

Indiana Jones and the Joystick of Doom: Understanding the Past via Computer Games

INTRODUCTION

In 1997 Jane Murray published 'Hamlet on the holodeck: the future of narrative in cyberspace', which forecast the computer as a future platform for interactive drama.¹ Yet a great deal of recent literature has focused on the failure rather than success of virtual environments (particularly three-dimensional ones) as an engaging medium of entertainment and education.²

In this article I will discuss three key problems in designing virtual environments that in some way depict the values of past cultures.³ The first problem is how to create a feeling of immersion or of presence in a virtual environment— how we make the past come alive for people so that they feel they are transported 'there'. This goal is often seen as limited by technical constraints such as the speed of the Internet or network connection, limited processing power, or the computer's capacity to render a large number of objects on the screen in real-time that are seen to impede the production of realistic virtual scenes. By contrast, this article emphasises the need to foster engagement not through realism but interaction.

Secondly, our idea of what reality is may be at odds with understanding the past or a distant place from a local perspective. What does reality mean when we are trying to recreate and understand cultural perspectives? Is it useful, desirable or even possible to interact with digital reconstructions of different cultures in a meaningful way? Culture understood from the distance of a hotel or guidebook is obviously not the same as the culture that guides, constrains and nourishes a local inhabitant. I would like to bring the same distinction to culture experienced through virtual environments, and argue that a virtual traveler is not the same as a virtual tourist. Despite or perhaps because they have a goal to solve, and have more constraints and more direct immersion in the local way of doing things, people who travel rather than tour arguably have richer and more interesting experiences.

Thirdly, if we do manage to create an engaging and believable virtual environment, will the novelty or entertainment value actually interfere with the cultural understanding gained by the users? In virtual heritage environments this is particularly evident in the conflict between individual freedom to explore and the more pragmatic need to convey historical information. We may for example create an entertaining game but will that allow us to convey varying levels of historical accuracy in reconstructing the past?

TYPES OF VIRTUAL ENVIRONMENTS

Virtual environments have been explored and described in science fiction and fantasy literature. Examples of these 'worlds' are Neal Stephenson's *Metaverse* and William Gibson's *Cyberspace* or the *Matrix* series. These virtual environments are popularly depicted in terms of sensory overload, and are often pervaded by a sense of a mysterious and evil alien intelligence.

Another popular and popularly known form of virtual environment is the online community chat room. Typically these are three-dimensional environments that your avatar can move around in. A panel tells you who else is currently 'in' the environment, and there is a 'chatpane' where you can type and read 'chat' between the users. In a few, like *ActiveWorlds*, people can even build their own houses. They have their critics though. Some have written that the three-dimensional component does not add to the social interaction and that if the background environment is merely a stage-set, (i.e. the participants cannot modify it), that one might as well use a text-based chat-room. ⁴

Other virtual environments include those designed for education purposes, such as the highly successful computer-based training programs and learning environments. . Public citizens use flight simulator games and so do the military, but as training programmes. Virtual environment-based games are used by the military because they can be re-enacted anywhere, you can focus on certain things to be learnt, evaluation can be built into the simulator, virtual missiles cost less than real ones, and you don't have to lose real soldiers in a virtual combat. For example, one of the major research partners behind the Web3D consortium (which creates a standard for 3D objects and programming on the Internet) is the Naval Postgraduate School at Monterey California.

There are even virtual environments designed to divert the attention of burns patients during surgery. Brain scan studies have shown the patients are not as aware of the pain when immersed in these virtual environments. Psychologists also use virtual environments to cure patients of phobias. The virtual environments do not even have to have high resolution and visual fidelity, for the phobias are so strong they compel the patient to react even to virtual stimuli. The success of these clinical, therapeutic (and even meditational) environments are evidence that highly realistic environment are not as important as the psychological impact of the elements and interactivity contained within.

My own research focuses on computer based three-dimensional reconstructions of historically significant artefacts and built landscapes. These virtual heritage environments are typically archaeological

reconstructions of past cultural settlements designed to help our visualisation of past objects rather than ‘embed’ us in past cultural values.

Some virtual environments are assessed in terms of ergonomics (how effectively ‘usable’ these environments are) or subjective involvement and engagement (also known as presence or telepresence- ‘the sense of being there’). This field is still in its infancy, and there is still confusion and debate as to the meanings of ‘immersion’ and ‘presence’ and hence research has tended to be task rather than context-driven. The majority of presence research has not concentrated on how engaged and involved users are, but whether they are sufficiently deluded into thinking they are in a real place.⁵

However, recent research indicates that being able to fill in the blanks, to imaginatively reconstruct, is more important than photo-realism when experiencing virtual environments.⁶ Questionnaire survey results of people viewing state of the art Virtual Reality-based exhibitions in Italian and Greek museums indicate that realistic environments can bore people if they do not have interactivity, tasks, and some idea of other people (also known as agency); all features of popular computer games.

Perhaps part of the problem is that designers have not fully explored how people can interact with virtual environments in engaging and educational ways. Advances in digital technology have tempted many to approach the holy grail of photo-realism. The challenge of visual fidelity may have obscured the pursuit for not just usable but also useful virtual environments.

As the archaeologist Mark Gillings noted: ‘...researchers and commentators have not yet begun to grapple with the question: What does it actually mean to describe something as virtually real? It is my contention that until they do the unique potential VR has to change the way we approach, study and think about the physical world will not be fully exploited.’⁷

In other words, there is still much research to be done on achieving inspiring and useful context and meaning via digital media. For effective learning via virtual environments, it would be useful for research to provide us with information on engaging ‘triggers’ so that only highly effective interfaces are needed to stimulate the participant’s engagement. Such triggers may include the recreation of native tools, locally specific goals, and a sense of embodiment during interaction (through having an avatar- a character that represents you on screen, which is affected by collision with other objects and by gravity etc).

Inert ‘Explorative’ Environments

The first and most common type of three-dimensional virtual environment available on the Internet is the

visual (sometimes with sound). An extension of the scripting language (HTML) used to write web pages was created in the nineties to create the sense of three-dimensional objects on a webpage. This language was called VRML (and confusingly either pronounced V.R.M.L or 'Virmil'). It was difficult for non-programmers to learn, slow and required a great deal of effort to make interactive. And worse, it was very slow. One of the great hyped technologies of the Internet, it never truly took off.

VRML environments were good examples of the limited interactivity of virtual environments that targeted visualisation. One can walk around objects, magnify the view or pan the camera around objects (say buildings), occasionally move between preset viewpoints and that was about it. Orientation and view were often manipulable, but the environment was not really interactive, as it did not affect the participant's actions, or could be modified by the participants. However, visualisation-based environments do have their uses. For example, they can be used to create a three-dimensional fly-through of a building for an architect's clients. The advantage and disadvantage is that the environment is really only a finished product: it is not affected by inhabitants, and so manages to be definitive, immutable, and appear consistent in appearance.

Due to the success of these architectural computing-based models, it has been suggested that Virtual Environment design be informed by architectural and planning theory.⁸ It might be argued that Computer Aided Draughting (CAD) applications are directly synonymous with building three-dimensional digital environments and therefore the CAD programmes used by architects are tailor-made for designing virtual environments.

The problem is that CAD was designed to get buildings built, to quantify rather than qualify the architectural experience. They show static additions to the environment, rather than environmental changes acting and interacting over time. There is no fog, no dirt, no wind, and often even no people. Yet the real world experiencing of architecture is always mediated through a dynamic and imperfect sensory interface: our minds and our bodies.

Computer reconstructions created from CAD programs typically do not allow for sensory cues, illusions, and limitations. The suggestion of dissolution of form, of mood (often through dramatic lighting), of multiple thematic interpretations, or the effect of time and personalisation (via erosion) are generally missing from virtual reconstructions. These factors, along with limited interactivity in general, may help explain why few virtual heritage environments are popular or engaging, especially when compared to chat-worlds or to computer games.

Lack of atmosphere is not the only issue. Virtual heritage environments are designed to preserve historically significant archaeological sites. Conserving and preserving a sense of history is an important and difficult task. Part of the problem though is that history is not a static immutable object, but a dynamic mass of interpretations, actions, intentions, and beliefs. One critical theorist has written a polemic attack on virtual heritage projects for rendering history and historical cultures in this one-dimensional and one-sided way:

In the postmodern world where things have systematically become monuments, nature has been transformed into 'reserve', and knowledge is giving way to information and data, it is only a matter of time before Other people and their cultures become 'models', so many zeros and ones in cyberspace, exotic examples for scholars, voyeurs and other interested parties to load on their machines and look at. Cyberspace is a giant step forward towards museumization of the world: for anything remotely different from Western culture will exist only in digital form.⁹

Many virtual heritage sites have brilliantly detailed temples, but are missing the element that 'places' the temple in its context. That missing element is people, and the driving forces that compelled them to inhabit and modify their 'world'. Every group of people has their own viewpoints, issues, and outlook on the world.

Without understanding this specific cultural agency, there is a danger that we may see the virtual heritage site only in terms of our own cultural perspective. This limited ability to represent social processes and 'intangible' heritage can create a second danger: the static and apparently immutable aspect of digital reconstruction can imply a certainty of knowledge that we actually do not possess.

In addition, too many scientifically accurate virtual heritage environments lack the ability to store interaction history. A truly interactive environment is affected by the actions and paths taken by its visitors. Yet many virtual environments do not record traces of what happened. Visitors may be able to change part of the environment but seldom does the environment 'remember' the visitors, their paths, actions, or discoveries.

For these reasons, visualisation-based environments are of limited use in designing virtual heritage environments that conserve and preserve history.

Activity-based environments

Activity-based virtual environments allow activities to take place. Many are games or training programs. More than a straight visualisation of objects, an activity based virtual environment allows one or more users to alter some character or element in pursuit of a defined goal. Video games such as Pacman are activity

based, as are Tic-tac-toe and Microsoft's Flight Simulator game. Activity-based virtual environments are arguably the most commercially successful type of virtual environment.

The technological limitations of internet-available visualisation-based virtual environments (such as VRML 'worlds') do not seem to have hindered the popularity of complex games. The most popular form of virtual environments is arguably the computer game. Entertainment software is the fastest growing of all types of entertainment, outselling films. The computing power of current game consoles also rival supercomputers used a mere decade ago. Computer game engines are also used for research into artificial intelligence.¹⁰

Games can have an 'atmosphere', tasks to complete, navigation reminders, inventories, records of interaction history (such as damage to surroundings) and social agency (such as real or computer directed opponents). Most popular games contain a personalized representation of the user (known as an avatar), and similar representations of allies and opponents. In creating effective virtual heritage environments, these features of games could be used. They could be designed around a task or goal, and include visual representations of the users and other significant characters.

There are several features of games that are also conducive to learning. Games are a familiar medium to users, and when in game mode, abstraction can be just as engaging to users as a sense of realism. Games train us how to learn and how to use props as cultural tools. As participants become engaged in the tasks, it is easier to observe them without damaging their level of engagement, especially as games traditionally have built-in evaluation mechanisms (scores, status points, etc). Furthermore, games cater to learning curves of new users by advancing in complexity over time, and can be personalised.

To explore both the possibilities and limitations of the games model for VHE, I will turn to the computer adventure game Heretic 2, as it is analogous in form to a virtual heritage environment. Only, in addition to a virtual heritage environment, Heretic 2 has added tasks, goals, and interactive features. In the game, the returning hero finds his town deserted except for the diseased and crazed survivors. His goal is to find the source of the virus and hence its cure. Unfortunately, battling to escape the town he himself is infected.

Time is now running out, and every so often he too faints (often at the worst possible moment). He must explore various palaces and towns belonging to different races, identify doors levers and portals in order to go further, gain more powerful weapons and other artefacts, find power-ups to boost health, and combat

ability, and survive being attacked by various creatures with various weapons and abilities. The terrain can be outdoors or urban, and he must avoid bursts of flames, outdoor spaces (vultures will swoop on him), remaining in one place too long (creatures will start tracking him), swamp, lava, or running out of air (by staying underwater too long).

What techniques does Heretic 2 use to engage the user? In Clive Fencott's terms,¹¹ Heretic 2 uses attractors (phototropia and glints of light, prospect of open spaces) to direct people to the next part of the adventure. There are also repellers (aliens guard power ups and narrow passageways), items that people will wish to avoid. To aid navigation and stress the range of movement and terrain, there are connectors (such as ropes and water portals and crates you can use as steps). The sureties are the constants in the game: hostile creatures, power ups (to recharge your health), water, land, and molten lava. Constraints (items that impede your journey) include periodic fainting, occasional route restrictions (every so often users have to follow certain paths) and initial weapons limitations (adventurers start with only a staff so they will be on the lookout for more powerful weapons). Affordances (items which aid the journey) are the ropes, weapons, power-ups, levers tools buttons ledges rubble (closed doors) and sliding doors.

I have suggested that people who wish to 'travel' rather than 'tour' through virtual heritage environments may require social agency (allies or opponents), changing landscapes and climate, culturally appropriate tools and a task to complete. Heretic 2 has dynamically attenuating physiological zones that record interaction history (the environment can kill you and it remembers where you used weapons and people you have killed and artefacts you have modified). It also has avatar dialogue (you can adventure online with like-minded players), artefact-related tasks to help direct him to the main goal, and a mostly static two-dimensional map (though it indicates your position on the map). These features of Heretic 2 could be effectively utilized in the design of virtual heritage environments.

Cultural or 'Hermeneutic' Environments

Virtual heritage may well need the above interactive features and more in order to be engaging. Yet despite the rich detailing of environments, agents, and artefacts, Heretic 2 does not have a rich sense of cultural immersion for the same reasons as other mainstream computer games. The only goal is for collecting artefacts for the vanquishing of others, social interaction is limited to violence, time spent on reflection is punished, and we do not develop any feeling for the perspectives of the local inhabitants as their actions are purely for fight or flight.

Therefore, we can argue that there are certain techniques that virtual environments can learn from game design, but which ones are the most effective? In our view, virtual environments recreating past cultures need such interactive features and more in order to be engaging. Yet despite the rich detailing of environments, agents, and artefacts, three-dimensional adventure games do not have a rich sense of cultural immersion. Instead adventure games are tainted by the 'Indiana Jones' quandary. Archaeology is glorified via popular culture, but not for preservation, only for exploration of novelty and the demonisation and destruction of other cultural perspectives. Indiana Jones films routinely involve an eclectic mix of historical and priceless artefacts that get destroyed by Indiana Jones' race against time or for just getting in the way of him and his extremely violent archaeological rivals.

Yet these films also help popularise archaeology even if they promote the destruction of the very objects archaeologists are supposed to respect and preserve. The wanton destruction of cultural settings is also apparent in the films based on the Lara Croft Tombraider computer game. The first one was set in Angkor Wat, and computer graphics-based fight scenes in the film portrayed the sacred temple complex as a shooting gallery rather than a religious precinct. In a similar way, computer games too often destroy rather than create cultural context. In other words, games do not change ways of thinking in relation to a culturally appropriate setting or 'place'.¹²

'Place' is an important concept for VHE design. For Doreen Massey, place may have any of the following features: a record of social processes; fluid boundaries; and internal conflicts.¹³ . A place leaves 'traces' of the people who saw and used it as a place, or it has features that communicate something to us about how we see our place in the world. A place is not a concrete fixed concept, and does not need to be a set of unique elements. Often places are full of mementos from other places. So a place is more like a nexus, or a web of associations, cultural affordances and memories. The question then is how do we gain such a sense of place via virtual environments?

We can argue that in order to create a virtual heritage environment with a notion of a 'place' (a region recognisable to a user as a culturally coded setting); we need to have more than merely identifiable or activity-based virtual environments. A place can also carry cultural indications of inhabitation driven by a similar or different cultural perspective to that of our own. A virtual heritage environment must allow us to see through the eyes of the original inhabitants, or at least feel that this place once belonged to someone else.

Hermeneutics argues that we must grasp the world of the interpreter as well as the world of the

interpreted in order to gain the meaning of the text or an artwork. For example, the philosopher Hans-Georg Gadamer wrote that language is inter-subjective, exemplified by how children learn. They learn by seeing how others respond to them: learning is a totally interactive process, and it is language itself that constitutes our life-world. To quote Gadamer's translator David Linge, '...the hermeneutical has to do with bridging the gap between the familiar world in which we stand and the strange meaning that resists assimilation into the horizons of our world.'¹⁴

Where our environment refers to a long extinct civilisation, such a bridging is perhaps impossible, unless we somehow can bring the ghosts of the culture back to life. In other words, a feeling of strong cultural presence requires social presence, the presence of others that we are socially bound to. If theoretically this 'hermeneutic' dimension could enhance virtual environments, the question arises as to how we can achieve this in practice. And one possible answer has already been canvassed in this paper, that we can achieve this by studying computer games.

Games, Culture and History

What is 'Culture'? Is it a product, something you can point to, or a process, something that relates things you can point to? Whatever culture is, it surely is more than a library of objects. Some have argued that culture is a learning and recording process. Researchers believe we learn about a culture through dynamically participating in the interactions between three major elements. These are the cultural setting, a place that indicates certain types of social behaviour; artefacts and how they are used; and people teaching you a social background and how to behave through dialogue devices such as stories and commands; (along with or counter to your own personal motive).

We could paraphrase the above, and suggest that cultural learning is derived from interactions between places, objects, and people. So in our definition, the cultural is a subset and recorder or clue as to how to act socially. To act as part of a social group, we do not need to use objects (apart from language) but to act culturally means we must encode objects with meaning and use them in reference to that perceived social meaning.¹⁵

We can avoid artefacts solely designed for conflict and destruction when we design virtual environments with cultural presence. But yet another factor that might conflict with interaction, and records of interaction history, is that (virtual) tourists traditionally look for authenticity. A time-based task (a typical component of games) means that people would be punished for contemplating their surrounds. So we need to

reduce or replace the time constraint, by making time based goals only part of the experience, or the timing could be triggered by significant events.

We could further allow the option of replays so that people can reflect on what they had done. However, there could be a problem with the pace and suspense, if there are periods of time-based constraints and then periods without time-based constraints.

Perhaps most importantly, if the virtual environment shows changes over time (something multimedia is brilliant for), historical accuracy in these changes is important for educational reasons, and this may be in conflict with the user's demands for autonomy and control. Virtual tourists want an opportunity to interact with history and to choose interpretations of the past, but as we advance in time towards the present the more factual the account of what happened, the less the opportunity for autonomy.

Test Case: Palenque Mexico

Tackling the above issues is the motivation for my research into virtual travel environments. I attempt to isolate and evaluate the types of interactivity people prefer when visiting three-dimensional virtual heritage environments. My site is Palenque Mexico, and the great majority of the artefacts of that city of inscriptions are simply no longer there. However the Internet can bring the landscape, the buildings, the artefacts, reasonably accurate reconstructions of the native music, representative animated avatars of the people, and past historical and environmental conditions all together in one multimodal interactive gestalt. And, it is deliverable over the Internet.

Virtual travel may not be like being there, but it may in fact be even more educational. It also coincidentally answers the problem of tourist erosion, the cost and fear of travelling, and the growing potential audience of people who for whatever reason cannot leave the house. Virtual representations cannot compete with actually visiting the site, but the point is surely whether such projects have a valid purpose and fit an important need, not whether they mirror reality.

If we wish to understand such ancient people as the Mayans of Palenque thought believed and acted, we need a non-realistic world to understand them and their beliefs. They saw and imagined and related to things in a way a Westerner will not understand by merely viewing the current remains of their past abode.

In order to understand locals we need to work travel and live under similar physical and cultural constraints to them. Travelers can be defined as people who do not just tour places (without having to leave their creature comforts) but as people who have to experience local conditions in order to get from A to B or

to complete a task.

If so, I believe the traveler-mode where people are embodied (physically dependent or affected by their environment) and embedded (socially affected by the local social structure) is more engaging than the tourist mode (where we merely view things in-situ but from the air-conditioned comfort of our own portable culture) and should be incorporated into virtual heritage environments.

From measured archaeological drawings, site surveys and photos I have created three-dimensional models of the most famous buildings and the terrain of Palenque. The constraints of online computing are utilised in culturally specific ways, for example, portals are used both to load virtual settings separately (rather than immediately as one large world) and to convey the Mayan belief in portals to the Underworld and to their Sky ancestors.

Other Mayan beliefs include spirit companions, which are used as potential tourist guides and alternative avatars (with their own distinct form of travel). Collision is used to constrain the visitors' path through parts of the environment. Fog and glare are used as navigation and atmosphere devices, as well as being used to indicate gaps or controversies in current archaeological knowledge. Fog also reduces the never-ending space feeling of large virtual environments, and can indicate the passing of time. Glare, dynamic light sources and positional sound can be used as navigation cues. Some acoustic and visual events randomly occur, or are triggered by certain user actions.

Avatars are sized according to the dimensions of the locals, so visitors can experience the difference in scale as seen by the local inhabitants. Each avatar also has specific gestures that can be triggered by certain events or places in the environment or controlled by the visitor. Visitors also have the ability to collect artefacts, answer the riddles of local inhabitants (via artificial intelligence), while mouse-over functionality provides users with information when they want it, rather than having to follow a predetermined sequence.

There are three different interaction modes. One mode is action based, and the participants had to push back slabs to find the hidden tomb (this was actually what happened in the discovery of the Tomb of Pakal under the Temple of Inscriptions). If they managed to push back the sarcophagus lid of Pakal when they reached the tomb, a portal appeared that took them to a reconstruction of Palenque's Ballcourt (the Mayan Ballcourt symbolised war, life and death, the growth of maize, and the victory of the Mayan ancestors over the Lords of the Underworld, Xibalba).

The second mode was observation based only, and participants were asked to find artefacts located in

the large and navigationally confusing Palace.

In the third mode, the three major temples of the Cross Group had scripted guides, representing a Mexican tour guide, King Pakal, and his son. Their movements and speech were proximity-based, and they got angry or fell over if participants ran into them. The goal was also to click and read information relating to the giant inscribed tablets in each of the Temples. At the end of the experiment people were asked to answer six questions for each interaction mode, to see if they had learnt and were able to extrapolate information from what they had seen.



Figure 1-3: A chat-guide based mode (Temple of the Foliated Cross), an imaginative reconstruction the Palenque ballcourt, and an activity-based mode (Temple of Inscriptions).

Evaluations were conducted in three stages, via a pilot study, then two evaluation groups. The pilot study was of a first year archaeology class of forty-three students studying Mayan culture, the second evaluation was of twenty-four more experienced participants who were either virtual environment designers or cultural historians with an interest in virtual heritage. In the third stage (yet to be completed) twelve people from Lonely Planet Publications (a travel publications company with a strong web-based presence), will be tested, but the three interactivity modes will be swapped around to ensure the findings are not affected by the different content of the three environments tested.

The first objective was to compare different types of interaction (observing and finding items of information, gaining information from scripted social chat-guides, and more game-style interaction involving spatial manipulation of the avatar and moving objects) and see if that affected the cultural learning of the participants. The second objective was to compare various types of evaluation to see if some were more useful than others.

In order to assess game-style interaction and realism versus context, four more imaginative and less authentic 'worlds' were created based on the cultural perspectives of the ancient Mayans in Palenque, Mexico. These four worlds were a Mayan Ballcourt, a Mayan underground cenote with ceremonial offerings, a Mayan peasant Village (Milpas), and a recreation of the Crocodile-Mountain of the Mayan world-creation

myth. In the Ballcourt, people had to play Mayan football, in the cenote participants had to find and deposit offerings, in the jungle they had to find the Mayan village and the maize (corn) and in the last world they had to find the World-Tree and catch up to the paddler-gods rowing around the base of the Crocodile-Mountain.

Since the imaginative worlds were more game-oriented, the evaluation hoped to find out if the games were more engaging or considered closer to a Mayan perspective than the archaeological environments.

The evaluation consisted of five different methods. The participants' knowledge recall of the archaeological environments was tested by six multi-choice questions for each interaction-mode. Their ability to find information in the environment was recorded. They were asked to rank the environments from 1-7 against a range of presence-style questions, and how interactive, challenging etc they found the 'worlds'.

The presence-style questions were:

Please rank in descending order from 1 for highest to 7 for lowest your preferred environment.

Feature: (In) which virtual environment...

Did you find the most challenging to explore, find or change things?
Was the most interesting to you?
Seemed most interactive to you?
Did you feel most closely represented the way Mayans saw their own world
Most effectively seemed inhabited by real people?
Most felt like you were in the presence of Mayan culture?

Participants were also asked to rank the environments in terms of frame-rate (speed) and how quickly time seemed to pass by. Finally, they were tested on what they observed in the environments, such as shadows, relative height of backpackers versus Mayans, how many real or scripted people they noticed in the environment and so on.

While it was expected that the action-based world would most help participants remember information, the findings so far indicate the observation-based world was more memorable than the activity-based and chat-guide based worlds. The tasks in the chat-based world had the highest completion rate, yet participants found the chat-guide based world the most challenging followed by the activity-based world.

It is likely that navigation rather than interaction severely curtail or aid understanding. More conclusive findings on interaction will hopefully be reached when the evaluation reaches stage three, and the interaction modes are switched.

The first year students were also much more interested than cultural historians and visualisation experts in changing avatars and talking to other people. However the students were not very interested in

studying the artefacts or even in answering the questions or reading the information despite studying the culture in class. Those with games-based experience also wanted to know if there were weapons and if there was anything to destroy.

There were also conflicting results between the game-style and imaginative worlds. While game-style interaction (such as in the ball court world) was quickly and eagerly taken up by people, very few thought that the game-style environments showed the Mayan cultural perspective.

Yet most people preferred the archaeological worlds for understanding the culture, and said they were more interesting and interactive, it was much harder to get them to leave the more imaginative game based worlds. Perhaps we should not trust the reliability of questionnaires. And perhaps the game genre can be intuitive but also impede cultural learning. For those that had computer-gaming experience and finished the tasks quicker, did not score better in observing aspects of the environment.

Conclusion

There are at least three major issues facing the design of virtual heritage environments, realism, contextual interaction, and narrative freedom. Many virtual environments have aimed for realism rather than for meaningful interaction. Yet this may not be the most effective means of educating and engaging the general public.

This research project has attempted to research contextual interaction, and its effect on cultural learning. If culture is an interactive process of observation, instruction and participation we need to know how to meaningfully replicate this process in virtual environments. This case-study has attempted to borrow from game-style interaction in order to answer this question and to improve engagement in virtual environments. The statistical calculations have not yet been completed, so the findings are still inconclusive. However they do suggest that issues of evaluating virtual environments are highly significant and may impede research, and that game-style interaction being so task-focused may not immediately help us with genuinely culturally appropriate contextual interaction, or fully augment the cultural learning experience.

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