Developing Design Consultants of the Future: Embedding Virtual & Augmented Reality in the Design Curriculum
Virtual and augmented reality technologies have grown to become one of the most significant new ways of imagining and developing our built environments. Long gone are the days in which they were marginal technologies, used by gamers but few other groups. Instead, they are rapidly becoming part of the mainstream of development, design, and planning practice and therefore of great importance to students wishing to enter these fields. It’s therefore excellent to showcase the Developing Design Consultants of the Future (DDCF) project, which is one of the first of its kind in exploring how we can integrate the potential of virtual and augmented reality technologies into the classroom.

The range of activities undertaken in the project is deeply impressive, engaging with students across the age ranges, and working with industry leaders to ensure that the cutting edge of technology and thinking is brought into the classroom. The outputs of the project are equally impressive, and I am certain that it will continue to have significant impact in years to come.

What really marks out DDCF is the way in which the possibilities of these new technologies are understood critically by students, and applied to real world urban issues. In doing so, the project has sought to think through the implications of questions such as what do we do with the amount of data we’re generating, how we ensure real public engagement in the design process, and how we apply these technologies to the wicked problems of climate change, urban growth, and an increasingly mobile world.
DDCF represents not only the future of how we engage students in thinking about cities, but also what we are seeking to do as a Department of Urban Studies and Planning - to make links with the best practitioners in the field, to equip our students with the skills needed in a rapidly changing world, and to think critically about the challenges and opportunities presented by technologies to create better, more socially just places.

Malcolm Tait

March 2018
“The interdisciplinary approach combines cognitive research on perception of space, design psychology, learning pedagogies and technology. With this we can contribute to enhanced design learning in terms of comprehension and expression, where a student with immersive learning can shift base from being a passive recipient to active participant and co-producer of the learning resource.” Dr. Bobby Nisha, Programme Director of MAUDP

“We hope this project will provide students with a glimpse of its potential and the skills to prepare them for the new and exciting ways the planning and design industry is starting to engage with stakeholders and end users.”

Bryony Olney, Learning Technologist
Project Overview

Pedagogic Philosophy of learning urban design with immersive reality: Students as Co-Participants, Co-Producers and Co-Consultants

The objective for the project is to introduce the use of fully immersive virtual reality (VR) and augmented reality (AR) technology at various stages of delivery of urban design teaching to increase students’ understanding and appreciation of such key factors as space and volume, and how students can harness the benefits of the technology to engage in different and new ways with stakeholders.

Immersive virtual reality is growing in popularity and whilst it is viewed as being firmly in the domain of gamers, it is seeing a significant rise in industries such as marketing, retail sales, real estate and engineering for a variety of uses. In urban planning and design an interest is beginning to emerge in how this technology can be used to improve public participation and stakeholder engagement in urban planning.
“creating spaces and places with greater awareness towards their users’ needs with virtual reality”

The project introduced into learning and teaching, the concept of designing with VR and AR, considerations posed by new technological developments, in line with emerging applications of it in industry. The following modules used VR and AR as a means of engaging with spatial design to achieve various learning outcomes of the module:

- TRP613 Urban Design in the Global South: Photogrammetry and Virtual Reality
- TRP4408-6408 Advanced Urban Design Software Skills: Peer assessment with Virtual Reality / spatial cognition with Augmented Reality
- TRP6423 Principles of Urban Design: Spatial composition with Virtual Reality
- Students expressing an interest in exploring this technology in their own independent research through the TRP6424 Dissertation were supported and were given access to the technology for stakeholder engagement and design testing process
HEFCE funded innovative Learning and Teaching project: Developing Urban Design consultants of the future that embeds cutting edge Virtual/Augmented reality technologies in urban design teaching.

Steering Group

The DDCF project has a steering group whose membership is representative of a cross-section of relevant stakeholders in the project including individuals from the urban design and planning industry; experienced developers of virtual reality content; University colleagues from Urban Studies & Planning, Faculty of Social Sciences, and Strategy Projects & Governance and representation from our student body.
TRP6408 Advanced Software Skills in Urban Design

‘To experience the city, built in the imagination of the other, with Virtual Reality’

Space Place Life - A virtual urban extravaganza student assessment

Conceptualised as a roleplay: Students were asked to produce content for a new age digital exhibition entitled: Space, Place and Life. The task commissioned design firms to capture the evolution of urban cities and present a visual / virtual story of the current day socio spatial dynamics. What has this city come to be....

The commission required depiction of significant public space / urban corridor/ significant place of interest in Virtual Reality. These were judged by a Design Review Panel:

Dr. Bobby Nisha - Programme Director, University of Sheffield (Academic Partner)
Bryony Olney - Projects lead, British Library (Client)
Farnaz Ganji - Head of Design ( City Authority)
Stakeholder Participants (Peer group members)

For the purpose of peer assessment, student groups were allocated a corresponding group at random on the day, to act as Co-Consultants.
The dimensions of urban form – with Augmented Reality

Task: Students were required to produce an A1 Poster that presented the summary of urban design analysis / design strategies for an urban area of their choice. The poster was to be made up of graphical representations in both 2D and 3D.

The 2D to 3D mapping utilized augmented reality whereby two-dimensional birds-eye view plans were used as ‘trackers’ which were mapped to their corresponding three dimensional extrusions.

Trackers are 2D images printed on to physical sheets of paper with a unique design. When used with a tablet or smartphone, the 3D model will appear in augmented reality, "anchored" to the 2D image on paper.
This module focused on assessing the components of the urban place and how they combine to form the unique qualities of place. In addition, students explored opportunities for improving the quality of the place and were assessed on their ability to create meaningful spatial compositions that were visualized in virtual reality.

**Paths... Districts... Edges... Landmarks... Nodes**

**Task**: Using virtual reality, create a spatial composition of a typology of urban landscape that incorporates one or more of the above five basic elements.

Spatial compositions were 3D printed at A5 dimensions.
TRP613 Urban Design in the Global South

‘Data Mapping with Photogrammetry’

Photogrammetry is the science of obtaining reliable information about the properties of surfaces and objects without physical contact. DDCF tested both Aerial Photogrammetry and close - range Photogrammetry (or Terrestrial).

Aerial Photogrammetry can create high precision orthomaps based on the laying of “Ground Control Points” that define specific measurements between locations and this information is extrapolated across the entire map and therefore model when created. These are highly sought after models and have great importance to urban designers. DDCF commissioned aerial photogrammetry in order to provide students with high precision resources for their urban planning skills development.
“INNOVATE. ACHIEVE. LEAD: THE FUTURE DESIGNER”

The INNOVATE. ACHIEVE. LEAD: THE FUTURE DESIGNER project helped the students in developing skills in VR while fostering design skills and hands on experience with new age immersive visualisation.

INNOVATE. ACHIEVE. LEAD: THE FUTURE DESIGNER provided a unique opportunity to Department of Urban Studies and Planning postgraduate students. INNOVATE. ACHIEVE. LEAD: THE FUTURE DESIGNER is a chance to build upon students’ theoretical subject knowledge by enabling them to gain practical experience in working with stakeholders in design co-creation with cutting edge technology. This will contribute to developing wider skills as they engage in the capacity of co-consultant in case-based learning design projects.
Participatory design process, reimagined with technology, adapted from Morritt (2015)
“ESRC Festival of Social Sciences: Urban Extravaganza”

MA in Urban Design & Planning students used cutting-edge virtual & augmented reality technologies to create digital footprints of cities across the world. The use of state of the art virtual reality tools has shifted the axis from simply viewing the city to immersively experiencing the city. The introduction of virtual reality into the design curriculum has enabled our future generation of urban designers to employ cutting edge technology to create and re-imagine spaces so they can be experienced in their actual dimensions. It is no longer the case that we look at the city to understand it, but are able to gain a sense of standing in the city and experiencing it.

The event showcased the origins and evolution of urban form in five cities (Sheffield, Edinburgh, Manhattan, Liverpool and Manchester) where the evolution of spatial form was presented as short film screenings; together with hands-on immersive walk-through experiences of the city’s core on the HTC Vive (VR equipment).
Students’ Experience

“The model was real and all around you. You could adjust the size making adjusting smaller parts easier and looking at the model from a larger scale easier.”

“it feels like in the real world and you could observe your model from 360 degrees”

“it will be a perfect method to show the design to customers”

“It was incredible and i got to experience the space and form relationship”

“The immersive VR environment assisted my understanding of space during the design and development phase of the spatial composition”

“The immersive reality environment provided me with a new and helpful way of reviewing my spatial composition”
DDCF had the opportunity to partner with MakEY: Makerspaces in the early years: Enhancing digital literacy and creativity (MakEY). The project explores the place of the rising ‘maker’ culture in the development of children’s digital literacy and creative design skills. Research projects will be undertaken in seven EU countries (Denmark, Germany, Finland, Iceland, Norway Romania, UK) and the USA in which staff working in makerspaces (including Fab Labs) will collaborate with academics to identify the benefits and challenges of running makerspace workshops in both formal (nurseries and schools) and informal (museums and libraries) educational settings.

DDCF led one of the key case studies for the Sheffield based project, at Norfolk Community Primary School, to study the digital literacy and creative skills of young children through participation in makerspaces in formal educational settings. Young children, using their imagination and cutting edge virtual reality technology, brought to life their ideas to create their own imaginary play spaces in virtual reality.
“21st Century Design Skills for the Built Environment”

With an increased interest in this technology within the urban design & planning industry, DDCF aims to prepare students to enter the industry and be well versed with VR technology, its application, benefits and drawbacks.

The accessibility of immersive visualisation software and hardware is making the use of Virtual Reality more appealing to commercial organisations in the built environment industry.

With visualisations that can improve stakeholder understanding of design changes, it is speculated that cost savings during the design-build process could far outstrip the initial investment in technology.

Conference Key Speakers

- Ian Besford, Mott MacDonald “Visualisation from past to future”
- Ryan Johnston, Transport Systems Catapult “Virtual worlds”
- Elliot Hartley, Garsdale Design “Geodesign technologies and the future of urban design”
- Troy Hayes, Troy Planning + Design “Using digital tools for smarter planning”
“Bolsover Council”

DDCF partnered with Bolsover District Council Economic Development Team to collaborate on a re-design scheme of the shop fronts on Shirebrook Market Square with a project value of £167,212. DDCF will oversee the creation of a virtual reality model to demonstrate how the market square can be reshaped to enhance the market town.

The virtual reality design concepts will be used to support community visualization activities and engagement of stakeholders in the project, as well as provide a final ‘vision’ for the improved shop fronts.

Through this collaboration, a ‘live’ student project has been identified for a period of six months, commencing 6th December 2017, to support the application of virtual reality technologies to the Market Square Enliven- ment project.

The focus of the student project is to develop the design concept for the improved shop fronts and market square and to model these in VR. There will also be a focus on community engagement and participating in stakeholder events to build consensus for the design plans.
Minister for Faith Lord Bourne experiencing immersive virtual reality at Bolsover council. Photograph Courtesy of Bolsover Council
Outreach Presentations & Publications

- Heritage Circle Alumni
  - 05.09.2018
- Developing Design Consultants of the Future Showcase
  - 03.26.2018
- Girls in STEM
  - 03.20.2018
- PlanningSoc: Making Places Better
  - 03.03.2018
- ESRC Festival of Social Sciences
  - 11.11.2017
- Heritage Circle Alumni
  - 10.27.2017
- World Design Summit Conference
  - 10.16.2017
- Institute of Science & Technology
  - 09.14.2017
- Playful Learning Conference
  - 07.13.2017
- Widening participation
  - 07.11.2017
- HEA Conference
  - 07.05.2017
- ICERI Conference
  - 07.05.2017
- MakEY spaces Conference
  - 07.03.2017
- TELFest Conference
  - 06.30.2017
- Girls in STEM School Event
  - 03.29.2017
List of Publications:


Nisha, B. The pedagogic value of learning with Virtual Reality; Journal of Educational Psychology (Invited to submit; original article under review)

Refereed Conference Papers / presentations:

Nisha, B., (2017) Towards the ontology of presence: Re-conceptualising inclusive design process with virtual reality, World Design Summit: 11th October, Canada (Invited)

Olney, B., (2017) Developing Design Consultants Of The Future: A Reflection On The Role And Value Of Virtual And Augmented Reality In The Urban Design Curriculum, ICERI: 16th November, Spain


Project Evaluation Framework

**Evaluation Themes**

The main objective is the accurate assessment of the impact and take-up of the work of DDCF between November 2016 to March 2018, with respect to the following four themes:

- Delivery of the Project
- Impacts for the Discipline
- Development of VR and AR uses and skills
- Pedagogical value to learning & Teaching

Data was collected with surveys, focus groups, reflective blogs and module attainment data.
Student Feedback
Enhancing Students Employability Through the DDCF Program

“It has been exciting to explore different interfaces of various virtual/augmented reality platforms to come up with their strengths and short comings” Chander Aggarwal

“As a project assistant I have re-explored aspects of scale, proportion that before were not entirely approachableness, as how they are with VR” Ana Monsalve

“Working as a project assistant has provided me with a valuable work experience in the academic field, as I got to work with educators and oversee virtual reality’s impact on improving students understanding of space. Furthermore, being an MA in Urban Design & Planning student, I was able to experience virtual reality through two different viewpoints.” Roweida Alshantir

“The project collaboration between the university and Bolsover District Council has shown me the possibilities that VR could have in the industry ... it is truly an enriching experience” Hala Alhadid

“My work as a Research Assistant on the DDCF project involved organizing and managing a series of data capture activities, such as focus groups and online surveys, with student groups. The aim of the evaluations was to draw insights from the experience of students to understand the impact of VR and AR learning activities on students” Blagovesta Tacheva
Project Team

Dr Bobby Nisha  
MAUDP Programme Director  
b.nisha@sheffield.ac.uk  
0114 222 6934

Samuel Dent  
Project Manager: Strategy, Planning, Governance & Change.  
S.dent@sheffield.ac.uk

Bryony Olney  
Learning Technologist  
b.olney@sheffield.ac.uk  
0114 222 6189

Roweida Alshantir  
MAUDP Student, 2017/2018  
Rowyalshantir1@sheffield.ac.uk

Chander Aggarwal  
MAUDP Student  
2016/2017

Ana Monsalve  
MAUDP Student  
2016/2017

Blagovesta Tacheva  
PHD Student  
b.d.tacheva@sheffield.ac.uk

Special thanks to Ralph Mackinder and Rob Stacey