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Virtual reality in the architectural technology curriculum in the UK.

WOOD, C.F., DOUNAS, T., SCOTT, J.R.

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VIRTUAL REALITY IN THE ARCHITECTURAL TECHNOLOGY CURRICULUM IN THE U.K

CAMERON F. WOOD, THEODOROS DOUNAS AND JONATHAN R. SCOTT
Robert Gordon University, Aberdeen UK
c.f.wood@rgu.ac.uk
t.dounas@rgu.ac.uk
j.r.scott@rgu.ac.uk

Abstract. This paper seeks to understand the climate for Virtual Reality (VR) within the Architectural Technology (AT)curriculum in the U.K. It seeks to assess through literature, focus groups and questionnaires VR's current place and seek to find a model to map an integration strategy of V.R. to the AT curriculum within the U.K. The paper uses focus groups, to highlight some of the problems that are still to be solved with the system and software. It also highlights for Architectural Technologists a new tool to communicate ideas with the three-dimensional world. We will assess virtual reality's current placement to see what steps have been achieved, therefore we can evaluate what is next for the technology for an A.T. This paper will query academics of other A.T. courses and their own implementation of V.R. within their curriculum and analyse what and why we should be using his type of technology in the education system. Looking back upon V.R.'s development we are able to see what progress has and is being made, to see if the time is right now to be implementing the technology with an appropriate method. The results show that it is a beneficial tool ready to be used by students to further their understanding of Architectural Technology. The paper was originally a dissertation by C. F. Wood in Robert Gordon University.

Keywords: BIM Manager, Role, competency, job descriptor.

1. Definition

Virtual reality definition according to Rheingold (1991) was the 'interactive computer technology' that simulates a space within the computer, able to be explored by the user. "Sometimes referred to as 'hybrid reality', mixed reality merges real and virtual worlds. This produces new environments and visualisations where physical and digital objects co-exist. The digital and physical objects can interact, in real time." (RIBA and Microsoft report 2018). Virtual reality has come a long way with its development and technology. The public now recognise it as a fully functioning technology available to the masses (Spaeth and Khali 2018)

1.1. RATIONALE

Architectural technologists' tools are changing. Technology is developing at a faster rate. V.R. is a relatively new tool to come to the curriculum; its opportunities were explored in the gaming industry and have come back to the construction industry as a more useful tool than previously (Spaeth and Khali 2018). Designers are now able to explore our models in a new dimension. This paper will seek to establish where virtual reality is placed within the Architectural Technology pedagogy in the U.K.

1.1. BACKGROUND

An Architectural technologist's role is to understand the concept given to them, see it through the stages to its completion and offer creative design solutions to an assignment (CIAT, 2018). Virtual Reality is helping to communicate these ideas from the mind of the technologist to the client. Three-dimensional representation is key for an A.T. to converse their ideas (Shujuan, Bo and Jie 2014). It is crucial in the early career of a student that they must concentrate on these new technologies such as V.R.

2. Introduction: Aim and Objectives

Two dimensional objects are only capable of showing the user a glimpse of the problem. By not being able to interact with it they are not able to make good decisions with a model that is probably for the most part a good model however to be able to understand it they must be able to relate to it in 3 dimensions (Kalisperis et al. 2002).

Horne, (2008) believes these are the reasons why students should learn V.R.:

- Rapid prototyping of models.
- Easy manipulation of objects and views.
- Makes the learning more exciting as they are exploring their own creation
- Scale models can be explored from the student's perception, i.e. they can walk through the model.

Bourdakis (2011) mentions the way designers are to represent their work is developing and is being analysed, with new technology such as virtual reality they must assess how to implement it to the pedagogy. By making the training process earlier on, the student will be more fluent with the technology in the later years. Baron and D'annunzio-green (2009) notes that students who are to cope at a higher level of education need to learn the skills as early as possible when they enter university. It is a new approach to learning compared to their previous years in education. It will aid the students and their way of learning as they are taught in a constructivist approach (Q.A.A. 2014). Thus, the aim of the paper is to understand through qualitative research and analysis, how V.R should be used in the Architectural Technology Curriculum in the U.K. To achieve this the paper investigates the reasons behind V.R.'s success in other industries, it analyses qualitative data from focus groups the authors have run on V.R application in the built environment and how people interact with the technology. It also analyses data from responses to a questionnaire, where the authors asked industry professionals and course leaders in A.T on their opinions on Virtual Reality in the curriculum, along with indicative quantitative data. The paper concludes with suggestions on how V.R. should be placed and exploited within the A.T. curriculum.

3. Methodology

The literature review will provide a basis for the topic in order to gain a true understanding of:

1) the current climate of how V.R and the extent to which it is being used in the curriculum,
2) who is best suited to undertake this field and teach the proceeding generations, making sure they can take this new technology into the industry,
3) And to predict where it is headed next.

Therefore, we must gather first-hand information from other universities and governing bodies of Architectural Technology within the U.K. To gather information, we must create a questionnaire to validate the literature review or challenge the review and provide new avenues for knowledge in the field.

The questionnaire will be released to programme directors of universities that teach Architectural Technology or of similar disciplines within the UK. The questionnaire will be limited to this particular group of people as having it online and open to all different groups of people will have cause for unreliable misinformed results.

Qualitative data in the form of observing the focus groups, should provide new questions. Whilst taking notes on how they interact with the given task. Denzin and Lincoln (1998) described qualitative data as information gathered from its source, this can be first-hand accounts of people's reactions and interactions with one another or a task. Creswell (1997) stated the fact that through the use of qualitative data, aids in creating 'open ended questions.' [Figure 1]

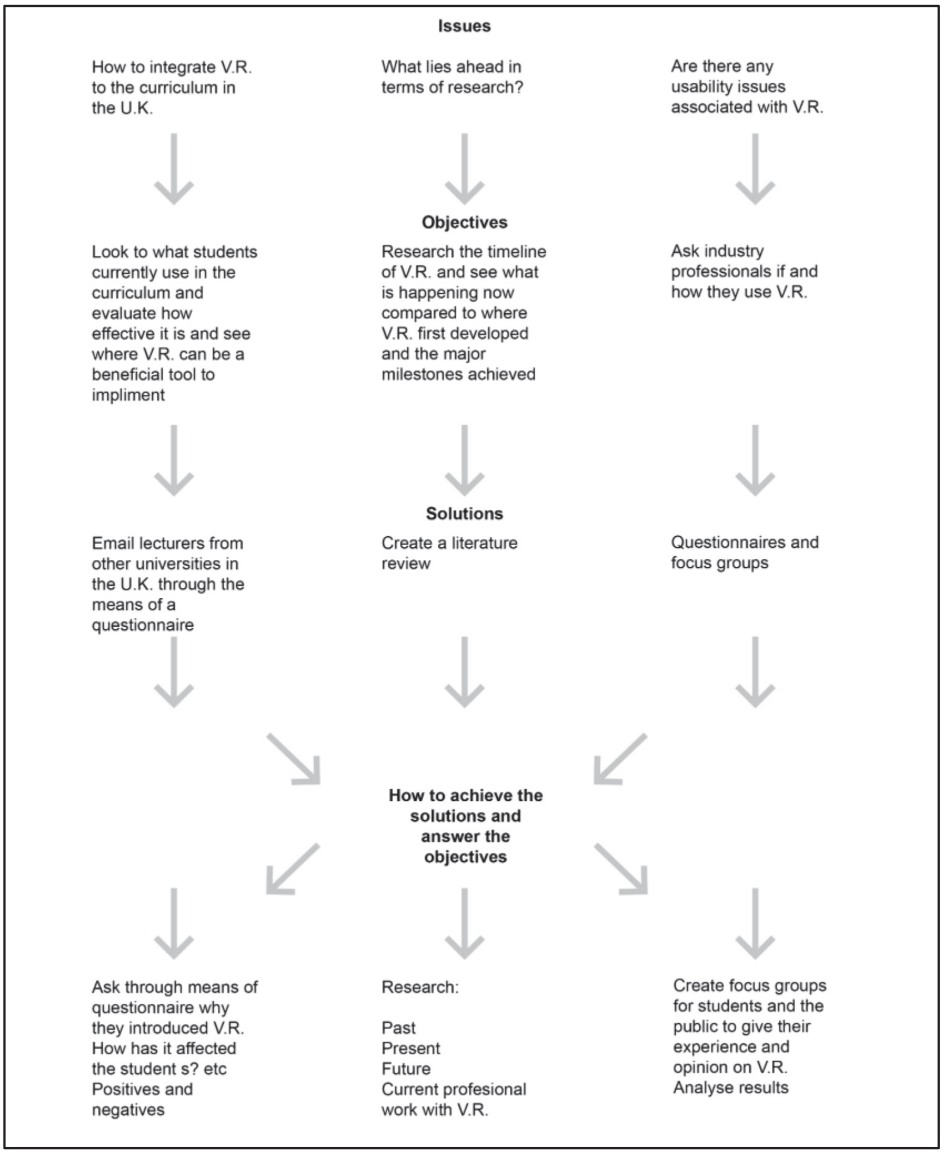

Figure 1: Methodology, diagram created by authors

4. Literature review

4.1. HOW IS ARCHITECTURAL TECHNOLOGY TAUGHT?

The Chartered Institute of Architectural Technologists (C.I.A.T) has outlined in the Subject Benchmark Statement by the Quality Assurance Agency (Q.A.A. 2014) that the course of Architectural Technology should be forward thinking in terms of technology. Hence the reason why we should adopt this new tool within the curriculum. Beetham (2013) mentions that students are more 'digitally connected' and the way they are learning must be geared towards this, for the future students benefit who are more digitally aware due to this new age of technology. Horne, M. states that new students entering the education system are expecting to be introduced to new technology and methods of learning.

4.2. VIRTUAL REALITY IN THE AT CURRICULUM

"Virtual Reality can be used when teaching using the real thing is dangerous, impossible, inconvenient, too time-consuming or too costly" (Pantelidis 1997).

A study was undertaken by Frank (2005) to ask students, "What do students' value in the Built Environment Education?" One aspect that students are only briefly shown and almost hidden from (not to the tutors' fault) is of the physical construction phase. Construction sites are hidden due to their potentially dangerous nature, this is where virtual reality can provide an insight to the construction phase.

Mujber, Szecsi and Hashmi (2004) described its uses and various fields. Showing us its rapid change and immersion in the industries such as prototyping and manufacturing. Designers need virtual reality to create, test, assess and repeat those steps until satisfied with the outcome. This ensures what we are designing as students is correct and fills the brief. Our principle as creators is to build, V.R. to us can be that building tool (Dvorák et al. 2005).

Advantages of virtual reality to the curriculum

- Assessment
- Learning
- Encourages collaboration

Milovanovic et al. (2016) stated that 'collaboration' is a key outcome with the future of V.R. and its effect within the groups using the technology. This only reinforces the fact that it is an additional tool that will add to the pedagogy of architectural technology.

4.3. HOW DO WE IMPLEMENT V.R. INTO THE CURRICULUM AND ITS FUTURE OPERATION IN THE EDUCATION SYSTEM?

"When people are asked to close their eyes and imagine a chair they don't think of the chair in section, elevation and plan, they picture it in 3 dimensions, people need to communicate their ideas in perspective" (Scott, J., personal communication by conversation. 2018). Technology and the nature of pedagogy work together and if one changes or develops, so does the other (Beetham 2013). With this in mind we cannot consider technology as a separate module within the curriculum, it must be integrated to every module (Bridges 1986). This can be transcribed to virtual reality also. Students whether they realise it or not are already exposed to virtual reality. The type of medium is the only difference. They may have experienced it in a video game or an advertisement on their mobile phone that uses V.R (Bourdakis 2011) V.R. is ready now to be transcribed to the education system. If V.R is to be utilised and understood more readily by the user, it must be taught well throughout education programs.

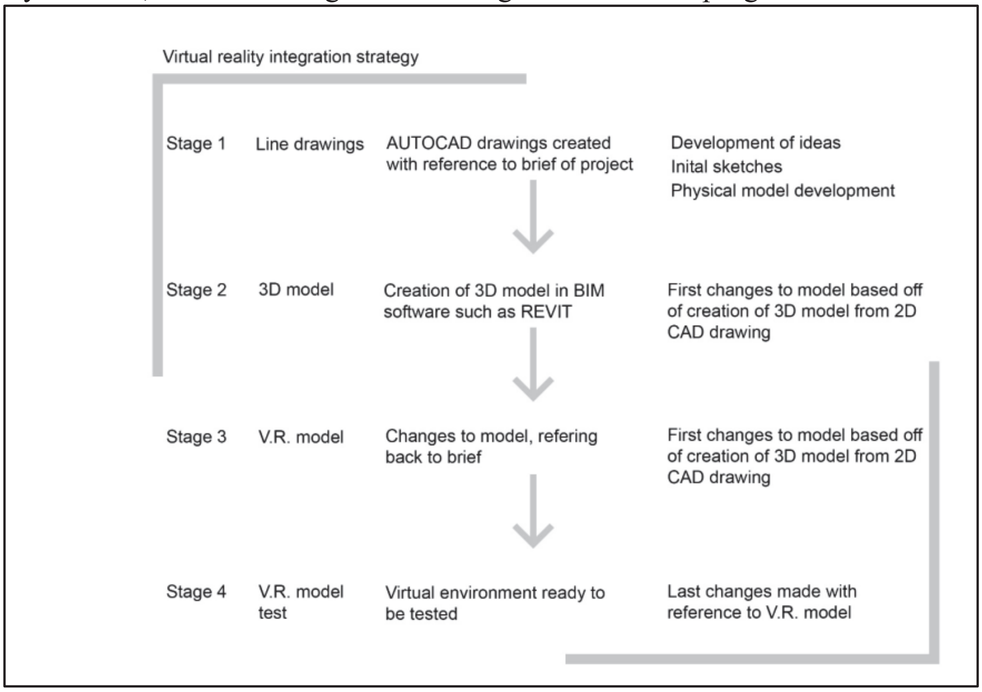

Figure 2: Process of generating a Virtual Reality Model, diagram created by Wood, with information from (Hamza 2006)

Figure 2 explains the process in which a V.R. project would be integrated to a student architectural technologists' role. We can see the first stage of how the AUTOCAD system begins to explain the design project through the use of line drawings, at this point the designer will begin to accumulate information regarding what the brief has specified, site analysis will be considered for the model. Then after, the 3D modelling stage (Stage 2) specific decisions regarding dimensions, orientation on the site and design will be finalised as regards to the brief. At stage 3 the virtual environment will be created on a PC, here we can improve the technical and design aspects.

Once that has been completed, at stage 4 the project can be simulated and rendered into the virtual environment. It is ready to present with the use of an HMD or a projection room. A projection room is a space in which projectors are used to cast images of an environment on the walls to create a simulation. This eliminates the need for a head mounted display, it is another type of V.R. (Whyte et al. 2000)

Lentz et al. (2007) highlights the benefits and the function of having sound within a V.R. environment, giving a fully immersed experience for the user. The simulations may eventually be 4 dimensional, meaning that the user can be able to experience the acoustics, relative humidity and thermal comfort of the design, these can be adjusted within the program.

Student's generally only experience the construction phase post education. Chin and Chia (2003) mention that students may be fluent in understanding a problem and know the solution, but Gallagher et al. (2005) points out that it may not be correct in practice. On paper it is correct, but an actual physical construction may not. This is where V.R. can bridge that gap and help with the understanding of the construction phase.

4.4. TIME AND DETAIL

In terms of the educational aspect of V.R. and its immersion we can make models, and their environments, explore these and manipulate them rather than building a physical model that may take a longer period (Haque and Saherwala 2004). This requires time to make the model detailed enough to get to a certain level of intricacy. It is here where students need to make a key decision of which level of detail to take within their model. If they create a model with more time and detail then they will have a model that can be used as a collaborative tool, due to the depth.

4.5. FOUR DIMENSIONS AND BEYOND

To create a fully sealed off virtual space then we must design sound into the equation, as vision and handling of the V.R. model is standard. The primary intent of V.R. is to show a 3D model, acoustics in V.R. is not given the same time and attention to detail as models are (Lentz et al. 2007). Sound would increase the model and its complexity and immersion, being able to have sound in the model, for the user to be able to understand the virtual environment completely then the space must be complete with all senses (Serafin and Serafin 2004). This aspect of the model is called the 'soundscape'. Sound events and ambient sound are two different types of sounds which can be placed into a model.

4.6. VIRTUAL REALITY IN OTHER INDUSTRIES

Other sectors that have benefitted from the use of this technology are for example the medical industry. V.R. has enabled them to gain more knowledge and understanding of what to undertake in a real-life situation without causing unnecessary injury to patients (Gallagher et al. 2005). It gives them the chance to learn from their mistakes. The one issue that has been found is that of what quality and skill level is this simulation within the V.R. environment, giving these trainees and if so, what calibre are they getting from it and is it suitable to the standards required in the field. For example, is the training through the virtual environment of an operating room better than that of a real one? In order for it to be, then it must be fully immersive.

Figure 3: Virtual Reality Timeline, created by Wood

5. Questionnaire Analysis and reflection

The questionnaire was sent to all architectural technology course leaders in the UK, thus cannot be used to justify and answer the ideas of the entire UK, for that we would require more results. It is only an indicator of the way V.R is currently being used by the whole of the U.K. We use the questionnaire to compare with the other aspects of the paper i.e. the focus groups and the literature to find the answer to the question of Virtual Reality in the Architectural Technology curriculum.

The initial findings from the questionnaire have shown that V.R. is being applied to the curriculum in some institutions within the UK. The results are consistent with that of what was discussed in the literature review with regards to V.R. being a great tool in collaboration, Milovanovic et al. (2016). The survey also echoed problems found within the focus group, the main issue was that setting up of the software to run the V.R. was difficult. On occasion upon initial start-up the computer did not recognise the HMD or that of the remotes, in the survey the general response was a medium difficulty in their experience of V.R. The focus groups provided more results with open ended questions and highlighted that even with today's advances in technology there will still be usability issues, which students might find. The responses were in some cases a little general to some of the questions, but I must highlight that it was not to the participants fault but since they didn't know the specific applications that they have at their institution. By constructing a general list of current and prominent applications on the market this may have solved this problem and able to give more clear results. Response to the questionnaires was less than 10% of the total emails sent out. This could have been higher if I had sent out the questionnaire over around June July of 2018. The responses overall shown that V.R. is being practiced in the education systems whether it is by the students or by the institution, it is up to the course leaders to work out where and how to assess if they see the need for it as part of their curriculum.

6. Focus Group Analysis and reflection

The focus groups aided in validating the statements brought up with the questionnaire as it gave a real-time simulation of how students would interact with the software and also helped to generate unforeseen questions to consider. The focus groups consisted of two Scottish Highers classrooms that visited the university and visitors during our open day that tested the VR equipment and software. The future use of these systems is to have one set up for students on every level of the school for them to test their models without the need for a lecturer to be present. This will mean live testing of models for students to work out whether their designs are going to work in an environment. This links back to the fact that the architectural technology curriculum is designed to encourage a constructivist approach amongst the students, virtual reality is encouraging this style of learning.

The focus groups gave us an understanding of the current systems, showed the benefits of the software as it encouraged teamwork amongst the 2nd year A.T.'s They discussed how parts of their design didn't work with relation to the height of windows needing to be higher, in order to let in more light. What is required to be adjusted will only be seen with the use of a V.R. model.

Overall the focus groups highlighted these key points:

- Students do not have a dedicated period for learning of this tool as time is given to other methods. Therefore, tutors must provide a means in which to give students the necessary starting blocks.
- New technology takes time, but they will benefit. In doing so and following those steps and guidelines students will gain a better understanding of 2D images and drawings, helping them to think more 3 dimensionally about their building.

- Students seeing their own work from Revit in V.R. gave them a new take on their work, opened new questions for colleges to help answer as they were able to see the project in 3D compared to 2D line drawings.

7. Conclusions

The ideas outlined and discussed have shown that the time is now for virtual reality to be introduced to the architectural technology curriculum, we have the affordable technology, applications such as Revit that run V.R., students have seen the need through the focus groups of the positive capabilities of the technology that can be seen in their own work.

The literature review helped to establish where the technology currently stands within the curriculum. With the help of examples where sectors that use V.R. technology have benefitted from the technology. Where it has gained traction in recent years with regards to its development, making it a more viable technology for more people to use and better understand its uses. Assessed whether it is an effective means in the pedagogy of the A.T. curriculum and that students would gain from its integration to their education.

The focus groups aided in the understanding of how the system is best set up within the curriculum and how students would benefit from V.R. It also helped eliminate issues before implementation of the tool, sorting out software problems and communication of data across applications that run V.R. The questionnaire results proved that institutions are aware of the benefits of the technology and identified its potential within the curriculum. This part of my research brought me back to Messner et al. (2003) paper which summarised that the space created in V.R. by students enriches them with a memorable atmosphere in which to learn and create. It is therefore key for course leaders to make the shift to integrate it to the curriculum for students to learn the technology from an early starting point so they can use it fluently throughout their years of study. A virtual model is able to be manipulated with ease (Arnowitz, Morse, Greenberg 2017). Overall if V.R. is to be mapped in an architectural technologists' role and the education system, there needs to be adequate software and a system that is readily available to the students in order to process the information into an interactive model. Giving them space and time required to learn the technology along with the set-out curriculum. As well as the students doing their own investigations to learn from mistakes at the educational level to be able to process the information. Starting this as soon as they begin their education is key to the development of this skill set.

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