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Designing for Diverse Learning: Case Study of Place-based Learning in Design and Technologies Pre-service Teacher Education

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Abstract: Place-based learning experiences in Design and Technologies education connect people and place with design processes and products. Drawing on place-based learning, this case study shares the experiences of eight final year pre-service Design and Technologies education students from the University of South Australia as they collaborated with in-service teachers and learners within a secondary special education setting. This study reports on the design and development processes that pre-service teachers adopted to produce a sensory teaching resource to stimulate interaction, coordination and fine motor skills for students with diverse learning needs. Qualitative data, incorporating a survey and group design folio, were collected from pre-service teachers to capture how design-based decisions were influenced through place-based experiences. Findings suggest that place-based learning facilitated opportunities for meaningful educational and social connections between people and communities. Through engagement in an authentic special education context, place-based experiences enabled pre-service teachers to develop an enhanced sense of civic responsibility and valuing of communities and citizens at a local level. Importantly, engagement in place-based learning scaffolded a deeper and richer understanding of the role that education can play in supporting individuals and communities to create preferred futures. This study suggests that higher education place-based learning experiences are valuable in providing opportunities for Design and Technologies pre-service teachers to foster knowledge, awareness and understanding of the relationship between design processes and products and the needs of people and place.

Introduction

Design and Technologies education provides experiences and skills required to engage learners in a rapidly changing world. Throughout this paper, Design and Technologies is conceptualised as a learning area which reflects an increasingly global and culturally diverse community where ideas, innovation and enterprise are central to the design and development of sustainable, socially responsible, preferred futures. In doing so, Design and Technologies education presents rich opportunities for user-informed design to connect people and place. Such an approach, referred to as place-based learning (Gruenwald, 2003), shifts traditional classroom boundaries and fosters authentic learning experiences in contexts

beyond classroom walls (Best 2017; Smith, 2007). Core to place-based learning is the connection with 'place', that is, involving people in experiences that respond to community needs. The study reported throughout this paper challenges traditional approaches to education, highlighting the immense opportunities that are created when learning occurs beyond the classroom. Importantly, this research serves to illustrate the importance of authentically connecting people and place: connecting pre-service teachers with a special education setting to design appropriate, tailored and user-informed outcomes.

This paper begins with a description of place-based learning and the role it serves in actively connecting people to the environments in which they live. An overview of Design and Technologies education will follow, to highlight how user-informed design can broaden opportunities to foster knowledge, awareness and understanding of the relationship between design processes and products, and the needs of people and place. A case study, drawing on the views of eight pre-service teachers will be presented to demonstrate that through engagement with an authentic special education context, place-based experiences enable pre-service teachers to develop an enhanced sense of civic responsibility and valuing of communities and citizens at a local level. This paper concludes with a discussion of how place-based learning experiences can be integrated in to Design and Technologies education to develop the capacities of pre-service teachers as informed, responsive and inclusive educators.

Place-based Learning

Place-based learning is premised on the involvement of participants in experiences that meet identified community needs and in doing so, aim to have some 'direct bearing on the well-being of the social and ecological places that people inhabit' (Gruenwald, 2003, p.3). The application of place-based learning as a means to cross and strengthen traditional boundaries between school and within the community is not new. In fact, place-based education has a strong foundation, emerging from the works of Dewey who emphasised the importance of experiential learning that connects communities with students' lives, cultures and interests (McInerney, Smyth & Down, 2011). Such beliefs arose in 1954 when Dewey identified the significance of connecting learning opportunities with students' local communities through nature studies as a means to develop a sense of place. One of Dewey's major criticisms of the American educational system at that time was the apparent lack of connection or transfer between students' knowledge from outside of the classroom and into the classroom, or from school into the community. That is, Dewey (1959) argued that there was a disjuncture between 'real-world' contexts and learning within classrooms. In essence, Dewey (1938) contended that truly authentic learning required students to engage in real-world activities, solving real-world problems.

Authentic learning experiences enable pre-service teachers to interactively connect with real-world and meaningful experiences (Smith, 2002a; Snape & Fox-Turnbull, 2013). This is reflected in Australian and international curriculum frameworks where authentic learning experiences and practices have been emphasised through constructivist teaching approaches. Like constructivism and experiential learning, place-based learning experiences connect contexts, people and places with purposeful learning (Gruenewald, 2003). As Smith (2002b, p.586) describes, the purpose of place-based education is to 'ground learning in local phenomena and students' lived experience'. Such a view has been echoed by a number of contemporary researchers including McInerney, Smyth and Down (2011, p.6), who for example, have argued that place-based learning serves to 'authorise locally produced knowledge'. Place-based learning aims to (re)connect people at a local level (Gruenewald

2003; Grunewald & Smith, 2008; Sobel, 2004; Smith, 2002a). In doing so, it supports learners to develop skills and dispositions such as the ability to critically reflect, to work effectively both autonomously and collaboratively, to problem solve, to learn from each other, and to be open to new ideas (Gruenewald & Smith, 2008; Zuber-Skerritt, 2002).

Definitions of place-based learning have varied, however Smith (2002a) has defined place-based education as real-world problem solving, where students are engaged through identifying school or community issues they wish to investigate or address. In doing so, they are scaffolded to become 'creators of knowledge rather than the consumers of knowledge created by others' (Smith, 2002a, p. 593). Such a view is not dissimilar to Sobel (2004) who positions place-based education around the notion of using local communities and environments as a base from which to teach across learning areas. He further highlights the hands-on and real-world learning that connect people and place, engaging students as active, contributing citizens.

There is little argument that learning is maximised when it is meaningful and connected to students' lives and interests (Best, Price & McCallum, 2015; Snape & Fox-Turnbull, 2013). However, place-based learning is more than connecting and valuing what can be collaboratively learnt at a local level; it involves nurturing communities to foster social and economic growth. Bowers (2006) suggests that engagement in place-based learning experiences enables participants to revitalise and reinvest into their communities, developing their capacity as responsible and caring citizens. Mirroring this view, Gruenewald (2003, p.3) has argued that 'place-based pedagogies are needed so that the education of citizens might have some direct bearing on the wellbeing of the social and ecological places people actually inhabit'. Given that learning occurs amidst social and dialogical exchanges (Best, Price & McCallum, 2015), place-based learning experiences can facilitate rich and meaningful reciprocal connections between schools and wider communities (Resor, 2010; Gruenewald, 2003; 2005; Powers, 2004).

McInerney, Smyth and Down (2011, p.5) position the concept of place as 'a lens through which young people begin to make sense of themselves and their surroundings'. It is though this lens that they develop relationships and social connections, where they gain a sense of community and the capacity to live within society (McInerney, Smyth & Down, 2011). Moreover, participation in learning experiences that reflect real-world problem solving develops a learner's sense of 'agency and collective capacity' where they are afforded opportunities to positively influence their community contexts (Smith, 2007, p. 192). It has been argued that place-based learning loosens the barriers between schools and wider communities, with Smith (2002a) noting the participatory role that community members can have in classrooms, and likewise, the participatory role that students can have in communities. Such immersion across community and school contexts has been linked to community well-being and sustainability (Best, 2016; Smith, 2002a). From this perspective, place-based education is arguably a fundamental approach in strengthening students' connections to others and to the communities in which they live (Smith, 2002a). For some students, engaging with their wider community can enhance their sense of belonging (Best, 2016; Gannon, 2009; Smith, 2002a) and serve to 'overcome the alienation and isolation that is often associated with modern society' (Graham, 2007, p.378).

Core to place-based education is the experiential approach that positions the learner at the centre of the educative process (Smith, 2002a). Therefore, embedding authentic learning experiences within the curriculum requires teachers to respond to the changing needs of teaching and learning (Snape & Fox-Turnbull, 2013). This is particularly relevant for the learning area of Design and Technologies, where student learning centres on the need to critically and creatively learn about and engage with traditional, contemporary and emerging

technologies (Australian Curriculum, Assessment & Reporting Authority [ACARA] 2012; Best & MacGregor, 2015).

Key to authentic learning experiences, particularly in Design and Technologies education, are students participating in real-world collaborative practice (Snape & Fox-Turnbull, 2013). Authentic experiences in Design and Technologies education should be founded on rich contexts (real-world), social construction (connected to communities, societal beliefs and understandings), meaningful connections (with mentors, experts in the field) and student engagement (through motivational and engaging educators) (Snape &Fox-Turnbull, 2013). If we therefore consider technology to be 'invention by design' (Ministry of Education, 2007), then we must provide students with opportunities to think and design in critical and creative ways which enable them to respond to real-world needs and wants.

Through providing pre-service teachers with meaningful and purposeful teaching and learning experiences, they develop a greater capacity for interpreting and adopting similar approaches in their own planning and teaching practices. In embracing the unique nature of the school context and the diverse needs of students, this paper is broadly guided by Gruenewald (2003), Smith (2002a) and Sobel's (2004) conceptualisations of place-based learning. Given the complexities of connecting a special education setting with Design and Technologies pre-service teacher education, this paper contends that there is a distinct relationship between place-based learning and user-informed design: that is, individual needs and contextual settings serve to inform how pre-service teachers connect people with place.

Supporting Diverse Learner Needs through Place-Based Learning in Design and Technologies Education

Place-based learning in pre-service teacher higher education aims 'to support dialectical and relational understanding of what goes on between the sensing, meaning-making person and the environment in which they find themselves' (Mannion & Adey, 2011, p.36). Fieldwork and place-based learning opportunities have been foregrounded as influential in providing pre-service teachers a richer understanding of the educational needs of students with diverse needs. These needs include (but are not exclusive to) those experiencing disability, learning difficulties, sociocultural, socio-economical, gender, identity or isolation due to geographical location. Such first-hand experiences and connections between space and place challenge curriculum, pedagogical and assessment initiatives. Each of which have been primarily dictated by adult stakeholders making decisions based on perceived benefits to the students (Price, 2016). Research suggests that providing forms of fieldwork for pre-service teachers within their discipline areas better prepares them for working effectively in diverse settings (Hourigan, 2007). We posit that Design and Technologies education is of no exception.

Design and Technologies is central in characterising and transforming communities, societies and cultures, 'yet its place remains obscure in learning institutions, government policy and in the public mind' (Petrina & Hansen, 2010, p. 12). As we live in an increasingly technological world, place-based learning experiences provide opportunities to foster meaningful educational and social connections to schools, their communities, people, and culture. As a consequence, these connections can facilitate a deeper and richer understanding of the wider communities in which schools and universities are situated.

The capacity building nature of place-based learning is central to Design and Technologies education which strives to sustain communities and society by producing independent, capable and critical thinkers. As Barlex (2011, p.9) has described,

> *Design and technology is unique in the school curriculum in that it poses pupils with practical challenges to which there is no single 'right answer' and require creativity and technical competence. This develops self-esteem and self-efficacy, a can do approach which sees the world as a place of opportunity where people are not at the mercy of their surroundings.*

With this in mind, and underpinning a central tenet throughout this paper, we argue the 'hands on' nature of Design and Technologies education and the experiential approach to place-based learning are complementary in providing meaningful and purposeful teaching and learning experiences.

Fundamental to Design and Technologies education is the process of designing, or as Barlex (2011, p. 10) describes, 'the act of generating, developing and communicating ideas for products, services, systems and environments in response to user needs and wants and/or market opportunities'. Within this definition is the understanding that designers must adopt, adapt and apply new knowledge which addresses a particular design task, audience or situation (Barlex, 2011).

Design and Technologies education often involves students creating artefacts based on their proposed designs (Best, 2017; Best & MacGregor, 2015). Yet, beyond school, we often find that objects are rarely designed by those who actually make them (Barlex, 2011). Although we could argue that this creates a disjuncture between the processes of designing and making, incorporating place-based practice provides real-world design scenarios. In doing so, learners are afforded purposeful opportunities to design and develop responses to real-world needs and wants. Barlex (2011) has argued that design tasks, and indeed the way such tasks are framed by educators, must both hold worth and meet the needs of the user for which the idea or artefact was designed. Awareness of the end user should inform the design of an artefact, and this, we argue, provides a valuable opportunity for integrating place-based learning experiences with diverse student needs.

The notion of inclusive design highlights diversity across the population, rather than focussing on particular groups, such as those with a disability alone (Newell & Gregor, 2002; Nicholl, Hosking, Elton, Lee, Bell & Clarkson, 2012). Such an approach recognises and responds to individual difference, such as abilities and desires (Nicholl et al., 2012) and enables designers to respond in a more inclusive and informed manner. As Price (2015) advocates, a focus on student capabilities rather than deficits advances inclusion initiatives. While Nicholl et al (2012) have suggested that inclusive design practices can position the user within the design process to facilitate an authentic experience, they caution that many such examples fail to authentically capture the needs of the user. For example, they suggest that many students' understandings of the 'user' are conveyed by others, where students 'embellish or decorate the surface of a routine product such as a bag or box' (p. 931), rather than designing for, or with, the specific needs of the user. For this reason, it is imperative that place-based learning draws on authentic experiences to capture the true essence of people and place. In achieving this, higher education plays a significant role in equipping pre-service teachers with place-based thinking and principles which underpin Design and Technologies education.

Further to this, Florian and Spratt (2013) contend that teacher education programs must equip prospective teachers to be reflective practitioners who possess skills and strategies that are responsive to diverse learner needs. Findings from Sharma and Sokal's (2015) study, investigating pre-service teachers' attitudes, concerns and teaching efficacy to teach in inclusive classrooms, recommended pre-service teacher courses address the sourcing and usage of resources appropriate to inclusive classrooms. We advance this recommendation to suggest that pre-service teachers, particularly those with specialist skills, may be in a position to design and develop individualised and meaningful teaching resources appropriate for the

diverse needs of learners within their own classrooms. We therefore suggest that place-based learning experiences in Design and Technologies education provides considerable opportunities to further pre-service teachers' understanding of, and responsiveness to, diverse learners' needs. In doing so, there is increased provision for more tailored teaching and learning experiences.

As tertiary educators, there is a commitment to improving the educational outcomes of pre-service teachers and ultimately, the students they will teach. Subsequently, this drives one beyond the boundaries of traditional teaching spaces and into wider local and global communities (MacGregor, 2012). Opportunities for collaborative and knowledge rich learning experiences for pre-service teachers can occur through place-based learning experiences that are embedded within higher education course content. The application of place-based learning provides an authentic means to cross and strengthen the boundaries between a university and wider the community. For pre-service teachers specialising in Design and Technologies education, these experiences can also facilitate the meaningful integration of discipline specific knowledge into community settings, inclusive of members' diverse needs.

The Study

The University of South Australia is one of few universities within Australia to offer a specific four year undergraduate Bachelor degree within the area of Design and Technologies education. Pre-service teachers specialise in either Secondary Design and Technologies or Secondary Food and Textiles. The Design and Technologies education courses are shaped by issues of environmental, cultural and human concerns. Current Design and Technologies education course content and assessments provide pre-service teachers with theoretical, practical and conceptual understandings as it relates to their specialisation. Pre-service teachers undertake four Professional Experience practicums in both primary and secondary school settings throughout their degree, with a specific focus on Design and Technologies education, to develop their educational practice, pedagogy and philosophy. In addition, pre-service teachers complete an Inclusive Education course in the third year of their degree, which aims to develop inclusive professional approaches to meet a diverse range of learner needs including disability, learning difficulties, sensory needs, and language and communication disorders.

This paper focuses on a Design and Technologies education course provided through the School of Education at the University of South Australia. The course was offered to final year Design and Technologies pre-service teachers. The elective course, titled *Technology by Design*, aimed to engage pre-service teachers in a range of place-based learning experiences that provided the opportunity to link with and build upon learning from previously studied Design and Technologies courses, in addition to the Inclusive Education course. In particular, throughout the Design and Technologies courses completed prior, pre-service teachers were scaffolded, through theory and practice, to actively question, critique and create new knowledge and responses to issues, rather than passively accepting existing understanding and ways of doing. In doing so, this study aims to explore how pre-service teachers drew on previous learning in order to apply, transfer and adapt their skillsets to an authentic community context. More specifically, this paper unpacks how pre-service teacher education can utilise place-based learning to authentically inform user-centred design.

The place-based learning experience that is central to this study involved eight final year Design and Technologies pre-service teachers working as a small group to produce an outcome to meet a community need. The pre-service teacher cohort consisted of six females

and two males, aged between 21 and 26 years. The community participants in this study were an in-service special education teacher, a deputy principal and ten secondary students with diverse learning needs. The special education school was based in metropolitan Adelaide, South Australia and the students who attended the school experienced varied intellectual disabilities and complex additional needs including sensory, social, emotional, behavioural and coordination. The school's principal approached the university to invite collaboration with Design and Technologies pre-service teachers. The identified community need involved pre-service teachers collaboratively designing and producing an indoor sensory teaching resource with staff members and students to stimulate interaction, improve hand eye coordination and the fine motor skills of students. Given the unique and diverse needs of learners, collaboration and co-design of the sensory artefact was primarily undertaken with teachers who advocated on the students' and school's behalf. Pre-service teachers visited the school throughout a fourteen week period to familiarise themselves with the educational context and community, observe and interact with students, and to discuss and modify their plans with staff. Pre-service teachers also visited the South Australian Special Education Resources Unit to gain a deeper understanding of the types of resources that could support the students' learning needs.

The school's need emerged from a number of students who were identified on the Autism Spectrum. As teachers at the school explained, sensory experiences were an effective approach in calming students and enabling them to interact with different materials. Following a number of discussions and school visits, pre-service teachers engaged in various design and decision making processes to arrive at some possible outcomes to meet the identified needs of the students and their context. Connected to a university assignment, the design task for the place-based project stated:

> *Working in a group, your task is to collaborate with an identified stakeholder to develop a Design and Technologies based outcome linked to a project that may serve to engage school students, staff and/or members of the wider community. Individually, you will need to keep a log of all school visits. Log entries must clearly document what tasks were undertaken and by whom. Log entries will also need to include weekly progress reports and highlight any new learning that occurred. The design folio will outline the processes of investigate, design, produce and evaluate that were implemented to facilitate the development of your outcome.*

Qualitative data were collected from eight, final year Design and Technologies pre-service teachers who were involved in the place-based learning project. Data were collected through two methods: a qualitative survey and analysis of the pre-service teachers' collaborative design folio. The survey was administered during a university workshop and was designed to gather information regarding the pre-service teachers' feelings prior to and after involvement with the project, their emerging understanding of diverse learner needs, how design-based decisions were influenced through place-based experiences, and how such an experience may inform future inclusive and responsive practice in Design and Technologies education. A design folio, collaboratively developed by pre-service teachers, documented the processes that they engaged with to conceptualise and create their sensory artefact. More specifically, the design folio was structured around the Australian Curriculum: Design and Technologies Processes and Production skills of investigate, design, produce and evaluate to document ideas, designs and product-based outcomes. In brief, the design folio was organised to capture the processes of:

- Investigate: Initial thoughts-questions; evidence of investigation/research; description of intentions; rationale behind ideas

- Design: Devise and document ideas, provide reasons for final choices; communicate ideas; sketches
- Produce: Work with materials; document process of making; discuss material and techniques used and reasons for choice; document safety considerations; evidence responsible resource management
- Evaluate: Reflect on product or outcome against criteria in Design Brief; reflect/critique the process used

The group design folio drew on annotated photographs to convey pre-service teachers' responses to the proposed design brief and to capture learning throughout the place-based experience. In addition, upon receiving the sensory artefact, students from the school sent a handmade card to the pre-service teachers, thanking them for their work and identifying what they liked about the newly acquired sensory artefact. Students' comments feature in the findings and discussion section below to portray the nexus between the design task, intended outcomes and those realised.

Given the situational nature of place-based learning experiences, case study methodology was utilised to position the context as an integral component in which the research was based (Cohen, Manion &Morrison, 2007; Gillham, 2000; Stake, 2006; Yin, 1993). The case study drew on qualitative data (Yin, 1993; 2003) and incorporated design folio analyses and a survey which was completed at the conclusion of the project. Analyses of survey data and the group design folio were primarily descriptive in nature and reflected perspectives and interpretations of designing for diverse learner needs. Pre-service teachers' qualitative responses were content analysed (Cohen, Manion & Morrison, 2007) with coding and interpretation based on thematically derived categories, as identified in the Australian Curriculum: Design and Technologies Processes and Production Skills, namely, investigate, design, produce, evaluate, collaborate and manage. Broadly coded categories, as well as code names (Lodico, Spaulding & Voegtle, 2010), aligning with the Australian Curriculum, were developed from an iterative, inductive and systematic process of examining and exploring the data. To facilitate content analysis of pre-service teachers' qualitative responses, data were thematically grouped and are detailed throughout the findings and discussion section of this paper.

Findings and Discussion

As pre-service teachers identified and devised solutions to the design-based problems they encountered, they worked through technological processes that mirrored those documented in the Australian Curriculum: Technologies (ACARA, 2014). The first of these processes included design thinking, where through identifying, investigating and understanding the needs of the students, pre-service teachers were able to generate creative and innovative solutions. They were able to plan, analyse and evaluate their ideas to arrive at successful outcomes. The second of these processes included project management, where through working collaboratively, pre-service teachers developed the skills to manage their project from conception through to successful completion. Tasks were delegated amongst group members and timelines and material costings were developed. Successful communication (via face to face, email and telephone) between group members and the school staff was central to the project's success. Reflecting the design processes adopted by the pre-service teachers, the section which follows details a case study of place-based learning in Design and Technologies pre-service teacher education.

Investigate

Aligned with authentic place-based learning experience and inclusive design practices, connection to a given context is paramount to designing and delivering user-informed outcomes. As Smith (2002a), and Snape and Fox-Turnbull (2013) have alluded, such an approach is pivotal in connecting to real-world and meaningful experiences. Initial phases of the investigative process involved pre-service teachers visiting the special education school to develop a sense of place. Not only was it important for pre-service teachers to gain contextual insight, but it was necessary to visualise the intended destination for their final sensory product and connect with the intended end-users of their design who were *'upper primary and high school students with severe additional learning needs, learning difficulties and/or disabilities'* (PST 1).

Pre-service teachers noted that through engaging with the community context, they '*learnt about the various aspects of the school's values, beliefs and teaching systems'* (PST 2). Such an immersive process guided pre-service teachers' understanding that any potential designs needed to reflect the needs of both the school community and the students within, that is, *'all [students] are vastly different and cope with schooling differently. Some need special coping tools to stay calm or maintain a less stressful state'* (PST 3), while another pre-service teacher commented that '*the students are identified as having additional learning needs which means they are not socially or emotionally where they should be and therefore special considerations regarding these aspects must be made'* (PST 1). A further pre-service teacher commented that some of the students *'like structure but get overwhelmed easily'* and *'there is a massive range in their needs, abilities and academic level'* (PST 1). Yet, pre-service teachers also connected with learners, noting the personal traits of the students for whom they were designing, describing the students they met as '*really friendly and really nice'* (PST 4). Developing connections with the community context through visiting the school on a number of occasions provided much needed understanding, as one pre-service teacher noted:

> *After visiting [the special education school] on a number of occasions we had a greater insight in to the needs of their students which enabled us to begin our design process. We had a better understanding of what the students liked, what worked for them and what they already had to support them' (PST 1).*

This process of active engagement is particularly important for a number of reasons: firstly, it provides genuine insight to the needs of the school and students, secondly, a connection between people and place is developed and thirdly, pre-service teachers gain valuable insight regarding the diverse needs of learners. Such insight is important given that students verified with a disability consist of 15-20% of the Australian student population (Department of Education, Employment and Workplace Relations [DEEWR], 2013). In particular, the real-world problem solving processes served to engage pre-service teachers through co-identifying a community issue they perceived as valuable (Smith, 2002a).

However, connecting with a genuine place-based setting was not necessarily comfortable for pre-service teachers who held limited experience working in special education schools. Although pre-service teachers generally commented that their initial visit to the school was *'a feeling of the unknown of what to expect'* (PST 5), others voiced their enthusiasm and eagerness to expand their professional knowledge and experiences. As the following pre-service teachers commented:

> *I actually have a strong interest in special needs education and so this site [school] visit really excited me. I was eager to see how students were learning and interacting in this particular environment compared to mainstream high school settings (PST 1).*

> *I had been to the [special education school] before so I knew what to expect. The staff are lovely, despite the challenging roles they are in. I knew this would be a rewarding and comfortable experience for me, and it was (PST 2).*

Design

In consultation with staff and students at the special education school, pre-service teachers decided to produce a sensory teaching and learning resource with a view to stimulating interaction and improving students' hand eye coordination and fine motor skills whilst accommodating sensory needs. Leading in from the investigation phase and throughout the design process, pre-service teachers researched and critiqued existing resources, considered a variety of potential artefacts and materials, and documented a range of possible design ideas. Further, several pre-service teachers visited a special education resource centre to broaden understanding and awareness of existing resources. Through exploration, pre-service teachers were provided with a deeper insight into the needs of the students they were working with. Such insight enabled pre-service teachers to engage with a rich, real-world design scenario, in which they were afforded purposeful opportunities to design and develop responses to real-world needs (Barlex, 2011; Best & McGregor, 2015). Following a period of investigation and initial critique, the pre-service teachers refined their focus to design an interactive sensory wall that consisted of three large panels containing tactile, colourful objects.

As the special education school was scheduled to relocate to new premises in the near future, the project brief required pre-service teachers to develop a design which could be transferred from one location to another. Given the secondary school age group of the students attending the special education setting, pre-service teachers were challenged to develop a sensory artefact, in this case, a sensory wall, which was '*engaging, bright, colourful and interactive* (group design folio) but '*not too child-like'* (group design folio). In addition, analyses of the sensory wall group design folio revealed specific features the pre-service teachers had identified to avoid within their designs: *'dark/intense colours, dangerous, sharp or loose objects, or small objects which children can put in their mouths'* (group design folio). Further, staff at the special education school requested a number of design preferences: '*size must be 2.4m x 1.2m and feature moving parts (exploration to encourage movement), different textures, light/sound, mirrors, bells and whistles'* (group design folio). As one pre-service teacher commented, *'we made our design in consultation with the school. We made the design to match what the school wanted'* (PST 6). Through engaging with student and teacher end-users, pre-service teachers initiated design processes which captured a particular design task, audience and situation (Barlex, 2011) to optimise their response to the specified design brief.

Working collaboratively, pre-service teachers initially brainstormed features which they considered appropriate for inclusion to the sensory wall. The pre-service teachers discussed possible ideas, before collectively deciding on a 'space' theme as they considered it to be *'timeless, not specific to an age, could be easily incorporated into lessons, and it will be easy to incorporate a lot of colours on to the wall'* (group design folio). As pre-service teachers developed their designs, they simultaneously and methodically devised a list of required materials and accompanying budget estimate.

Upon developing a schematic design, pre-service teachers forwarded their designs to the special education school. Although the school's response was positive and the design somewhat well-received, staff at the special education school considered it *'a good idea, but we are worried that it might be easily dated, and would prefer something 'funkier''.* Based on

the collaborative relationship between parties (Snape & Fox-Turnbull, 2013), and to suit the needs of the end-user, pre-service teachers redesigned their initial idea, deciding to move away from one large sensory wall, and toward three panels which would be defined with different colour schemes. Underpinning the decision to divide the wall in to separate panels better fulfilled the need for the project outcome to be transportable.

Produce

Throughout the producing phase of the project, pre-service teachers documented, with annotated photographs, the steps in creating their sensory wall. In doing so, they explained the reasoning behind their choices, evidencing the needs and wants of intended users, and placing them at the fore of their thinking. Such an approach aligns with the views of Nicholl et al (2012) who has argued that inclusive design practices position the user within the design process to facilitate an authentic experience. For example, pre-service teachers considered safety implications where they *'made sure that we used child-safe glue so that there was no risk concerning ingestion'* (group design folio). Pre-service teachers were furthermore mindful that some students experienced physical challenges, and although they had intended to include a music box within their sensory wall design, they reassessed that *'a bigger handle which is easier to turn'* (group design folio) would be a more inclusive response to enable all students with access to the sound element. Such inclusive design moves away from targeting a particular population of students, to enabling access for all students wanting to engage with the sensory wall (Newell & Gregor, 2002; Nicholl et al., 2012).

Pre-service teachers creatively painted each panel with bright colours and carefully embedded a variety of tactile materials with each having a different sensory feel. Again, pre-service teachers were conscious of the students for whom their project was designed and made the decision to *'place adhesive contact on the back of the mirror, so if it happens to break, all the pieces will stay together'* (group design folio). Pre-service teachers worked well beyond their university timetables to ensure that the sensory wall was completed in time for both university assessment procedures and in accordance with the timeline negotiated with the school. Through participating in a learning experience that reflected a real-world problem, pre-service teachers fostered an authentic sense of agency and civic responsibility where they wholeheartedly engaged in an activity to positively influence a community context (McInerney, Smyth & Down, 2011; Smith, 2007).

Evaluate

Throughout the investigating, designing and producing processes, pre-service teachers evaluated and made judgments about the quality and effectiveness of their designed solutions. In analysing the pre-service teachers' evaluative comments within their group design folio, they commented that *'we are incredibly happy with the final outcome and hope that [special education school] is just as happy as with the final outcome as we are'* (PST 6). Upon analysis of the thankyou card received by the pre-service teachers, this hope was realised through an overarching comment from the students at the special education school: *'we love our new sensory wall'.* Further, one student also commented, *'I like that the wall is full of surprises, some things make a noise, other things are soft to touch, I like everything about it!'.*

Pre-service teachers noted that place-based learning experiences can be complex when collaborating with a very busy school. That is, pre-service teacher communication with

the special education school needed to be negotiated around school hours due to the teaching commitments of staff. Pre-service teachers retrospectively documented the challenges they confronted throughout the production phase, detailing the nature of the challenge and how they worked to rectify issues. Given the pride the pre-service teachers had taken in the presentation of their sensory wall, they were particularly aware of aesthetic appeal. For example:

> *The most significant setback that occurred was after gluing the faux fur balls on to the wall. As the glue dried it expanded and leaked out onto the wall. We were quite upset by this. Once the glue was dry we had to cut this off gently making sure not to ruin the wall and then we had to paint over the patches (group design folio).*

Almost contrary to the feelings of anxiety and apprehension voiced upon commencement of the project, pre-service teachers' feelings upon completion of the sensory wall were overwhelmingly positive. For example, *'I was very happy with the final product we produced and was pleased that the school was happy with their product'* (PST 6) and *'it felt good; it felt like we made a difference! It felt like it is something that could be used all the time'* (PST 4). However, what also became evident was the pre-service teachers' personal investment and connection with the project and students. As one pre-service teacher explained, *'I felt nervous! I wanted the school to be as proud of the product as we were and I hope that it does meet the intended need'* (PST 3). Analysis of the students' thankyou card to the pre-service teachers suggested that indeed, the intended need to stimulate interaction, coordination and fine motor skills for students with diverse learning needs had been met. One student from the special education setting, for example, commented *'my favourite thing is the music wheel, I really like hearing the music',* with another student who stated *'I like the buttons and that you can touch them to turn on the lights'*. The notion of physically interacting with the sensory wall was similarly highlighted by another student who wrote *'I like playing with the wire beads and looking at myself in the mirror'.* Through insights such as these, the relationships, sense of social connection (McInerney, Smyth & Down, 2011) and appropriateness of designed artefacts developed throughout the place-based experience are clearly evident.

Incorporating place-based learning experiences within pre-service teacher education courses enriches learning, not only within Design and Technologies, but across all aspects of professional practice, knowledge and experience. As one pre-service teacher's reflective comment highlighted:

> *I learnt that whilst there is an overall need or a group of students – each individual has different wants and needs. This means it is important to consider having variations within the item that can allow for each individual to have their wants and needs met (PST 1).*

The notion of inclusion and inclusive teaching permeated pre-service teachers' contemplative views with one noting, '*because all students have different needs and capabilities, it is essential to teach in different ways so that students have the chance to strive'* (PST 7). The heartening nature of place-based learning experiences was further echoed through the following statement, '*just because the students have learning disabilities, it doesn't mean they can't be taught! We can [all] learn from this'* (PST 4). While such insightful comments are humbling, it highlights the reciprocal benefit across communities, with perceptions of experiences invariably shaping teaching philosophy, pedagogy and practice. For example, through engaging in place-based learning, pre-service teachers developed their capacity to more appropriately and inclusively plan for diverse learners, with one pre-service teacher commenting that such an experience assisted them to '*better*

understand how unique and different students are, and this will allow me to know that different processes and planning are needed for these students' (PST 8).

Connecting pre-service teachers with diverse learners through the design and development of sensory artefacts has been the focus of this paper. Reflecting on the personal insights from participating pre-service teachers, such a meaningful learning experience has resonated throughout the participating university cohort. These findings challenge common perceptions that Design and Technologies education occurs solely within the confines of workshop spaces. As evidenced in pre-service teachers' comments, the learning area extends much further than this. For example, *'there are great opportunities for Design and Technologies to be included into special education or for students to participate in products created for special needs students'* (PST 3), with another pre-service teacher commenting:

> *Having skills and understanding in Design and Technologies presented us with numerous opportunities to develop a product that could support the students in your focus. Our textile skills enabled us to make appropriate decisions around selection and construction of materials. The challenges that we faced included ensuring that there was still a strong link between our knowledge and not just our skills (PST 1).*

Likewise, another participant iterated similar points, *'there are massive opportunities for Design and Technologies that can have a special education focus. Like this assignment, finding a need (regarding special needs) and designing and creating ways to address these needs'* (PST 7). And finally, *'simply realising that it's possible to link Design and Technologies in supporting special needs education is exciting and a great opportunity to develop more programs [courses] that can support these needs'* (PST 1).

This paper has positioned Design and Technologies education as a powerful medium for connecting people and place. Although the seed for this university project was planted in an on-campus classroom, the learning stretched far beyond and provided a meaningful way for pre-service teachers to connect to wider communities and develop their capacity as responsive and inclusive educators. As one pre-service teacher explained, *'the biggest opportunity for us was the opportunity to give something back to the community and help others out'* (PST 6), with another participant stating, *'as teachers, we need to focus on what students can do rather than on what they can't'* (PST 8).

Conclusion

This paper has focused on the authentic experiences of eight final year pre-service Design and Technologies education teachers as they engaged in place-based learning experiences to produce a sensory teaching resource for a special education setting. Findings from this study position place-based learning as a pedagogical approach to enable pre-service teachers to meet identified community needs, facilitate reflection on learning in context, gain broader and deeper understanding of user-centred design, and foster an enhanced sense of civic responsibility (Bringle & Hatcher, 1996). As pre-service teachers' comments conveyed, connecting with diverse learners through the design and development of sensory artefact furthered their understanding of diversity, inclusive education and inclusive design.

Significantly for higher education, and indeed, pre-service teacher preparation courses, this research suggests that place-based learning experiences present immense scope to enhance social justice and equity perspectives through engagement with place to inform practice. Although Sharma and Sokal (2015, p. 277) have argued that 'little is known about how to foster development of effective inclusive teaching practices', we suggest through proactively engaging with schools, teachers and students with diverse needs, opportunities for

valuable interaction and discussion arise. Therefore, positioning learning experiences within authentic learning contexts enables pre-service teachers to develop knowledge, skills and understanding of user-centred design, a term this paper has conceptualised in relation to generating informed designed outcomes for a particular need. However, in progressing this understanding, we argue that such a view can be extended by developing a user-informed teaching philosophy, practice and pedagogy which is responsive, inclusive and prioritises the needs and respective strengths of learners (Best, 2016; Best, Price & McCallum, 2015). To advance these findings, subsequent studies may benefit from capturing the perceptions of experiences from community members including parents/caregivers, students and staff, to develop greater understanding regarding the reciprocal benefits of place-based experiences. Engaging learners in the investigation, design, production and evaluation processes presents scope for further exploration. Although this study primarily focussed on the inherent benefits of place-based learning and the transferability of skills, understanding and knowledge to pre-service teacher education, further research may extend findings through more specifically unpacking how such experiences subsequently shape teaching practice.

As this study has evidenced, there is immense value, both personally and professionally, when pre-service teachers engage with place-based learning experiences. However, such experiences are often confined to courses with a relatively small student cohort. Given the need to connect with community stakeholders, courses with large enrolments can be pressed to facilitate and manage authentic and meaningful place-based learning experiences for all involved. Logistically, place-based experiences are complex.

Drawing on the experiences of eight final year pre-service Design and Technologies education teachers, this paper portrays how they engaged in place based learning experiences to produce a sensory teaching resource for a special education school. While this paper has focussed on the learning area of Design and Technologies education, place-based learning experiences can extend across the curriculum and facilitate multidisciplinary and interdisciplinary learning (Resor, 2010; Sobel, 2004). As one participant in this study reflected, *'place-based projects are relevant and highly important for pre-service educators. Involvement in a community project at university provides invaluable experience and gives new meaning to what 'successful' is. It enables us to make meaningful contributions to the greater community'* (PST 6). This research suggests that place-based learning experiences present immense scope to improve in-practice design education through immersion in place to inform practice. Connecting with people and place through authentic contexts expose future teachers to experiences that traditional classroom boundaries too often preclude.

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