Visualising the Unbuilt: Design Investigation in Architectural Pedagogy

Augmented Reality creating live investigation in architectural studio learning

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Introduction

Research into the use of augmented reality in the learning environment is relatively emergent in the academic arena. However, the possibilities for exploration of spatial, geometric environments abound. The boundaries of augmented reality in the academic field are now being explored at an ever increasing level, allowing for ‘live’ investigation of design. As the pedagogical landscape is now changing in terms of cohort requirements, as a reflection of new societal goals, the pedagogy of 5 years ago has already begun to change. What is expected in today’s pedagogic environment is now different, with learner’s requiring a change and deeper learning.

In this paper we present the second phase findings of an educational project focusing on the use of augmented reality in the design process of an architectural student. The initial study seeks to evaluate the use of AR as a tool in the design stages, allowing effective exploration of spatial qualities of design projects undertaken in the studio. The use of augmented reality facilitating in both pedagogic and didactic in the use and application of this exploratory tool within the architectural studio. The learning process is guided by the exploration and detection of a design idea in both form and function, the virtual environment can provide such a dynamic environment (Mantovani, 2001). This is further reflected in the constructivist theory where the learning processes use conceptual models, which are used to create incremental stages that become the platform to attain the next (Winn, 1993).

Aim

Design thinking and the journey we take towards a solution takes what Cross refers to as ‘middle path’ and is primarily concerned with appropriateness, understood as that fragile quality which is achieved when the best of human intentions are realised within the constraints of reality (Cross, 2001). The current dichotomy emerging in studies on the use of visualisation in the design process would suggest there remains confusion as to whether design is thinking or doing? This summary of findings attempts to observe and correlate the iterative learning ‘loop’ of thinking and doing, which forms a critical part of the self learning and reflective feedback that is fundamental to acquiring knowledge.

The study assesses second phase of analysis of using AR within the architectural studio. The initial findings of thinking and doing into ‘design thinking’ where the augmented reality models are used to explore and raised queries from the cohort, that the learning journey may never have anticipated without the use of augmented reality. The initial research tracked emerging routes of learning and their linear/ timeline occurrence in the learning journey are also noted and assessed in relation to the traditional studio based expectations of and the qualitative differences when choosing augmented reality as an exploration tool in the architectural studio environment as against non AR tools, such as physical model building or manual sketching.

What is Augmented Reality, What is Virtual Reality?

The use of both Virtual Reality (VR) and Augmented Reality(AR) need to be contextualised and understood in order to clarify the focus and aim of this study. When posed to the cohort in the initial study, both augmented reality (AR) and virtual reality (VR) were often seen as or taken as the same tool. It is true that both are considered immersive, however, it is only virtual reality
that is deemed truly ‘immersive’ as it allows to user to only see and experience the virtual world, with no visual ‘connection’ to external stimulus. Whereas, when using augmented reality the user is allowed to experience the ‘altered world’ and the existing real world environments simultaneously. The augmented model is accessible and visible as an object ‘superimposed’ over or within the real environment surrounding it.

The use of AR in academia has began to occur in early pedagogic research by academics such as Shelton and Hedley. They used the ‘tool’ of AR in the teaching of their undergraduate students, which included simple rotation of images and shapes that represented the planets and their relationship to the sun. The ‘tool’ of AR allowed the cohort to experience how planets and objects aligned in a format that was not only 3D, but could be ‘walked around’ and experienced from many differing viewpoints almost simultaneously by the cohort. This used AR to allow for new levels of learning that were outside of those studied and formalised by Schon and Bruner. This allowed for the learning experience to be autodidatic, in that the student using AR learns about their design during their journey without the formal interaction of the studio tutor, in reality the student becomes ‘self-taught’.

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The augmented models that are used allow for the synergy of both physical and digital modelling and exploration to occur seamlessly, the student explores the unbuilt ‘models’ their schemes, allowing for abstraction and learning during the creation of the artefact in its form and spatial expression. This readily accessible and seamless environment allows for a greater accuracy and finer levels of manipulation to be achieved and to be synchronically manipulated in a blended and deeper learning journey. It is now understood in academia that the pace of technology in the learning environment is impacting of the differentiation between digital physicality and physical digitality. These previously separate domains are now becoming increasing integrated and the clear lines between the two are now blurred. There is concern amongst many teaching in architectural studios within academia that this integration will bring with them a new era of exploration within studio design, that of synchronic exploration of building form using both traditional and increasingly digital methods, this goes against the long held traditional norm of non-digital methods of pedagogy in the studio environment. There is a new pedagogic classification occurring when we use BIM and AR modelling in architectural teaching, that of ‘depth of learning’. The initial study findings indicated that when using the BIM model, the cohort were able to explore more ‘what if’s’ in rapid succession which, in turn, enriched the final learning journey and its pedagogic outcomes. Using AR the learning was deeper still; the connection with the model was far more immediate, seeing the model in a real world setting seemed to communication between student to student or student to tutor dialogue. Both perception and interpretations of the models studied were richer in detail and created a new critique dynamic. The learning via abstraction using AR to explore the model(s) allows for a critical synthesis of these cognitive skills, as interactions with the model are simultaneous with posed design iterations of the student that allow multiple design iterations to be abstracted and used to achieve constructs towards the final artefact. The levels and details of these explorations can be seamlessly and simultaneously reviewed and assimilated in parallel.
The three stages of analysis, synthesis and evaluation of the base iterative ‘loop’, has evolved via the emergence of a digital domain in the studio, to include the concept of problem and solution space proposed by Maher (1996). Maher’s concept suggested the idea of movement from problem space to solution space as the learning occurred. This second stage study confirms the original findings, that utilising AR allows the problem finding – problem solving phases of the design journey to be far more acquiescent. The point in time within the journey at which the design can be explored in spatial and conceptual levels can be achieved at the identical point in time within the journey. Such plurality of abstraction indicates a fundamentally altered concept than the traditional abstraction -representation within Maher’s original construct of the iterative loop of learning. Such opportunities in abstraction and understanding of concepts and their forms within buildings offers many benefits and a richer appreciation of the artefacts being created within the academic studio.

This paper investigates the original study’s findings of AR implementation in curricula by using both an initial survey and then structured interviews of current graduates from the School of the Built and Natural Environment, Semester 2, January to June 2014. The paper is structured as follows, first, we have an overview of technological change literature will be presented and will introduce the concept of AR in curricula. Next, we will describe the how the data is collected and analysed in this study. Then we explain the results of this study. Lastly we will conclude the findings.

Methodology

This exploratory study has been carried out in a field of research that is still emergent. The ongoing research follows a heuristic approach to evaluation, which consists of an iterative process of analysis, design and re-test phases. This approach has been adopted for this research as there are no current guidelines as to how AR should be tested and what data should be achieved in both type and amount. The cohort were introduced to AR using basic, freely available software from AR Media. This approach was used as it allowed for rudimentary methods of interfacing with their building models.

The data for this second study mirrored the original study and was captured in two stages. Seminar sessions were used to review and explore the building model via the use of AR, the findings made by the cohort and the dialogue of these sessions were captured and analysed. The same cohort were also asked to capture their learning journey, findings and how the model was navigated and explored. This ongoing research follows a grounded theory methodology using observations and interviews over 8 workshop/studio sessions to allow the studio dynamic to be captured faithfully in terms of the resulting integration of AR for design exploration in the academic studio. The specific objective of this study was to establish those challenges and the potential benefits of using augmented reality within the learning journey of the cohort studying this module. The study included a questionnaire to the 45 students studying the Virtual Project module. The final submitted number of questionnaires totaled 41.

The New Iterative Loop: The ‘Thinking and Doing’ via Augmented Reality

The study of design activity has grown progressively over the last 30 years. During this period a rather small number of studies have been undertaken. These studies were often small in scale and remain untested, as their findings were not verified in repeat studies. The initial study ‘How Augmented Reality can be used as an exploratory tool in the design learning journey’ (Morton, 2014), found that the problem finding - problem solving phases of the design journey to be far more acquiescent, as many levels of exploration of a model can be explored and then abstracted in parallel. This mirrored the findings of studies by Cross (1999), which concluded that there are distinct phases of activities within the design learning journey. Cross developed this further by formulating three phases of cognition; (1) Formulation, (2) generation and (3) process, with these phases allowing for an clear identification of design as a process in the context of academia.

Immersion and Synthesising of Design Ideas: Exploring the Unbuilt

The process being observed in this study is the process of design, the creativity that drives the progression and the activities that are involved. Creativity itself is often...
stated as an event of singular occurrence. However the 'creative leap' is often debated in academic theories and academic research as a manifestation of a series of smaller events that culminate in the 'leap'. The findings of this second study suggested that the creativity of building the AR model is at times a diversion to true creation in the learning journey. The concern is that the use of software packages like AR are setting out the parameters that the designers have to follow, should this not be the other way around? The majority of software today is sold on the premise that it aids the designer in their creative process, however the question that needs to be explored is does it? The software being used today in the majority of architectural academic studios is driven by basic geometric form, with proportional rules and constructs to allow us to build and morph shapes together to create our own form specifically for the project at hand. What these software packages do not have is the knowledge and behind the forms and what they are to become in the model, be it a beam, column, roof element or floor, they symbolically express shapes and forms, that have no rules other than that of geometry.

Conjectures and Refutations In a Digital Design Journey: A R - a Design Tool that Requires Prior Knowledge of Concept

The study demonstrated a pedagogic journey undertaken by the cohort using AR that reflects a problem finding – problem solving structure. The AR environment created an immersive journey that allowed for collectively seeking, and synthesising information from the model. The use of AR also allowed increased frequencies of opportunity for reflection and abstraction of the artefact in model form. However, 67% of the cohort noted that the software only allowed modelling using basic geometric forms. For example, circle, square, triangle which did not ‘support’ the expression of ideas in the way simple sketching or hand drawing may allow. When this finding was explored further with the cohort, the data suggested that a large majority of the cohort deemed the AR exploration to inhibit the creative design journey at some levels of abstraction.

The cognitive steps taken by the students in 58% of the cohort studied followed a linear progression similar to Piaget’s, constructing operational thinking findings (1979). However, although the progression is linear using AR, the progression is a series of parallel linear progressions. The student creates abstract concepts and articulated intuitive progressions from which they begin creating constructs that arch between these parallels. When asked, 73% of the cohort cited the software as a ‘barrier’ to exploration of their designs when moving from initial spatial and abstract forms into more detailed modelling of their schemes, the geometric forms available in the software were deemed ‘too generic’ and ‘lacking flexibility’ for modification, to be used within the students design proposals. Yet these findings were in direct conflict to what was being viewed in seminars and workshops for the module being studied. The visualisations were seemingly convincing and used generative forms that were complex and proportionally correct. On further examination and discussions with the cohort, it became apparent that a number of students were creating visually stimulating design ideas and forms, whilst at the same time unsure of how such forms would work.

Conclusion

Creativity within the digital studio: do digital design tools require new concepts for learning?

Almost two decades on from the original studies into the ‘digital pedagogic shift’ in the academic studio and the use of augmented reality in teaching has imbedded
itself deeper into the exploratory landscape of academic studios, than initial suggested by Oxman in 1996. The tools available to the architectural cohort are creating a seemingly digital future landscape within both the pedagogic and studio context. This digital domain affords the cohort benefits of increased levels of investigation at micro and macro scale, which can be considered in parallel and at multiple accessible stages of the design process. However, the activity known as ‘design cognition’ with pioneering studies undertaken by Eastman (1969) have now created a new learning journey paradigm. The digitally of the studio increases the ability to abstract, a key skill in design. However, the same digital tools are now the possible visualisation of a proposed scheme is now possible, with outputs for critics being visually authoritative and seemingly correct. Although visual output is key, these outputs are rather more of a distraction and cover designs that in some cases lack constructional conviction or possibility, what Hertzberger (1991) called ‘fake creativity’ rather than ‘real creativity’.

The use of AR in the design journey allows, as discussed in initial findings of this study, for exploration by abstraction. The understanding of exploration in the metaphoric and metonymic forms have been observed and analysed for over 50 years. In 1968, Arnheim first considered the concept of visual reasoning in architectural design. Three decades later, in 1995 and 1999, Goldschmidt continued these observations into reasoning and visual relationships of design elements. More recently Oxman (2002) continued the inquiry into design discourse, with research indicating that domain knowledge can be employed in virtual design, within the architectural context of design. Oxman has established that digital media has made significant impact on design processes and methods of pedagogic discovery. Prior knowledge of concept is essential to allow the cohort to govern themselves and their outputs from digital tools such as AR. Without this knowledge, the outputs cannot be questioned and abstracted further to enhance the design process. These findings echo the original studies of Cross (1977) and Whitehead and Eldars (1964), that digital tools can be effective, but require further development to align themselves with the of the architectural design process in order to become effective tools or become devices that merely inhibit design process and become what Hertzberger (1991) referred to as ‘fake creativity’.

These digital tools are effectively Maslow’s hammer (1966), where there is an over-reliance on familiar tools, ‘I suppose it is tempting, if the only tool you have is a hammer, to treat everything as if it were a nail’. Is their an over reliance of such digital tools in the architectural academic studio, with little understanding of the forms that the model is symbolically expressing, such as functional requirements, materials and the technology needed to construct such building artefacts.

References
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