

Augmented Reality in Design Education: Landscape Architecture Studies as AR Experience

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Abstract

The rapid and ongoing development of digital technologies continues to create new opportunities for education. Over the last decade this has enabled the establishment of blended learning approaches and online education. More recently, Augmented Reality (AR) has emerged as a unique technology that can transform learning experiences across diverse disciplines. This article outlines the development of an AR prototype, *Master of Time*, which was created to educate first year students and non-designers on the foundational principles of landscape architecture. This study examines the learning potential and benefits of AR technology with a focus on creating new practices in digital storytelling across situated experiences. In outlining project outcomes, the authors propose a series of critical design principles, strategies and methodologies for educators to apply when developing AR learning experiences across disciplines. Included within this is a framework for transdisciplinary and co-design collaboration, which is essential for educators working in the forefront of learning technologies.

Keywords

augmented reality, landscape architecture, landscape design, mobile learning, m-education, educational technology

Introduction

With the wide adoption of smartphones and an increasing use of augmented reality (AR) for a variety of contexts, from orienting tourists to locative gaming, it is unsurprising that this technology is being perceived as a new modality for learning. AR is a technology that combines real and virtual information together, allowing it

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to be accessed in 3D physical environments (Kipper & Rampolla 2013). This can lead to rich immersive experiences and allow for different environments to be transformed into responsive and personalised learning spaces. The unique educational opportunity this presents is explored in this study through the development of a mobile device-based AR prototype titled *Master of Time* [1]. This is an experimental work commissioned as part of a series of milestones celebrating 50 years of landscape architecture education at Queensland University of Technology (QUT), with a central aim of showcasing future pathways for education. The initiative is approached as a way to develop new pedagogies for design education and create transformative learning. This article outlines both the design process and outcomes of the project in order to contribute to the growing field of educational technology studies.

Mobile-driven AR is identified as being a highly pertinent emerging technology for landscape architectural education as site visits are historically integral to its pedagogy. The site for *Master of Time* is the Brisbane City Botanic Gardens, selected due to its close proximity to QUT's campus and historic landscape design. In order to facilitate maximum usage, it is accessible for free via Apple's App Store and the Google Play Store, which not only allows its primary user group QUT's first year Landscape Architecture students to partake in the local learning experience, but also members of the public, including local and international tourists, as well as prospective landscape architecture students. The educational aim of the prototype is to teach users about the underpinning foundations of landscape architectural design. Encompassed within this is viewing the City Botanic Gardens through the eyes of landscape architects and exploring the fundamental 'ways of seeing' that is core to disciplinary practice. These 'ways of seeing' are closely aligned with the technology's ability to add layers of understanding and knowledge to real spaces. The overall project aim sees its educational core not simply being based on a transferal of knowledge, but using the technology to assist in facilitating a *shift in perspective*.

In developing the project it became apparent there exist few precedents. Due to the conceptual approach and technological and design complexity of the educational model, this required the project include participation from other design disciplines at the university, including staff from interactive and visual design and the creative arts. As a result, a methodology for educational design, based around transdisciplinary collaboration, is developed for the project. Also involved in this methodology is collaborating directly with potential users of the platform, through a foundation of co-design and user/student-centred design. Entailed here is the participation of current and recent landscape architecture students and potential future students, currently in high school, all of whom could be regarded as 'digital natives', the key target demographic for the work.

Augmented reality and education

AR is a combination of both real and virtual information, it is interactive and operates within a 3D environment (Kipper & Rampolla 2013). Azuma's (1997) foundational work identified that augmented reality systems are those enabling real and virtual objects to coexist within the same space for interaction in real time. Azuma also distinguished AR from virtual reality (VR), noting that the latter is a derivative of the former. VR represents a complete environmental simulation. The most common AR model today sees content accessed via smartphones. Typically AR will

occur through utilising a mobile's GPS functions to identify locations and points of interest, or alternatively by a user using their camera and screen to point at identifying markers. Digital content is then revealed at these points.

From the 1990s onwards AR technology has been applied across the industries of medicine, military, manufacturing and entertainment, and more recently it has expanded into advertising, healthcare as well as education (Akçayır & Akçayır 2017; Bitter & Corral 2014; Bower *et al.* 2014; Uzunboylu & Yıldız 2016). Within education, the adoption of AR and most commonly AR apps, represents a strand of m-learning and technology-enhanced learning (TEL). Such terms identify broader changes occurring across educational paradigms. M-learning relates to mobile-driven technologies being used for educational purposes, while technology-enhanced learning encompasses technologies and approaches such as augmented reality, ubiquitous learning (u-learning), serious games and learning analytics (Bacca *et al.* 2014; Johnson *et al.* 2014).

One of AR's key strengths lies in learning content within this context being 'dynamic' and not 'static' and 'two dimensional' like most pre-existing educational materials (Kesim & Ozarslan 2012). Uzunboylu & Yıldız (2016) have noted this difference may be integral in engaging contemporary and future students, who are regarded as digital natives. Radu (2014, 1539) identified that there is unique benefit for these students through the physicality of the experience, wherein 'the learner is physically enacting the educational concepts'. Bower *et al.* (2014, 6) also noted in this regard AR 'offers educators the opportunity to provide "perfectly situated scaffolding" in ways that were not previously possible'.

Key challenges have been identified for the emerging field of AR-based education, including the critical lack of expertise in teachers working in this area in terms of theoretical, design and technical skills. Early on, Kerawalla *et al.* (2006) identified these barriers for successful AR educational models, and also speculated that the additional time required for educators to work on AR-based learning, in contrast to other teaching models, represented a further major impediment. Rasimah *et al.* (2011) noted limitations occurring due to a lack of a foundational knowledge and 'conceptual framework' for teachers to apply this technology. Ertmer *et al.* (2012) observed that without such deep understanding, implementation can become 'superficial' and ultimately unproductive. Such instances risk the technology being perceived as a novelty, rather than a rich, new educational tool.

Landscape architecture & AR

While tertiary education has explored AR usage, landscape architecture as a discipline is markedly absent from documented applications. Despite this there is clear opportunity for development in this domain. While landscape architecture's core distinguishing mode of education has long been studio-based learning, as it is in many design-related disciplines (Chou 2017), a key characteristic of the landscape architectural design studio is the complex site-specific nature of studio projects and the importance of field trips to such locations. In this context learning related to culture, ecology, indigeneity, perception and seasonality occurs outside of the classroom and in selected outdoor and indoor locations. Teaching design through situated or site-centric learning however, is becoming seriously challenged in universities. This is similarly occurring in other disciplines with a strong field-based component, such as geography, geology and the environmental sciences (Webb &

Stafford 2013, 29). Smith (2004) observed the limiting of such activities being due to time and budget constraints for both students and universities, and this continues to present day. A potential solution to address this is for students to independently explore environments, guided by designed resources, outside of class time and at their discretion. At present, arguably AR represents the most sophisticated form of learning resources to assist with this.

Some effective models which educators can draw upon to develop site-based resources exist within informal learning contexts, which have proliferated in their use of AR faster than formal educational contexts. Two broad, contrasting approaches exist here, though both share the application of the same core elements: defined paths, digital text, images, videos, audio clips and interactivity. Most common is a straightforward, pragmatic approach, while the other is more evocative and creative. In terms of landscape architecture, encapsulating the pragmatic approach is the 'Garden Guide' smartphone app for the Chicago Botanic Gardens (Chicagobotanic.org 2018) and reflecting a more evocative approach is the 'fairy hunting' app for the Melbourne Botanic Gardens. The Garden Guide app enhances a visit to the park through using its GPS features to allow visitors to find their way to any plant or point of interest, as well as providing curated walking tours of the most popular display gardens. Encompassed in this app is a 'plant finder', which contains photos and information of over 2,500,000 plants in the collections database. In terms of design, this represents an encyclopaedic use of AR and a rich, self-directed 'outdoor classroom' for individuals. In contrast, the more experimental 'Disney Fairies Trail' app for visitors to experience the Melbourne Royal Botanic Gardens is designed particularly to engage children. Created in collaboration with entertainment company Disney, the app encourages children (and other users) to explore the gardens using a phone or tablet screen on which fairies appear to hover in the garden and this leads to a tour of the space. While this creative and narrative-based approach is popular, it has also been criticised for its emphasis on story experience over educational value (ABC News 2014) and for its constant, dominant use of technology while users are in a natural environment.

Significantly, the *Master of Time* project explores developing a learning prototype based in what can be considered the middle space between these two exemplars. It attempts to seamlessly combine a story-driven, fiction-based narrative experience with a more traditional fact-based and walking guide-based approach.

Master of Time: a transdisciplinary and co-design-based collaborative process

In terms of design process, in order to meet the aims of developing a future-facing learning model for first year students and non-landscape architects, a collaborative, co-design framework was established. This approach directly applied literature emphasising that 'collaboration is viewed as the basis for the making of new and novel artefacts in contemporary cultures' (Thomas 2015, 296). Consequently, representatives from the university's interactive design, communication design and interior design disciplines all came to participate in the project alongside the landscape architecture staff, as well as past, present and potentially future landscape architecture students. In the case of the students, this participation acknowledged the importance of users being true experts of their own experience (Steen *et al.*

2011). Through applying a co-design framework, user insight and creativity was utilised throughout all key design stages.

In selecting technology for the AR experience, the design team determined early on that rather than develop a standalone app and navigating complex technology design and costs, an established app platform would be utilised. Consequently, it was decided to design the prototype for delivery within a pre-existing, local GPS driven app, *Story City* (see <https://www.storycity.com.au/>), which allows for transmedia content and supports local artists and designers. Traditionally, though, *Story City* has been used to create fictional, choose-your-own-adventure style stories. The *Master of Time* project sought to reinvent what an augmented reality experience could be within the parameters of *Story City*, operating beyond the platform's established formats. As the project defined itself further and the possibilities for learning experiences were explored, the collaborative team expanded to include cinematographers, visual effect artists, a fiction writer, actors, a musician, and locative media production staff. Integral within this multi-disciplinary team was the design studio, Ai3D (see <http://www.ai3d.com.au>), which specialises in 3D digital imagery and animation, and is directed by a former student of QUT's landscape architecture programme.



Figure 1
The co-design process

The co-design process for the project is summarised in Figure 1. This displays that following the initial selection of specific technology and the site location, a series of co-design workshops occurred. These workshops consisted of multiple sessions and allowed for collaborators to work together and foster transdisciplinary design ideas for the project. Importantly, the workshops allowed for all collaborators better to understand aspects of the technology being utilised through participation in experiential learning. In total, two all day workshops occurred with over 25 participants in each. Following the workshops the team worked independently within areas of specialisation for the project (i.e. the writer developed a draft script, animators worked on animating film footage etc.). Asynchronous communication via email and online shared documents allowed for team feedback to occur across contributions, and ensured all participants understood overarching project direction and development.

Master of Time: co-design outcomes and user journey

Key outcomes generated in the initial co-design workshops centred on (a) the narrative storytelling experience and (b) defining a unique, multi-sensory user experience. In terms of the narrative design, developed here was a unique interweaving of educational aspects with an overarching story, specifically conceived to give an *emotional depth* to the work. In framing the narrative, a core concept/theme emerged, which centred on why urban parks exist and what needs they fulfil in our contemporary world. This theme was iterated into a storyline which entailed a lead character needing to escape the 'busyness' of the modern world and eventually finding peace in the tranquillity and timelessness of nature. In the story, the main character (an avatar for the user) is approached by a 'mysterious guide' with an invitation to the Gardens and he promises to teach the secrets of time in the natural space of the park. As the narrative progresses, it is revealed that the mysterious guide is Harry Oakman, one of the landscape architects who designed the City Botanic Gardens. Throughout the story, across various locations within the park, the main character learns to obtain respite from the busy world through the timeless experience of nature, hence becoming a 'Master of Time'.

This narrative approach saw the AR experience depart radically from an instructional format, which is standard for park and nature tours. A final narrative – primarily driven by video sequences, which features actors and incorporates experimental photography and animation-based special effects – was developed to directly link five selected locations across the park. Along with the story progressing at each of these park locations, key foundational principles and understandings in landscape architecture design are revealed, integrated directly into the story itself.

To complement the narrative, in the second workshop the team began to conceive further the work from a foundation of user experience, which involved defining the multisensory impressions that would envelop the entire user journey. In reflecting upon the story's theme of peacefulness and respite in a park, this came to encompass an experience of *mindfulness*. Aubrey (2017) notes that mindfulness is 'conscious attention on what you are experiencing, right at the present moment' and observes that it 'creates space and quiet in your head'. As such, the work's user experience design aims to create a sense of mindfulness that can also be seen as being meditative and healing. This experience approach then defined the creation of all the media assets for the work, from design of type to soundtrack to

interface design to art direction and editing of video footage, as well as the construction of the script.

In terms of the final *Master of Time* user journey this consists of visiting six separate locations in total and ‘unlocking’ and viewing a short narrative video at each. These sites are:

1. Starting point: a city location on the QUT campus at the edge of the park where the user is met by the mysterious guide;
2. the Banyan Trees, the oldest and culturally significant trees in the Gardens;
3. the Bamboo Thicket, which operates as the ‘quiet heart’ of the park;
4. the Lily Pond, in which a hidden ecosystem thrives underwater;
5. the Ring of Palm Trees, which reflects the change of seasons; and
6. the edge of the Brisbane River, representing the traditional land of the Jagera/Yaggera people.

Within the AR experience, in order to navigate from one of these locations to the next, users follow instructions on their mobile device. Wayfinding is provided via directional guides from the narrator, as well as text-based instructions and a Google map identifying where the user is and where to go. When the prototype detects the right location, it unlocks the next part of the story in the form of a video vignette. Each of the videos relates to the location of the user and occurs with narration and progresses the storyline. Text is also provided on-screen to assist users.

Visuals taken from the video vignettes are displayed in Figure 2, 3, 4 and 5. In each case, these demonstrate the distinctly cinematic approach taken in the video-based storytelling. Figure 2 displays footage activated at the Banyan Trees (location 2), where the timelessness of the trees is emphasised through visual effects indicating the passing of time. Figure 3, 4 and 5 display footage viewed at the Lily Pond (location 4), displaying unusual perspectives of the space. This sequence begins with water lilies being revealed from underwater (Figure 3), then water lily flowers opening and closing in response to changes of day to night (Figure 4) and finishes with the thriving ecosystem underwater (Figure 5). Within this ecosystem are tadpoles, worms, eels and water bugs, and even the feet of ducks swimming above through the water are seen, and the sequence



Figure 2
Footage activated at the Banyan Trees



Figure 3

Footage viewed at the Lily Pond. Water lillies being revealed from underwater

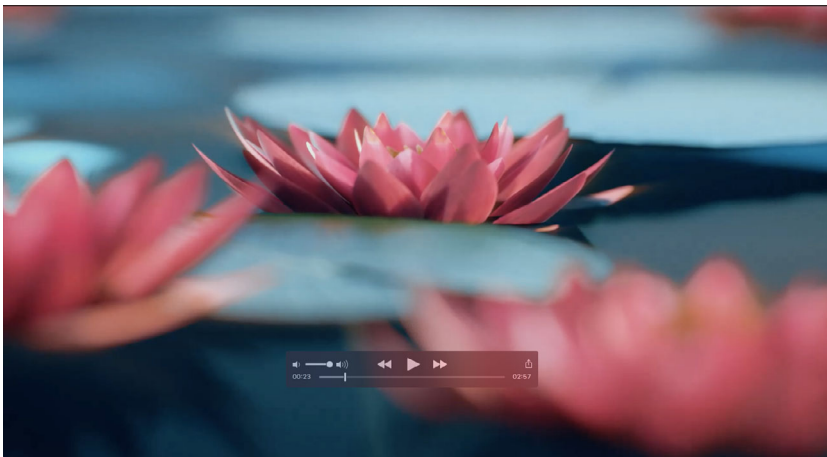


Figure 4

Footage viewed at the Lily Pond. Water lily flowers opening and closing in response to changes of day to night

also zooms in to capture tardigrades, microscopic creatures that live within the ecosystem. Figure 6 shows a visual from the video displayed at the Ring of Palm Trees (location 5), highlighting the dramatic transition of shadows across the day from an aerial view.

Master of Time: initial user experience evaluation

Following the *Master of Time* prototype becoming operational, site user testing was undertaken by members of the wider collaborative team and volunteer QUT staff and students. The testing occurred either independently or in pairs and saw users complete the AR experience in its entirety and afterwards provide a full journey evaluation. Data collection consisted of each participant recording observations



Figure 5
Footage viewed at the Lily Pond. Thriving ecosystem underwater



Figure 6
Visual from the video displayed at the Ring of Palm Trees

verbally via a device as they undertook the AR experience, as well as when reflecting on the experience holistically once completed. Seven users tested the prototype in the initial evaluation stage and a thematic analysis of user feedback transcripts was undertaken to identify key impressions and insights and to inform further iterations of *Master of Time*.

In terms of overall feedback all of the participants saw the work as successful in its key aims of providing a unique, engaging and education-based experience. There were five major themes identified within user feedback:

- An engagement with the narrative,
- Impact on learning
- Connection with nature
- Engagement with visualisations
- Ease of interaction and navigation

These are outlined below and serve to clarify why the work proved effective.

An engagement with the narrative

All users identified a level of delight and enjoyment in undertaking the journey across the sites and following the story depicted in the video vignettes. The theme of gaining respite from the pressures of the modern world resonated with all users, regardless of background and age. For some users this seemed to have a larger impact, with three noting it prompted reflection and consideration of their use of time and work-life balance.

Users identified that the story effectively linked all the site locations and that each section of the narrative seemed to contribute meaningfully to the overall story. It was observed that the educational aspects relating to each site added to the story and overall worked seamlessly within the context of the narrative. Two respondents identified that prior to undertaking *Master of Time* they felt that this form of AR experience might be 'drawn out' and repetitive. Upon undertaking the experience, the users stated that each location visit seemed to 'flow' and build purposefully upon the previous. The users noted that the unique content and different forms of video depiction were key in distinguishing each site and preventing a sense of repetitiveness.

Impact on learning

Users found the *Master of Time* a valuable way to learn, acknowledging they greatly appreciated the immersiveness of the experience and that it changed their perception of natural spaces and how they are designed. The majority of users (all those without a landscape design background) felt they had begun to understand the foundational elements of landscape design, and that it changed their awareness of how landscape architects understood and related to the natural environment.

Users noted that seeing content on the screen, presented in a specific way, and then looking at it first hand, made points resonate strongly. This directly relates to what Radu (2014, 1539) identifies as a major strength of AR, being that it allows for multiple representations to appear close together or at the same time and he suggests that this form of information delivery can assist students to learn better. In this case it was seen by users as a key factor in allowing them to 'unlock' what landscape designers see in the environment that non-designers may not yet see.

Connection with nature

All users, each of which had used the park previously, noted a shift in their appreciation of the space and an increased 'connection' to it through using the prototype. All indicated they had a deeper understanding of how the park could make someone – including themselves – 'feel' and better understood the therapeutic qualities of such locations. Users identified an experience of 'relaxing', 'slowing down' and 'taking in nature' within the space, which is aligned to a sense of mindfulness. These users did note, however, that these sensations were not experienced initially as at first they were somewhat overwhelmed as they had to become accustomed to the AR interface, and ways to operate it and navigate the park.

In terms of identifying how a sense of mindfulness was generated, one user indicated that the role of the soft-spoken narrator was extremely influential. Noted here was that throughout the vignettes at each site the narrator would draw attention to features and details surrounding the user – the sound of nature, the casting of shadows, the reveal of sunlight, the texture of leaves – very much like a

guided walking meditation in nature would do. It was observed that this process raised awareness, and slowed the user down so there was a focus entirely on specific aspects of the environment.

Engagement with visualisations

All users made specific reference to the cinematic qualities of the video vignettes. Here it was noted that the footage ‘beautifully captured’ aspects of the park that ‘we just wouldn’t be able to see otherwise’. The most popular sequences for users were those which involving flying above the park, time lapse, and underwater shots, capturing aspects of the park not possible to see with the human eye and encompassing the ephemerality of landscape architecture.

Users appreciated the short length of each instalment, one stating it acted as a ‘burst of information’ that also allowed time for the user to appreciate each setting in terms of the ‘real world’ once the video finished. In respect to watching the videos, users stated that they did not feel this aspect dominated the experience. It was observed by one user that as he was surrounded by the ‘scene’ (in the real world) as he viewed each vignette, this meant the small screen footage never ‘took over’ the experience completely.

Ease of interaction and navigation

All users viewed the experience as relatively seamless, which is seen as an essential design consideration (Billinghurst *et al.* 2001; Bower *et al.* 2014; Chang *et al.* 2010). As mentioned previously, users found the navigation process awkward at the beginning, however once it was understood at the first site location, most noted the experience became more straightforward. It was observed that the challenge of navigating the AR interface was assisted through it being consistent throughout the work and across all sites. Users appreciated the approach whereby multiple guidance options to locations were given and content was generated as the participant moved through a location, rather than relying on them to interact directly with the interface. It was recognised that the content generation allowed for an emphasis on viewing the locations and not a preoccupation with operating a device.

The key usability issue identified in feedback related to the external environment affecting a user’s ability to follow content on a mobile device. Most commonly cited was sunlight hitting the mobile screen and obscuring content. One user noted that he compensated for this by moving out of direct light at each location (notably areas of shade were factored into the choice of these). Also noted was that the sounds of people and other sources in the park made listening to the soundtrack, including the narrator, difficult at times.

Emerging principles for AR education design from *Master of Time*

From examining and reflecting over the *Master of Time’s* design outcomes, user feedback and the creative process itself, the following series of five key design principles were formulated to inform future approaches in site-driven AR learning initiatives:

- Identify and develop a core experiential theme/s for the user.
- Develop a unique conceptual approach for the narrative.

- Design to be multisensory – but consider both AR and real-world contexts.
- Apply AR and its multimedia elements in meaningful and authentic ways and design for gaps.
- Apply an approach for transdisciplinary collaboration.

These strategies represent a foundation which the research team aim to test and iterate in upcoming projects, and which may contribute to field work of other researchers.

Identify and develop a core experiential theme/s for the user

The application of an overarching *experience design theme*, which in this case was creating a sense of mindfulness and connection to the serenity of nature, served to unify the diverse aspects of the AR experience and create something that was harmonious, engaging and memorable, and distinct from the learning experience. It is recommended that an experiential theme/s should be explicitly identified by a design team to ensure all design elements – ranging from the overt to the subtle – align throughout the learning experience. Aspects to consider here include visual design and branding, photography and videography of content, use of sound, types of pauses and designed engagement with the surrounding environment. It also bears mentioning that an experiential theme could change as the narrative progresses, with all aspects of the experience design adjusted accordingly.

Develop a unique conceptual approach for the narrative

Interwoven with the experiential theme is for the learning to incorporate a supporting original story/narrative. In aiming for a unique narrative to drive the AR experience the learning firmly applies a pedagogical approach based on edutainment. Evidence captured by this study and others (Jarvin 2015; Nemeč & Trna 2007) increasingly demonstrate the learning potential of this creative-led approach to education. The AR format allows for a distinct breaking away from conventional and traditional pedagogies – and this project serves as a model of how this can occur with a simple narrative, and how it may be employed within the format of video/drama-based vignettes. In terms of developing a potential storyline and narrative approach, the design workshop model based around design thinking ideation is an effective approach to apply, allowing a team to collaborate to create an appropriate and authentic narrative that is also original.

Design to be multisensory – but consider both AR and real-world contexts

In conceptualising an AR-led education project consider all five senses of the user – both in terms of the technology being created, as well as their sensory experience in the ‘real’ environment, outside of the technology. Attention should be focused on making sure there is no conflict between the two contexts, such as distractions from sounds or competing visual content. Considering this explicitly is a way to avoid a risk of ‘cognitive overload’ (Dunleavy *et al.* 2009) in AR education. In applying this approach, it is essential that designers undertake multiple site visits and gather data on the environment and its multi-sensory experience at the different times users may use it. Following the development of AR content, the prototype should then be extensively tested within the site environment to ensure a cohesive and unobstructed experience. Also essential in

undertaking these multiple site visits is ensuring health and safety risks are considered in the design.

Apply AR and its multimedia elements in meaningful and authentic ways and design for gaps

A key strength in utilising locative AR media is that it allows a user to be able to *see* and *experience* a space in new ways, rather than rely on verbal communication and text (the traditional modes of learning) to impart knowledge and understanding. As such, appropriate media should be used to provide focus and information (ideally through visual means that show rather than 'tell') and opportunities need to be created for the user to simply 'be' within the environment, in order to assimilate the learning. It is essential that space is created for the environment to be understood so as learning is not principally occurring through the AR media. Such moments of engagement and reflection within a site are possible through integrating cues within the AR experience to ensure these pauses occur.

Apply an approach for transdisciplinary collaboration

The approach presented in Figure 1, with its distinct collaborative phases and structure, is a proven model that can be used not only in developing AR education projects with inexperienced teams, but be adapted for developing learning initiatives across all forms of new technology. Educational projects centring on new technologies typically require multi-disciplinary teams, yet often these works are created 'organically' and without a defined design process. This model serves to ensure all stakeholders understand the technology with experiential depth at the start of the project, and have a vital role throughout the process. The co-design workshop and follow-up online collaboration model can result in a more efficient production process and a cohesive work that is defined by shared goals. Such a model allows for potentially more ambitious edutainment works to be created, and in some ways sees AR learning production approached like a film collaboration, rather than adopting a standard app design workflow.

Conclusion

Early review and testing demonstrate that the *Master of Time* project has succeeded on multiple levels as a landscape design educational tool. Certainly this will be further explored in future, larger-scale user testing across first year student groups. While in the past the foundational knowledge contained within the AR initiative might be attempted to be relayed through the more passive experience of a lecture or a reading, or a class excursion to a site, this work shows how technology can be used in new ways to facilitate active and meaningful learning which immerses the learner. In effect, *Master of Time* allows for curriculum to now be delivered via what can be considered as a new form of *mobile blended learning*. Blended learning with videos in online lectures can prove engaging for students and improve application of theoretical principles to individual site-based project work (Thomson *et al.* 2014), though such lectures are typically not readily accessible while students are in the field. AR offers a new individualised learning experience, a 'burst of information' while engaging with theory and being surrounded by a site in the real world.

At a time when educational models are in a state of flux with the emergence of new technologies, this project demonstrates how future learning can become richer and have more potential impact. Consequently, it shows that the additional effort needed to develop such technology-heavy resources may be worth it. Indeed, such effort is further justified when one considers that once dynamic learning platforms like the *Master of Time* are developed, they are ongoing and self-sufficient. Moreover, these can be used outside of formal curriculum to promote a degree or discipline to the public as well.

Given that mobile media is becoming the dominant and ‘natural interface through which humans function’ (Oppegaard & Grigar 2014, 29), it is necessary to explore the many possibilities through which education can occur via this device. With *Master of Time* experimenting with pedagogical approaches – and stretching the boundaries of how AR can operate and engage users – it is hoped this will inspire others. Furthermore, its successful collaborative model represents a practical framework for future-focused transdisciplinary design within the educational sector.

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Note

1. *Master of Time* is accessible via the Story City web site (<https://www.storycity.com.au/stories/new-QUT-landscape-architecture-venture/>) and available on the Story City app at Google Play (for Android devices) and at the App Store (for iOS devices). Full functionality of *Master of Time* is only available on site at the Brisbane City Botanic Gardens.

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