was produced for an interdisciplinary master's design studio working with microclimate design in inner-city Melbourne, Australia. The 2020 pandemic lockdown in Melbourne imposed severe restrictions on public movement and congregation. This resulted in students not being able to access outdoor sites and having to work from home using personal computers. While completely immersive digital experiences have been found to improve student's engagement and interest with site conditions, these often require access to specialised hardware in laboratories (FISCHER et al. 2020, FLOHR et al. 2020, PORTMAN et al. 2015). In this instance, teaching remotely meant that the digital site visit had to be accessible and functional from a range of home devices whilst also introducing students to the diversity and variability of designing with urban microclimate phenomena.

2 Capturing and Revealing Microclimate Dynamics

The methodology begins with capturing and curating material to populate the digital site visit. The range of material is gathered to fulfil two purposes: to expose site-specific microclimate phenomena and further to demonstrate landscape design site investigation methods. The site recordings and data were captured using three established techniques – data logging, photography and sound and video recordings. These techniques are widely used in traditional physical site visit analysis and here they continue to be employed as the primary devices for capturing spatial, visual, and audio observations for informing the early stages of design.

The framework for capturing site information is based on explicitly revealing microclimate dynamics within the site. The aim is to highlight localised microclimate and atmospheric behaviours by exposing environmental differences and revealing comparisons. To do this, two walkable transects across the site are chosen to create critical parallels which can demonstrate microclimate fluctuations within close spatial proximity. Data is captured by physically walking the transects while logging environmental information using air temperature, humidity, and air flow sensors. In this example, iButton temperature and humidity sensors and a handheld digital anemometer were used concurrently. Capturing microclimate variance through physical walking and wearable data tools has become increasingly common in recent years and there is a wide range of suitable tools for the task (CHOKHACHIAN et al. 2018, DZYUBAN et al. 2020, NAKAYOSHI et al. 2015, TOH & WALLISS 2016).

The organising principle for collecting data is further informed by the timing of the data recordings. Data loggers are programmed to take readings at regular intervals, for example, every minute. Subsequently, the act of walking is necessarily matched to the selected timed intervals. The walk is broken into a series of timed stops in a rhythm. This generates a sequence of regular moments or *key points* along the transects. This structuring device works to create a simple comparative spatial matrix of different microclimates within the larger site. The same transect walks, stopping at the key points are repeated on separate days, times and

in different conditions, producing a set of environmental data which deliberately exposes the microclimatic patterns and variance at the site.

Each key point, where the environmental data has been collected, is further illustrated with video recordings and photographs to highlight the spatial and environmental phenomena in context. Street-level video recordings are used to demonstrate microclimate phenomena in action. For example, the sound and influence of wind moving through space, rain fall or visually tracking the changes to sun exposure and shade. Video is also used to record demonstrations of the data logging and field observations methods. This includes the instructor speaking to the camera, demonstrating the equipment and 'talking through' the process. By incorporating the demonstration videos into the digital site visit, students are provided with both the microclimatic material but also insight into the methods of how it was produced. Photographs are taken to highlight very specific site features or moments in time. While these cannot capture dynamic qualities, still images can be easily annotated to draw attention to precise details. Static panorama and 360° photographs are also used as the primary orienting and direction-finding visuals within the digital interface as these allow the user to pan and zoom as they choose. These direction-finding decisions become important as operational distinctions in navigating the digital site and investigating the site information.

3 Assembling the Mosaic – Compilation and Navigation

In assembling the material, the method draws on two compilation strategies: highlighting the deliberate contrast in the site data and the application of navigational *flow* from game design theory. Flow is described in game design as managing the user experience so that is not too easy and resultingly boring but equally not too difficult and frustrating (URH et al. 2015). In this case, creating appropriate *flow* is used as a playful mechanism for engaging students with discovering the nuances of variable microclimate conditions. In the digitally reconstructed site, the environmental data and recordings are embedded at different locations, some more evident than others. In effect, creating a virtual 'treasure hunt'. Through applying the principles of flow, the treasure hunt becomes progressively more challenging as students become more familiar with the site and the digital interface. By hiding and revealing the content, students are encouraged to pay close attention, investigate the material widely and open their investigations beyond the immediate and most obvious aspects of the site.

Creating the interactive and exploratory digital site utilises the H5P platform. This is an open-source HTML content editor which can host a variety of media to create interactive presentations and videos within a web-browser. The interface can accumulate information types and overlap multiple recordings of experiential qualities with data and other spatial information. Being web-based also overcomes some of the issues of accessibility for a student cohort who are working from home without access to specialised hardware or software.

The initial entry point to the digital site uses an aerial plan view which can be 'zoomed' into at the key points generated from the data collection along the two orienting transects (Fig 1.) Once zoomed into, the points are digitally viewed as a sequence of 360° ground-level site photographs that can be freely navigated to 'look around', pan, and zoom.

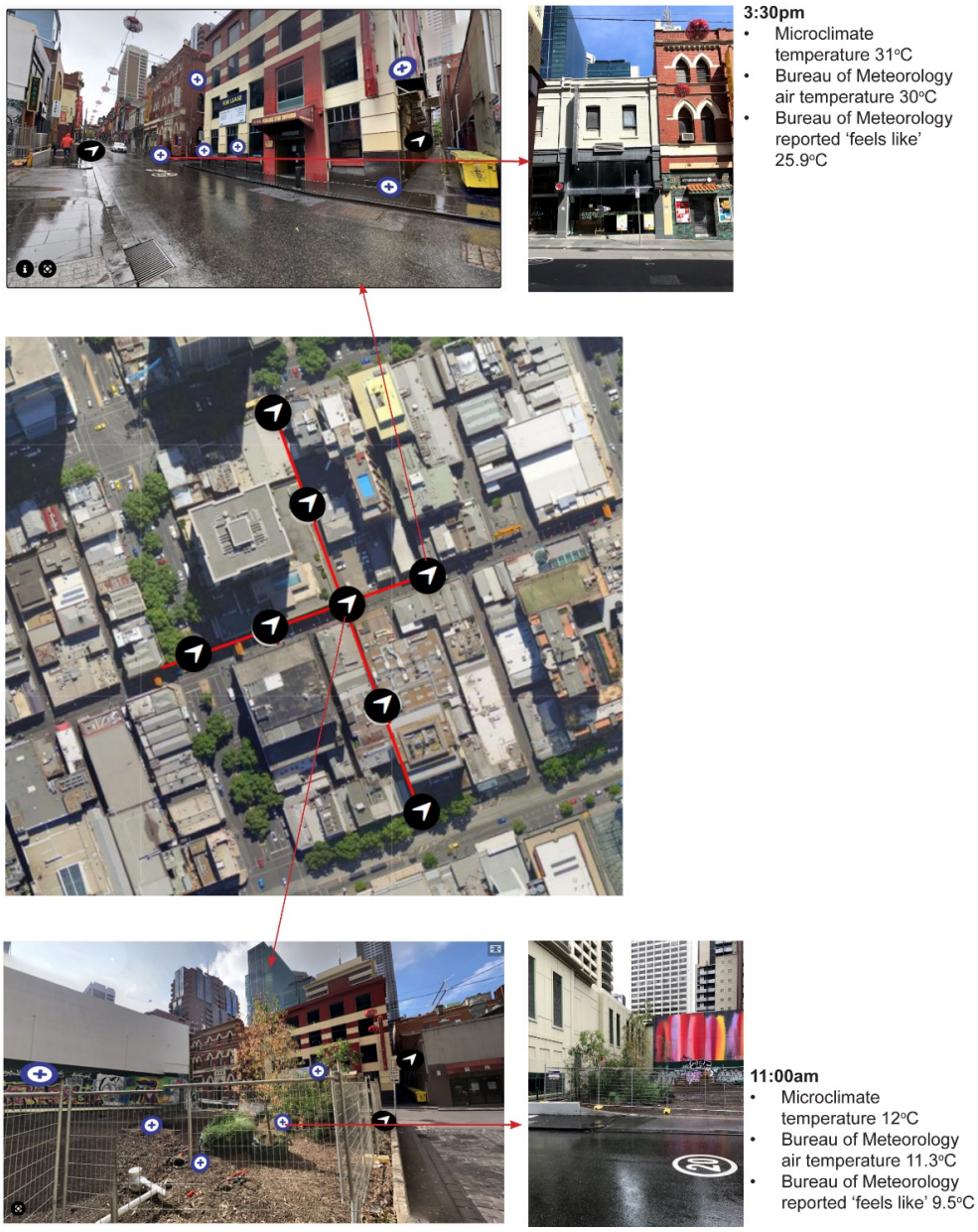

Fig. 1: Diagram explaining the structure of the digital site visit. Within the digital space site images are embedded with navigation arrows alongside spatial and microclimate details including temperature data, timestamps, and other media.

The street level images are further embedded with other resources such as readings from design theory, scientific research, and larger-scale meteorological data. The resulting mosaic of information offers a spatialized mode of exploring a site which is enriched beyond the existing capabilities of Google Street View or Near Maps.

The transects can be virtually traversed at street level by clicking navigation arrows which recreates 'walking' through the site. In moving along the transect from point to point, the sequence of images purposefully changes the representations of the temporal conditions that affect the microclimate. Thus, the student might virtually 'walk' from a rainy morning into a bright, sunny afternoon. While the static structures of the site remain as they do in real life, the changing atmospheric, weather and microclimates are revealed by moving and exploring the digital space. The changing visual representations are directly annotated with the site microclimate data alongside the other resources. This allows students to align the numerical data with explicit spatial and environmental characteristics and to associate invisible changes such as air temperature within the more obvious visual changes.

As the navigation is not prescribed, the virtual space can be fluidly moved through. The layering of information can highlight site phenomena or strategically hide details within the images. By constructing the digital site visit as a microclimatic treasure hunt or mosaic, the pieces exist concurrently where students must unpack and explore the range of information within the constructed visual-spatial representation (HOLLAND & ROUDAVSKI 2016, SEZGIN & YUZER 2020).

4 Application to Design Teaching

The method described here does not aim to produce a 'digital twin' of the site or a real-time virtual experience. Beyond simply packaging and providing the material to the students, the digital site visit aims to engage students in a deeper investigation of working out why the site microclimate behaves in particular ways. By structuring the material using game theory, the exploratory aspect of the digital space also allows students to make discoveries and further develop their observations. The game-like device of presenting the site and microclimate information to be discovered aims to foster curiosity and exploration towards exposing opportunities for design rather than reducing the site to single or static conditions (KAMUNYA 2020, MAJURI 2018, MARSANO 2019, TURAN et al. 2016).

As a teaching tool, the digital site visit can be configured to focus on specific points whilst also allowing students to seek out details and 'hidden' data. Whereas this library of information could be presented to students as an unstructured resource, by associating the material within the site's spatial conditions, students are offered an important set of connections between resources and site. The mosaic of information created by the digital site visit produces an effective lens for directing student focus – in this case on the role and effects of microclimate phenomena. This is useful for landscape architecture students who are just learning to interrogate microclimatic behaviours, where visually locating and connecting data overcomes some of the initial difficulties of interpreting numerical representations of environmental phenomena. Simultaneously, the careful curation of material provides important guidance to students through ensuring the quality of information and resources.

While there are clear opportunities in this method, there are also limitations to the approach for both design instructors and students. From the instructor perspective, there is a considerable amount of time and some expertise required in creating the entire resource. The full process of capturing suitable recordings through compiling and curating the media and further aligning theory and research is both labour and time intensive. Similarly, the method described here requires some physical site visits by at least one person and adequately capturing environmental variance entails multiple visits. While there are examples of remote site-based investigations produced by harvesting social media recordings from Instagram or Snap Chat, largely these studies offer a different focus to a designer-led site analysis. Many are framed around the user and audience perceptions and the emerging practices of consultation through digital storytelling and ephemeral communications (GEROS 2020, KAUSEN 2018, SONG & ZHANG 2020).

In the initial applications of this method to design studio teaching, students have demonstrated a complex understanding of site-specific microclimate dynamics in the context of landscape architectural design. However, without a physical site visit, there have been fewer opportunities for these students to engage with broader contextual site information that would usually inform their design work. In addition, under the instructor-led gathering and curation of information, students do not get to participate in the methods of site analysis themselves. While the site analysis techniques are demonstrated through recordings within the digital site visit, this does not equate to students applying the methods themselves – a potential gap that must be filled later in a student's landscape design education.

To further develop the method, there is a clear need for proper evaluation and comparison with other remote teaching tools and techniques. Particularly as design teaching and learning continues to transition into hybrid forms of remote learning. There may be opportunities for this method to be used in concert with more advanced digital experiences. Similarly, it is important to further develop the links between a digital site visit and the unique pedagogy of landscape design studio.

5 Conclusion

Undoubtedly for landscape design, having students visit a site themselves will always have an embodied benefit. By physically experiencing a site, students can position and make sense of a space directly through the tactile and haptic phenomena of real conditions. However, the events of 2020 have highlighted the need for diversity in design teaching methods and approaches. Physical site access will not always be possible. With increasing numbers of students choosing to study remotely, having alternative methods for providing site-specific information will continue to be beneficial.

The mosaic method described here has been most useful to early-stage students who need very specific direction or focus on topics and has proven valuable in teaching urban microclimate design to a remote cohort. The curation and assembly of material within the flexible digital space allows students to practice aligning different media and numerical information. Further, the method promotes engagement with the material by enhancing the playful aspects of navigating in digital space. By making the material exploratory as well as informative, the tool aims to motive students to explore in a way that might be closer to a physical site visit.

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