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Research Article

Ten minute trips: a case study examining student perceptions of the value of virtual reality in A-level Classical Civilisation

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Abstract

Virtual Reality is regularly heralded as a tool which will revolutionise teaching and education, yet little research has been done into its use and, in particular, into its use with secondary school students. Through a case study of a Year 13 Classical Civilisation class this article investigates student perceptions of the use of Virtual Reality in the Classics classroom and its impact upon their learning. This study demonstrated students' positive attitudes towards the use of Virtual Reality and that it appeared to have a positive and lasting impact upon their understanding of Ancient Greek sanctuaries. The study is limited in its scale – both in terms of student numbers and time period – but it can, I hope, offer encouragement for greater use of, and research into, Virtual Reality within the secondary Classics classroom.

Keywords: virtual reality, Classical Civilisation, secondary school, Greek sanctuaries

Introduction

The world of education has seemed for many years to be on the brink of a Virtual Reality-driven revolution. Each year reports with eye-catching headlines will confidently proclaim that Virtual Reality (VR) is the future of education at all levels – from Primary ('Virtual reality project transforms learning for Glengormley pupils' [BBC, 2017]) to Tertiary ('Could VR help universities teach students?' [BBC, 2020*a*]). Yet, while such articles regularly appear, they all (including these examples) seem to make the claim that VR will soon transform education as we know it. It is quite clear, however, that the long-foreseen VR revolution has, as yet, failed to materialise.

The primary reason behind VR's slow break-through into the classroom is its cost. Thankfully, however, in recent years VR has become significantly more accessible for individuals and educational establishments. While highly impressive *Oculus* headsets retail for £299, placing them well out of range of many budgets, the availability of mobile VR now enables the technology to be more accessible. Smartphones can be placed into simple headsets – such as *Google Cardboard* – which can be purchased for around £5 each. Given that 83% of children aged 12–15 in the UK own a smartphone (BBC, 2020*b*) and with many VR mobile applications being available for free, this technology allows for the majority of children in the UK to access VR. Within the next decade this significant reduction in cost will surely lead to, if not a 'revolution', then at least growth in its use in the classroom.

What is virtual reality?

At this stage it is worth exploring what the term 'virtual reality' actually means. Firstly, it should be distinguished from 'Augmented Reality' (AR) which is defined by the Oxford English Dictionary as 'the addition of computer-generated output, such as images or sound, to a person's view or experience of his or her physical surroundings by means of any of various electronic devices' (OED Online, 2022). VR, by contrast, is defined as 'a computer-generated simulation of a lifelike environment that can be interacted with in a seemingly real or physical way by a person'. In short, while AR seeks to, as the name suggests, augment a user's reality, VR seeks to replace the user's environment with an entirely new one.

VR's creation of a 'computer generated simulation' can be further subdivided. Freina and Ott (2015) identify two distinct forms of VR – non-immersive and immersive. Non-immersive VR involves the use of a conventional screen such as a computer monitor. The user is therefore unable to feel truly situated in the virtual environment and always retains an awareness of the physical environment in which they are situated. Immersive VR, however, employs a Head Mounted Display (HMD). This device obscures the user's 'real' environment and replaces it entirely with a simulated one. Motion sensors within the HMD allow for the tracking of head movement, enabling the user to explore their virtual environment in a manner which replicates real world experiences. The result is that the user feels far more immersed in the simulated environment than could ever be possible with traditional screens. When VR is discussed in an educational context it is usually with reference to the immersive form and from VR's earliest uses this immersion was identified as being key for its potential to support learning (Psotka, 1995).

My own first experience with immersive VR was during a session run by Dr Paul Grigsby from the Warwick Classics

Network. I freely admit that prior to this session I had some reservations about the educational benefits which VR might offer – I was prepared for the technology to feel 'gimmicky' and likely to distract from learning rather than contribute towards it. I did not remain sceptical for long. Exploring the Acropolis through the *Athens in VR* application by Lithodomos (2022) gave me an understanding of scale and context which I had been unable to gain using traditional textbooks and 2D images. I felt that my experience – which had been both enjoyable and educationally stimulating – was one which I wanted to share with students. This is something which I was able to do during the Second Professional Placement of my PGCE, at an independent school in Cambridgeshire.

Research questions

Since I had found the use of VR so impactful for my understanding of the Acropolis, I felt that its employment in A-Level Classical Civilisation had significant potential to benefit student learning. Two modules in this course – Greek Art and Greek Religion – require knowledge of this site. As such I decided to introduce the use of VR into lessons for both of these modules for a Year 12 Classical Civilisation class comprised of two students aged 16/17. My aim in doing this was to analyse the impact of VR with regard to one major research question:

RQ1: What are students' perceptions about the value of the use of VR in lessons?

In addition, I felt that it was important to gain some understanding of the extent to which the use of VR had actually impacted upon student learning. While not the main focus of my research, this would allow the students' responses and their understanding of their own learning to be placed in context. It would be interesting to analyse whether students' perceptions of the value of VR appeared to match the reality. With this in mind, I also wished to undertake some research with regard to a second, subsidiary research question:

RQ2: To what extent is student learning impacted by the use of VR in lessons?

The state of research into VR

Prior to beginning this research, I undertook a literature review. This review produced some surprising results. Given the manner in which VR had become a regular feature of news articles, I had expected significant quantities of research to have been conducted on its uses as an educational tool. However, while there is a general sense that VR is likely to provide positive learning outcomes for students, there is, in reality, 'a shortage of large-scale longitudinal research on the impact of VR/AR on educational objectives.' (Daniela and Lytras, 2019, 325–6). There is a particularly notable lack of research conducted into the use of VR in the Secondary school (11–18) Classics classroom. In a systematic review of studies into the educational use of VR between 2010 and 2017, Kavanagh *et al.* (2017) found that more than half of research was conducted into the use of the technology for Higher Education (51%), with Secondary Education accounting for only 9%. They also found that interest in VR was highly subject-specific, with 35% of the research they identified relating to medical education, 19% relating to engineering, and 16% relating to science. This pattern was also independently observed by Freina and Ott (2015), who note that 'a significant number [of papers] is related to [the] medical area'.

Kavanagh *et al.* (2017) concluded that interest in VR for educational purposes was focused upon highly specialised simulations for training purposes, intending to facilitate the learning of practical skills. Within this category can be found surgical, flight, and construction simulations, with VR providing the primary benefit of allowing the practice of potentially hazardous tasks in a safe and consequence-free environment. 'In a computer-generated virtual model', Haluck (2000) quite rightly states, 'there is no patient who might suffer'.

The small number of studies within the sphere of Classics education have tended to employ non-immersive VR, but have demonstrated the technology's potential to improve student outcomes. Utilising VR's ability to provide simulation, Taranilla *et al.* (2019) found that it proved beneficial for students in their fourth year of primary education (aged 9–10). 45 students were taught about Roman Spain through the use of a VR application (VirTimePlace [https://www.virtimeplace.com]), while a control group of 53 students were taught using a textbook. The students who used the VR app recorded higher results in a subsequent test, while also reporting that they felt more motivated. The use of a control group and the relatively large number of students who participated, all of whom were in the same school year, across three different schools, makes the study a robust one.

Non-immersive VR was also employed by Ijaz *et al.* (2017), who recreated the ancient city of Uruk using the programme *Second Life* and populated it with AI-controlled inhabitants. These inhabitants were programmed to look and behave and interact with one another as the original population of Uruk would have done so. 60 undergraduate university students with no prior knowledge of Uruk were separated into three groups of 20. The first group were taught through the 'traditional' method, being given an illustrated text to read. The second group watched a documentary about Uruk in which the text given to the first group was read aloud and accompanied by video footage and content from the simulation of Uruk. The final group was asked to explore the city of Uruk and engage with the environment and converse with the AI population. All three groups worked with the same content; it was simply presented to them in different ways, ensuring that the method of learning was the major factor contributing to their outcomes. Despite the 'traditional group' spending on average only 11 minutes on their reading task, they reported that they were not engaged and found the study to be excessively lengthy. The 'virtual' group, however, spent on average 37 minutes on their task, reporting high levels of enjoyment. The 'virtual' group also performed significantly better on a test they were given immediately after the completion of their task. The mean mark for the virtual group was 26.11 – far higher than 17.65 and 16.25 for the 'traditional' and 'video' groups respectively.

Interestingly, the study found that students in the virtual world most effectively learnt through 'conversations' with the AI inhabitants of the city. Knowledge imparted through such (text-based) conversations was far more likely to be remembered during the test than knowledge which appeared in 'more information' text boxes placed throughout the virtual city. This suggests that interaction within the virtual world is important to the imparting of knowledge and that active engagement should be sought when designing such worlds. What the study, unfortunately, did not attempt to show was the extent to which each method of learning was successful over the long term. Tests were given as soon as participants had completed their task, with no follow-up test to establish the extent to which their knowledge was retained.

Surprisingly little attention has been paid to VR's potential for providing alternatives to school trips. Indeed, this would not even

fall within Freina and Ott's (2015) possible uses. They define VR's use of 'simulation' as allowing access to what 'cannot be accessed physically', but their understanding of what 'cannot be accessed' is narrow. Alongside historic events this refers, in their view, to situations which would be dangerous or unethical to experience and areas of 'physical inaccessibility' (the example given is the exploration of other planets). There is little consideration given to the fact that physical inaccessibility can also result from a lack of time or finances. Indeed, for some students the Acropolis which they learn about in Classical Civilisation may seem every bit as inaccessible as the surface of a planet which they learn about in Physics. Freina and Ott (2015) therefore omit a potentially powerful use of VR in education – as a technology which is able to provide a feasible alternative to school trips.

Such an alternative is sorely needed. While trips offer benefits for the learner, there are barriers to their use. These can be practical – the level of administration and planning which needs to be undertaken, particularly for overseas trips, is significant. Moreover, there is limited time available within the school year and schools can be reluctant for students to go on trips at the expense of time spent in the classroom. Most significant, however, is the large financial cost. Again, this is most clear with trips abroad. As a result, the majority of students are not able to afford such trips, widening the gap between the privileged students who are able to afford to travel abroad, and the underprivileged who are not.

In a rare example of research into this area, Schott (2017) designed a virtual fieldtrip using non-immersive VR for second-year undergraduate students on Sustainable Tourism Development. Schott's primary concern was the clear conflict between the students' study of climate change and the traditional use of air travel to enable them to observe the impacts of this in person. Schott (2017) and his team created a virtual Fijian island using *Second Life*. Talks given by inhabitants of Fijian villages were embedded into the virtual environment and watched by the students. Tellingly, Schott comments that 'this paper does not propose that traditional residential fieldtrips can simply be replaced by virtual fieldtrips while achieving the same outcomes' (Schott, 2017, 19). Furthermore, his posing of a further question hints at his uncertainty about VR fieldtrips:

> In view of the virtual fieldtrip's GHG [Greenhouse Gas] emission equating to a fraction of a real fieldtrip, do the learning outcomes reached by the students equally equate to only a fraction of the ones achieved on a real fieldtrip to Fiji?' (Schott, 2017, 19).

Schott notes that this question was beyond the scope of his investigation but his belief is clear – that less meaningful learning has taken place during the VR trip than would be expected from a traditional one.

Schott's (2017) conclusions seem damning, but they are not as negative as they might appear. Firstly, less stimulating non-immersive VR was employed. In addition, the manner of the research project seems unlikely to have instilled enthusiasm into students. While their trip was replaced with a visually unimpressive computer-based tour, their lecturer did himself make the trip to Fiji himself in order to research the real island and incorporate his findings into the virtual one. It can be suspected that this would have caused resentment and led students to approach the experience in a negative frame of mind. While Schott comments that 'motivation and enjoyment are critical to effective learning' (2017, 19) and that VR has the potential to provide this, it is notable

that he does not record that any of his 91 students commenting that they enjoyed the VR experience. The absence of any investigation into student motivation and enjoyment during this study is a significant oversight since it is a crucial factor in learning.

In summary, a review of the literature on the use of VR in education identified a number of significant gaps. Little research has been done into the use of VR for the study of the ancient world, and where this had been done it looked at the impact upon primary school or university students. There is a notable lack of research into how VR might impact students of secondary school age. Furthermore, this research into Ancient History education was exclusively based around the use of non-immersive VR. The development of mobile VR, and the high level of smartphone ownership among students aged 11–18, now enables immersive VR to be used within most secondary school classrooms. The relatively recent nature of these developments means that their potential impacts upon student learning have not yet been explored, including the opportunity to use this new technology either to replace or support traditional trips. Finally, there is a significant lack of research into student perceptions of VR. Research has been focused upon its effects with regard to their learning, but studies often show far less interest in how students perceive the VR with which they are engaging. My research was, therefore, albeit at a very small scale, intended to target these gaps in research.

Methodology

My research into VR took place with a Year 12 Classical Civilisation class comprised of two students. *Google Cardboard* VR headsets were used with mobile phones and two free mobile applications – *Scooterise* and *Athens in VR*. Both of these applications are the work of *Lithodomos*, who have recreated a large number of other historical environments for VR (Lithodomos, 2022). Through these two applications students were able to view virtual reconstructions of a number of ancient sites and buildings, including those of Delphi, Olympia, and the Acropolis.

Each use of VR was limited to ten minutes at the beginning of five (non-consecutive) 75-minute lessons. The reasoning for this was a combination of choice and necessity. Firstly, I wanted the VR to feel like an integrated part of a normal lesson which supported and complemented the more traditional forms of learning to which students were accustomed. I felt that this would be the most effective use of the technology within the classroom and, crucially, I did not want to devote an excessive amount of time to the use of VR when the students were required to learn a significant amount of content. It would be unfair of me to prioritise my research over their needs. Furthermore, I felt that a series of shorter experiences would be more beneficial since it would allow the students to become accustomed to and comfortable with the use of the technology. Ijaz *et al.* (2017, 917) found that when students were comfortable with the technological aspects of VR (for example how to navigate) their learning was far more successful. I felt that a sequence of shorter uses of VR, rather than a single, longer session, would be more effective in ensuring confident and effective use of the technology. I also felt that this extended sequence would also serve to counter the novelty effect – whereby 'individuals participating in a research study (a novel situation) perceive and respond differently than they would in the real world' (Gravetter and Forzano, 2011, 595).

More practically, I was reluctant to use VR for extended periods of time due to the risk of adverse effects upon the students. Use of VR headsets can result in 'VR sickness' – causing headaches and

eye-strain – with a variety of factors influencing the likelihood that this can occur (Widyanti and Hafizhah, 2021). Having experienced eye-strain myself whilst using *Google Cardboard* headsets for a prolonged period of time I was eager to avoid my students suffering the same issue.

The non-consecutive nature of my sequence of lessons was also driven by practical considerations. Whilst I was extremely fortunate that there were applications available to allow the study of a number of Greek temples and sanctuaries on the syllabus, there were also many which had not been reconstructed for VR. During lessons when these temples were being discussed I did not have the option to use VR. The applications used placed further limitations upon how VR could be utilised within lessons. While Ijaz *et al*. (2017) had found that students learned best through communication with AI characters inhabiting a virtual world, sadly neither of the applications available populated their worlds with characters. This potentially fruitful method of acquiring knowledge was unfortunately not available to exploit, although Athens in VR does contain narration which provides additional information about sites.

There were further limitations resulting from differences between the applications. One (*Scooterise*) does not allow for exploration or movement. Users simply select the location to which they wish to 'travel' from a menu and are taken there. If they wish to move, they must return to the menu. An advantage of this is that students can quickly and easily navigate to the relevant site without the risk of 'getting lost' within, for example, the Odeon of Agrippa as they attempt to make their way to the Acropolis. This is something which can (and did) happen when using the second application (*Athens in VR*). With this application the user can freely explore the reconstructed Athens and make decisions about where to move. My initial impression – and something that I wished to test – was that this would provide students with a far greater understanding of the space which they were exploring. However, I also feel that it would be more difficult to implement within lessons (particularly with larger classes) if students were required to find their way to specific buildings.

An important technological factor which dictated the way in which the VR could be used was the limited visual quality of the mobile VR. While modern phone screens contain over a million pixels, they are not designed to be viewed from the close proximity which is required by the *Google Cardboard* headset. The result of this is limited visual quality, particularly with small details. In both *Scooterise* and *Athens in VR,* while the overall effect of buildings was clear (and often extremely impressive), it is generally difficult, if not impossible, to make out the finer details of the sculpture which adorns them. As a result, where VR was employed in Greek Art lessons, I made the decision to use it as a tool to allow students to gain a greater understanding of the context rather than the content of the art being studied.

I decided to use a combination of approaches to teaching with VR to best suit the application being used in each lesson and the aspect of Greek art or architecture being studied. There were five lessons in total for which VR was used. Four of these were for the Greek Art module and one for the Greek Religion Module. The four lessons for Greek Art followed the same format. Three different buildings were explored over these four lessons – The Siphnian Treasury at Delphi, the Temple of Zeus at Olympia, and The Parthenon on the Acropolis. VR was used twice to look at the Parthenon since its pediments and frieze were introduced in different lessons. At the beginning of each lesson students spent ten minutes using the headsets to view the Greek building to which they were going to be introduced in that lesson. I asked questions about what they could see and their impressions of the buildings and its art. There was little guidance about exactly what they should look at or for. For reasons of image quality my primary aim was to ensure that the students were able to understand the context in which the art was situated – both in terms of the building on which it was situated, and where relevant, the sanctuary in which it was located. Although the headsets were used primarily at the beginning of the lessons, they were not put away afterwards. If relevant questions arose later during the lesson, students could be encouraged to return to the VR and see if they could answer it for themselves. One student, for example, asked which subject of the Siphnian Treasury's frieze would first be observed by a visitor to Delphi. They were able to answer their own question by looking back at the VR and observing the sanctuary's spatial relation to the Sacred Way.

For the Greek Religion lesson, I adjusted the structure. The students were required to have knowledge of the Acropolis and the Panathenaic Procession, not simply the Parthenon. Therefore, I wanted the students to explore the whole sanctuary. I hoped that this would enable them to gain a good understanding of the site and the relation of each aspect to the others. In order to provide some structure students were supplied with a list of buildings which they were required to locate.

The timing of the sequence of lessons in which I used VR presented a further opportunity to further investigate students' perceptions of the value of VR. During this sequence the class visited the Museum of Classical Archaeology (https://www.classics.cam.ac.uk/museum/about-us/why-casts), Cambridge. This enabled them to see casts of a number of the works of sculpture which they had been studying in the Greek Art module. Students could therefore be asked not to make a general judgement about the merits of VR when compared with trips in general, but to make a specific comparison between their use of VR and a recent trip during which they had viewed related content.

Research methods

For RQ1 ('What are students' perceptions about the value of the use of VR in lessons?') I chose to employ an anonymous online questionnaire (see Figure 1). Given the extremely small class size, however, it is probable that students were aware that their answers would likely be easily attributable to them. The questions asked are recorded in Figure 1. In considering the design of the questionnaire I wanted there to be two sections. The first was more structured, asking students to respond to a statement using a rating scale, selecting a number between 1 and 5 where 1 represented 'strongly disagree' and 5 represented 'strongly agree'. Although there was the potential for this section to be superfluous (the questions were similar to those of Section 2), I chose to include it so that I would have clear data in the event that students were not forthcoming in answering the open-ended questions. Section 2, with its open-ended questions was where I hoped to receive a significant amount of my useful information for RQ1.

My second method of data gathering for RQ1 was my own observations of student responses to VR. I also used this for RQ2 ('To what extent is student learning impacted by the use of VR in lessons?').

Finally, in order to ensure that objective data was collected I also chose to assess students' learning through an assessment following the conclusion of the lesson sequence. As students were at this time sitting or preparing for assessments in a number of subjects, I was keen for this assessment to be short and not to be burdensome for

Question	Required Response
1. Using VR headsets is enjoyable	Rating scale
2. The VR headsets have helped me to better visualise the art of the Greek Art module	Rating scale
3. The VR headsets have allowed me to better understand the context of the Greek art I study	Rating scale
4. The use of the VR headsets was more helpful to my understanding of Greek art than my visit to the cast gallery	Rating scale
5. The use of VR headsets is more helpful for my understanding of Greek art than viewing 2D images	Rating scale
6. The use of VR headsets made the content of the lesson more memorable	Rating scale
7. What, if anything, have you found enjoyable about using the VR headsets? Please give as much detail as possible.	Written Response
8. Do you feel that the VR headsets have had any benefit upon your understanding of the Greek Art module? Please explain your answer, giving as much detail as possible.	Written Response
9. Did you find the trip to the cast gallery more or less enjoyable than the use of VR headsets? Please explain your answer, giving as much detail as possible.	Written Response
10. Did you find the trip to the cast gallery more or less useful for your understanding of Greek art than the use of VR headsets? Please explain your answer, giving as much detail as possible.	Written Response
11. Do you feel that the VR headsets have had any benefit upon your understanding of the Greek Religion module? Please explain your answer, giving as much detail as possible.	Written Response
12. Do you have any other comments you would like to add about the use of VR headsets in your lessons? Are there any aspects you particularly enjoyed or did not enjoy? Are there any areas in which you found the headsets particularly useful (or not!)? Do you have any other thoughts about their use?	Written Response

Figure 1. Student questionnaire questions.

them. Since I could not assess every aspect of the content which had been explored through VR, I decided to ask students to annotate from memory a simple map of two of the three major sanctuaries about which they were required to learn – the Acropolis and Delphi. Students were given a list of buildings or features to locate on a rough diagram of each sanctuary. The reason for this task was twofold. Firstly, I wanted to see whether students were more able to correctly situate the buildings which they had seen in VR within their respective sanctuaries. Secondly, I wanted to see whether students would have a greater understanding of the layout of the Acropolis, which they had been able to freely explore using the application Athens in VR, than they had of Delphi. My suspicion was that this would be the case. Ideally, as a control, I would also have included a further sanctuary about which they had learnt but had not viewed through VR, but, unfortunately, they had used VR with all three sanctuaries on the syllabus.

As discussed, Ijaz *et al.* (2017) had demonstrated that VR could be highly beneficial for short-term learning but not analysed whether this knowledge was retained. I wanted this assessment to be sat after a reasonable interval had passed since students had last used VR, and without students being aware that they would be assessed. In this way I would be able to understand whether it had been beneficial to their long-term understanding of the sanctuaries.

Results and discussion

Both students in the class completed the questionnaire. Here the most notable aspects of their responses will be discussed. The full results are included in Supplementary Appendix A.

Both students agreed that 'Using the VR headsets is enjoyable', with one responding to this question with a 4 and one with a 5.

Their written responses clearly demonstrated that they had enjoyed the experience. Both students commented that they enjoyed being able to see the sites as they would have been seen by an ancient audience and found this to be a particularly interesting aspect. Student A noted that 'being able to explore places such as the Acropolis was very enjoyable since it may be difficult at the moment to go and see it in person'. This response was interesting for two reasons. Firstly, the student clearly saw VR as an alternative to a trip which was not possible at this time due to the uncertainty caused by the Covid-19 pandemic. Secondly, the idea of exploration was noteworthy. The limitations of the applications used (see above) resulted in the Acropolis being the only sanctuary able to be freely explored. This suggested that the ability to freely roam had been particularly enjoyable for this student.

Both students were also overwhelmingly positive about their perception of how VR had impacted upon their learning. In the rating scale questions they strongly agreed that the headsets had helped them to better visualise the artworks they were studying (both rating this 5), that they had helped them to better understand the context of the art (rating this 4 and 5), that the headsets were more helpful for their understanding of Greek art than 2D images (both rating this 5), that the headsets made the content of the lesson more memorable (rating this 4 and 5), and that the headsets were helpful in their understanding of the Greek Religion module (both rating this 4). The written responses were equally positive. There were recurring themes in these answers. Both students commented upon how the VR had helped them to understand the size and scale of the art and the physical context within which the art was situated.

One of the more surprising (yet pleasing) responses to the questionnaire was Student A's answer to the question 'Do you feel that the VR headsets have had any benefit upon your understanding of the Greek Religion module?' Student A responded, 'Yes, absolutely. I had never realised that Delphi was as grand and ornate as it was before I looked at some of it through the VR headset. I have been in person, but that doesn't give a sense of how bright it would have been in ancient times.' This was pleasing for two reasons. Firstly, the response clearly demonstrated the student's perception that VR has benefited their learning. Secondly, it showed the perception that VR can provide unique learning opportunities which cannot be offered through any other medium. The student believed that it offered something to them which even a visit to the site had not. The ability to see the ancient sites as they had been, not as they are in their current ruined form, was something both students commented upon in response to other questions. Student 1, for example, commented that they believed that their understanding of Greek Art had been increased by seeing how the art would have looked 'in their original context, something that is difficult to do today'.

This perception that seeing art and sites in their original forms was also commented upon by both students in the questions which asked them to compare the use of VR with their recent trip to the Cast Gallery at the Museum of Classical Archaeology in Cambridge. My expectations for this question had certainly been that the students would see the physical as far more beneficial and enjoyable, with VR serving only as an inferior substitute. This belief was partly a result of a discussion I had with the students following their visit to the Cast Gallery. Their enjoyment of the trip was clear; they were enthused about the statues they had seen and had come away with new opinions and understanding of them. I expected, therefore, their comparisons between VR and their trip to be rather dismissive of VR.

In actuality, the students' responses were remarkably thoughtful and considered. In answer to the statement 'The use of VR headsets

was more helpful to my understanding of Greek art than my visit to the cast gallery' the students responded with a 2 and a 3. This suggested that they were not as dismissive of VR as I had expected. When asked whether they had found the physical trip more or less enjoyable than the use of VR Student 1 commented that 'they are very different experiences' and that they had found the ability to view 'sites in their original context and location, as an Ancient Greek might have seen them' to be particularly enjoyable – something which they commented that they could not do at the Cast Gallery. Student 2 likewise stated that context was the key aspect of VR which they enjoyed being able to explore. Their comment that they 'don't think it is fair to compare which one I enjoyed more' was telling. Both students clearly felt that each experience was enjoyable in its own way. Furthermore, they perceived that each experience offered its own unique benefit to their understanding of Greek art. They were, in the words of Student 2 'both very useful in different ways'.

Looking back at the use of VR in lessons, I realised that I should not have been surprised by such positive answers. My own observations supported many of the comments made in the questionnaire. The most memorable moments from the use of VR were the initial responses to it. There was, without fail, an exclamation of 'Wow!' when the headset was first raised and the Siphnian Treasury appeared before their eyes. This was no less the case in the staffroom when other teachers eagerly took the opportunity to try VR for themselves! The excitement of students was also clear at other specific occasions. When they 'encountered' the Caryatids of the Erechtheum – about which they had previously learnt – and when they suddenly realised which myth was being depicted on the Parthenon's West pediment while using the VR. The students enjoyed using the VR to such an extent that there was clear excitement amongst them as soon as they noticed that I had brought the headsets to lessons. There were, in addition, repeated comments made by the students during lessons about how they had not realised the way in which the buildings of a sanctuary were related to each other, and about how they were surprised at their size, their colour, or their sheer number. In all aspects I felt that my own observations matched well with the students' responses and gave me confidence in the validity of the data.

One final observation feels worthy of mention with regard to RQ1. As stated above, my repeated, short uses of VR had been intended, in part, to ensure that its use felt integrated into the lessons and not a disconnected element of them. A single student comment showed that I had been successful in achieving this aim. When the students were asked to fill out the questionnaires and understood that the VR had been part of a research project they were surprised. One commented simply, 'I thought it was just part of the lesson'. I felt that this comment was revealing. Not only had the use of the technology felt integrated to the students, they had clearly also felt that it was a worthwhile exercise. They would not have viewed the use of VR as simply 'part of the lesson' if they had felt it to be 'gimmicky' or lacking in any educational value. To them, it appeared to have some aspect of educational value in the same way as the textbooks or *PowerPoints* to which they were more accustomed.

Student comments during lessons were also incredibly useful for my understanding of RQ2 – how much the students' learning had actually benefited from the use of VR. In my observations of the students' use of VR I was confident that it was having a beneficial impact upon their learning outcomes. The (often unprompted) comments above in which students stated what they had learnt from the experience were telling. Other examples of their comments included one student noting that they had not realised that the Athenians had left the Old Temple of Athena in ruins following its destruction by the Persians, how they had not realised that there were such a large number of monumental statues on the Acropolis, and that they had not realised how close the buildings of the Acropolis were to each other.

For RQ2, the assessment sat by students also provided some interesting results (see Supplementary Appendix B). The one building from Delphi which students had viewed using VR (the Siphnian Treasury) was located relatively accurately by both students. Neither, however, placed it in exactly the correct location, with one being too far along the Sacred Way, and one the wrong side of the Sacred Way. However, given that this was the first building they had viewed using VR, and that this had been over three months prior to their assessment, I felt that the level of accuracy displayed was impressive. The Siphnian Treasury was one of only two buildings placed accurately by both students (the other being the Athenian Treasury). Even major features such as the Temple of Apollo and the Theatre were not placed accurately by both. This might suggest that the VR experience benefitted the students' understanding of the spatial layout of the sanctuary at Delphi.

The annotation of the map of the Acropolis showed that students possessed a much better understanding of the sanctuary's layout than they did with Delphi. Both students placed the majority of features in relatively accurate positions, including the Parthenon, the Erechtheion, the Old Temple of Athena, and the Propylaia. While it must be acknowledged that the Acropolis is a more famous sanctuary and that students are more likely to have encountered it before, the results do appear to show a significantly greater understanding of its layout. It would seem likely that the ability to freely explore the environment was responsible for the greater understanding of the way in which its features relate to each other.

The data collected for the subsidiary RQ2 was evidently limited in nature. It does, however, suggest that students' understandings of the sanctuaries were more accurate with regard to areas which they had viewed using VR. VR, therefore, does appear to offer a benefit to students' learning, giving them a greater understanding of the physical nature of Greek sanctuaries and, therefore, the context in which Greek art was located.

Conclusions

Only tentative conclusions can be reached on the basis of this research. With only two students in this class the results cannot be seen as conclusive. The data collected are demonstrations of the way in which VR worked for these two students within their particular context. The research can however, I hope, show that the value of VR in the classroom is worthy of further exploration.

The results of the questionnaire and my observations demonstrated that the students who took part in this research perceived VR to be of significant educational benefit. They felt that VR was useful not only when compared with the traditional use of 2D images – something which I expected would be the case – but also when compared with physical trips – something about which I was surprised.

The results of this study will most certainly influence my future practice. I will continue to use VR headsets for the Greek Art and Greek Religion modules at A-Level. I feel that its ease of use and the short investment of time it requires will also make it extremely useful for Year 13 students when they are revising these modules. In

addition, I would be keen to expand its use into other Key Stages and topics within the school. There are a great number of opportunities to use VR within a wide range of school-based settings since Classics is, perhaps surprisingly, extremely fortunate in the breadth of VR experiences available. Originally created for Melbourne Museum, Zero One Studio's *24 Hours in Pompeii* (Zero One Studio, 2022) which shows the stages of the eruption of Vesuvius in 79 AD is available as a VR experience on *YouTube*. The University of Bristol's *Virtual Reality Oracle* (The University of Bristol, 2022) allows users to experience consultations of the Oracle of Zeus at Dodona. Developed in collaboration with schools and museums the VR *Oracle* and its accompanying resources have the potential to significantly enhance students' understanding of ancient oracles – particularly for those studying the Oracle at Dodona for A-Level Classical Civilisation.

With regard to trips, I certainly would not replace them with the use of VR. The students clearly demonstrated their perceptions that VR and trips were both useful in different ways. I will certainly make use of this. It would be potentially useful to integrate the two experiences. Students could, for example, view a statue or building in person and – at the same time – gain a better understanding of its original appearance and context by using VR. The perceived benefits of both the trip and the VR could be combined to ensure that the experience is as educationally beneficial as possible.

Supplementary material

The supplementary material for this article can be found at https://doi.org/10.1017/S2058631024001028.

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