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Using virtual reality with autistic pupils: Information and advice

Virtual reality for autistic pupils in schools

Having worked with a range of virtual reality (VR) technologies and autistic groups for over 10 years, I have seen these technologies used with some positive effects and impact. I worked with colleagues and autistic groups with the Michigan State University in 2015/6 and then undertook a project with the University of West England (UWE), to investigate the use and role of virtual reality head mounted (VR-HMD) technologies with autistic pupils aged 6 to 16 years during 2017/8. The final phase of this project involved a review of empirical studies on the use of VR-HMD with autistic children and adults, and a pilot study of using VR in schools with autistic children.

Virtual reality options

As I write this (October 2018), there are several options available for VR-HMDs. Some we have used, some we are starting to use and some we haven't used at all yet. However, I wanted to briefly outline what we've used and the lessons from this so far. We have by no means experimented with the equipment in its entirety. So what I offer are some initial insights and ways to get started. I will briefly outline two of the options we've explored, namely:

- HTC Vive
- Cardboard VR with a smartphone/device

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I will discuss these in turn and also provide some examples of interfaces that can/have been used successfully. In addition, I have included four tables in this document:

- Table 1 - an overview of the advantages and disadvantages of using both options
- Table 2 - HTC Vive, equipment needed, costs and where to buy (in the UK)
- Table 3 - cardboard HMD, equipment, costs and where to buy (in the UK)
- Table 4 - content that can be used with the cardboard HMD and the HTC Vive or similar.

HTC Vive

HCT Vive (https://www.vive.com/uk) is the most expensive but also the most immersive. It provides high quality visuals with lots of existing applications. There are excellent input options too; gestures and hand controls. The use of Steam (an interface for using software) is required and available for free download here: https://store.steampowered.com

The Vive needs to be connected to a powerful gaming laptop or desktop PC via cabling. Set up is straight forward and clearly explained via the instructions provided in the box. You will need to fix movement sensors to either a wall (about 6 foot high) or you can use two tripods - these are specified later in the document.

Cardboard HMD

The second option is a cardboard HMD with smartphone combination (https://store.google.com/gb/product/google_cardboard). It might sound primitive but the cardboard is a good option. It's robust enough for using with a range of pupils in schools — or so we've found. We purchased two for our work (covering four schools, 40+ pupils and 10+ teachers) and both are still in one piece 6 months later.

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The cardboard option is supplied with a strap to hold it in place. A smartphone or similar device (for example iPod) is situated in the cardboard HMD (as illustrated above) and 360 degree VR content can be viewed when played on the device. The content is somewhat restricted to 360 degree video and/or still images. In other words the interaction can be very limited - there is a button on the top to enable some interaction with content and eye-gaze helps to initiate interactions.

Available content for the cardboard version is plentiful and can link well to the school curriculum. For example, we've used content related to geography, history and science. At the end of this document I've listed some of these apps and content. Most of the content can be played via a YouTube app installed on either an iOS or Android device. Others can be installed and run independently of this.

We believe that if teachers, teaching assistants, and schools would like to trial VR, the cardboard HMD option might be a good initial first step. So I'll focus on this option in a little more detail in this document.

Table 1 below provides an overview, in our experiences, of the advantages and disadvantages of both systems.

- green boxes = positive
- red = negative
- orange = somewhere in the middle (neither/or).

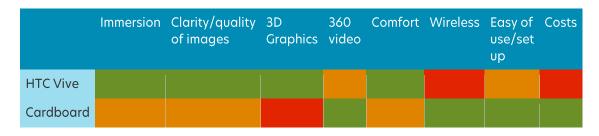Table 1: Overview of HTC and Cardboard HMD options

	Immersion	Clarity/quality of images	3D Graphics	360 video	Comfort	Wireless	Easy of use/set up	Costs
HTC Vive	green	green	green	orange	green	red	orange	red
Cardboard	orange	orange	red	green	orange	green	green	green

Table 2 highlights the costs and some links to purchasing HTC Vive equipment

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Table 2: List of required equipment for both high- and low-tech options

HTC Vive equipment	Cost (from)	Links
HTC Vive HMD, controllers, motion sensors	£499	https://www.currys.co.uk/gbuk/tv-and-home-entertainment/gaming/virtual-reality/htc-vive-10144056-pdt.html
Gaming Laptop (with a graphics card = 1060 or higher)	£1049 - £1499	https://www.currys.co.uk/gbuk/computing/laptops/laptops/hp-omen-17-17-3-intel-core-i5-gtx-1060-gaming-laptop-1-tb-hdd-128-ssd-10182219-pdt.html
Tripods (if you require portability)	£23	https://www.amazon.co.uk/Umbrella-Lighting-Youtube-Shooting-Photographic/dp/B00899801A/ref=sr_1_cc_1?s=aps&ie=UTF8&qid=1539776871&sr=1-1-catcorr&keywords=htc+vive+tripod
Steam software	Mostly free; just need to create an account	https://store.steampowered.com/

The next table provides links to cardboard and Smartphone/device options (prices and links correct/working as of 18th October 2018, UK prices).

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Table 3. Cardboard and smartphone device options

VR Cardboard equipment	Cost (from)	Links
Smartphone/device	From £119 - £179	**ipod:** https://www.amazon.co.uk/Apple-MKHX2BT-32-iPod-Touch/dp/B011ROE8U0/ref=sr_1_2?s=electronics&ie=UTF8&qid=1539776954&sr=1-2&keywords=ipod **Nokia 5:** https://www.amazon.co.uk/Nokia-SIM-Free-Android-Smartphone-Matte-Black/dp/B072J2FSSW/ref=sr_1_5?s=electronics&ie=UTF8&qid=1539777066&sr=1-5&keywords=smartphone+nokia+5
Cardboard HMD	From £5 - £6	https://www.amazon.co.uk/Virtual-Real-Store-Comfortable-Smartphones/dp/B072ZYWVS5/ref=sr_1_2?s=electronics&ie=UTF8&qid=1539777123&sr=1-2&keywords=google+cardboard
Youtube app	Free; just need to install and play	www.youtube.com

Process for setting up a VR HMD Cardboard experience

1. Purchase a cardboard VR HMD (see table 3 above).

2. Download content to your device. You can install one or both of the options below:
   o Install YouTube app and locate some content (like: Lions 360, National Geographic, Planets, Journey to the Edge of Space, London Guided City Tour).
   o Install stand alone apps (like: VR Moon, Guardian VR, Discovery VR).

3. Once you've downloaded the app, search within the app for '360 vr" or "360 vr education" and you'll find some materials. Click the video/experience you want to try.

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Then rotate your device 90 degrees (sideways) and select the goggle icon on the screen (tap the screen to get the interface to appear first).

The goggle icon looks like this:

4. Attach your device to the cardboard and close the flap this is attached to.

5. Wear the device and enjoy the experience!

The next table sets out some content you can use with the cardboard HMD and the HTC Vive or similar.

A list of some content available via (1) stand alone apps; (2) YouTube; and (3) Steam VR
* These indicted the apps / content we've explored and found to be enjoyable and useful to the pupils who used them.

Stand alone apps and content for cardboard HMD / device	YouTube 360 and VR content for cardboard HMD / device	Steam content for HTC Vive or similar (i.e. Oculus Rift)
Maze walk VR	Lions 360*	Google earth VR*
VR Scuba diving	National Geographic*	The league of bone builders*
VR Moon*	Pac-Man 360	In cell VR
Google Cardboard	360 VR Tour (of various cities)	NVIDIA Fun house*
Sky VR	How animals see the world	VR Museum of Fine Art*
Guardian VR*	360 Underwater Park*	Tilt Brush (paid)*
Discovery VR*	Virtual beach-relaxing	Job simulator (paid)
Sharks VR	360 Cockpit view	Lifeliqe VR Museum
MatterPort VR (in app tours)*	Battle Road: American Revolution	Coffee trainer VR
	The body VR*	Rome reborn
	Inside the human body*	Sharecare VR
	Atlantis found VR	Stanford Ocean Acidification
	Bletchley Park VR	London museum of water & steam
	British Museum 360 video	Witly language tutoring
		Everest VR (paid)*

We have not surveyed all available content, however the above list is meant to provide a starting point for people interested in exploring VR HMDs for the first time. Spend some time looking and you'll most likely find other content that might be specific to you/your lessons and pupils. If you do please email me (details on the last page) so I can keep adding to the list of content.

Please note that the content is not specific to autistic pupils. Although we have found various apps that have some close links to support the learning of autistic pupils, there is nothing specific I can point to at present. For example, one school I worked with found using Google Earth a great tool for supporting some pupils who were planning to travel and felt nervous/anxious about this. In addition, we've found Job Simulator a useful tool in developing a range of social and job-related skills.

There have been some positive results when using the above apps with autistic pupils, but nothing very specific. This is, of course, is the next endeavour for our research that seeks to explore these (and other HMD) technologies used with autistic groups. We are looking to use VR to support skill development with 16-18 year old autistic young people as they transition from school into university, work or independent living. Exactly how we achieve this, and what we achieve, will only be known once we've asked the autistic community and a range of other key stakeholders.

Considerations when using HMDs and VR

I think at this point it is worthwhile pausing and thinking about the impact of using this technology with autistic pupils, and reflecting on some aspects we've encountered to help ensure safe and appropriate use of VR in classrooms.

Having worked with a range of users including children/young people and older people, we feel there are several things to consider when using VR with autistic and non-autistic pupils in the classroom. These are not meant to be complete or everything you will need to know — again you might encounter others (in which case do share).

1. Physical space. Make sure you have suitable space and that all possible items that could be knocked over, hit or broken are removed or made safe. Make sure there are no chairs that could be tripped over or table edges that could cause accidents. When wearing a HMD the user cannot see anything in the real world.

They can become very immersed in what they are experiencing, so be aware of this and verbally guide the user of the HMD at all times (if you can).

2. Supervising. Be sure to supervise the pupil at all times. They should not be left alone to use this technology in schools. To address health and safety concerns, supervision at all times is paramount.

3. Negative effects. Check at regular intervals for any possible negative or side effects. These include being aware of pupils:
    o feeling sick
    o having a headache
    o getting eye strain
    o any balance/coordination problems.
    We have not had any reasons to suspect these will arise but you must check. Asking every 2-3 minutes "are you okay, any problems?" helps. We removed the HMD after 5 minutes to check visually. Indeed a break every 5 minutes is recommended — even if they continue using it immediately after.

4. Balance and falling. Younger children (i.e. 6-12 years) using the HTC Vive can present with balance problems when fully immersed and interacting with their hands (using controllers), causing them to fall. We therefore suggest that younger pupils remain seated until they have gotten used to the motion and movement within VR. For those at the younger end of the range (i.e. 6-10) remaining seated would be strongly recommended. For pupils aged 6-12 years we found that 'shadowing' them, and being prepared to support their balance, a good idea.

5. Groups. When working with the HTC Vive we would suggest you have no more than two or 3 pupils in the room. Having more than this means longer waiting times and pupils not 'taking part' for periods of time, which can cause problems. Working with two pupils also seems to encourage good verbal interactions and collaboration, enabling them to develop confidence in using VR (a new experience for most of them).

6. Post-VR experience. Having spent some time using a HMD and VR, it is recommended to check for negative effects up to one hour afterwards. Checking for eye strain or headaches after using the equipment is good practice and could help identify any further problems throughout the day.

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