

VIRTUAL REALITY AND AUTISM

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Summary

- Why VR for autistic users?
- Background, context and history
 - *Recent work and evidence-base*
- In-situ use of VR for autistic children
 - *In schools and cultural setting*
- Messages for VR use in schools and practical implications
 - *Trying to draw out what we've found and how to take this forward*
- Future challenges, responsibilities and ethics

Why VR for autism?

- Computers and applied technologies have been shown to support autistic users because...:
 - Initiate interaction(s)
 - Slow down communication processes
 - Mediate f-2-f channels of communication
 - Provide a voice / be heard
 - Enable creative expression
 - Support and test social situations
 - Learn communication skills
 - Recognise facial expression(s)
 - And more....

- And because computers/technology *can*:
 - *Be predictable and controllable*
 - *Not always socially complex or overly/ unnecessarily complex*
 - *Can be less worrying / stressful for some*
 - *A space to 'test' and therefore remove stresses associated with real-life consequences*
 - *Often a one-2-one interaction; less complex information to process/deal with*
 - *Provide a means to specify and control programs (from a designers/researchers perspective)*
 - *Play to the strengths of the autistic community*

VR and autism research

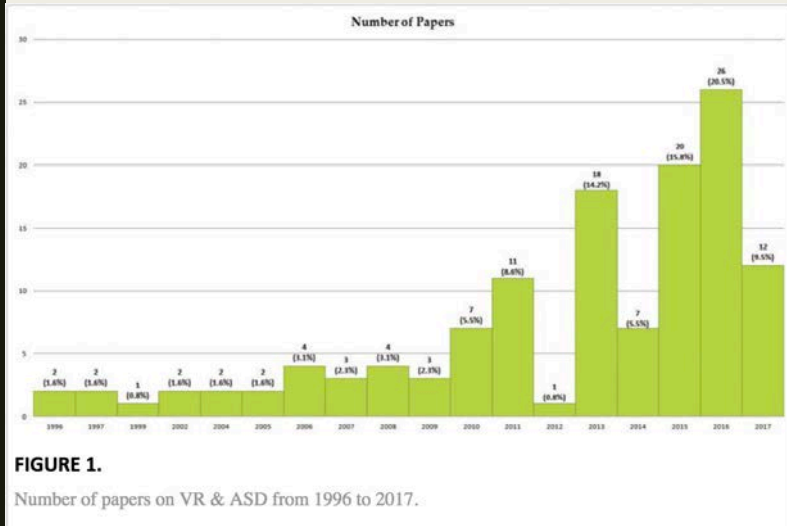


FIGURE 1.

Number of papers on VR & ASD from 1996 to 2017.

Fernández-Herrero, J., Lorenzo-Lledó, G., & Carreres, A. L. (2018). A Bibliometric Study on the Use of Virtual Reality (VR) as an Educational Tool for High-Functioning Autism Spectrum Disorder (ASD) Children. In *Contemporary Perspective on Child Psychology and Education*. InTech.

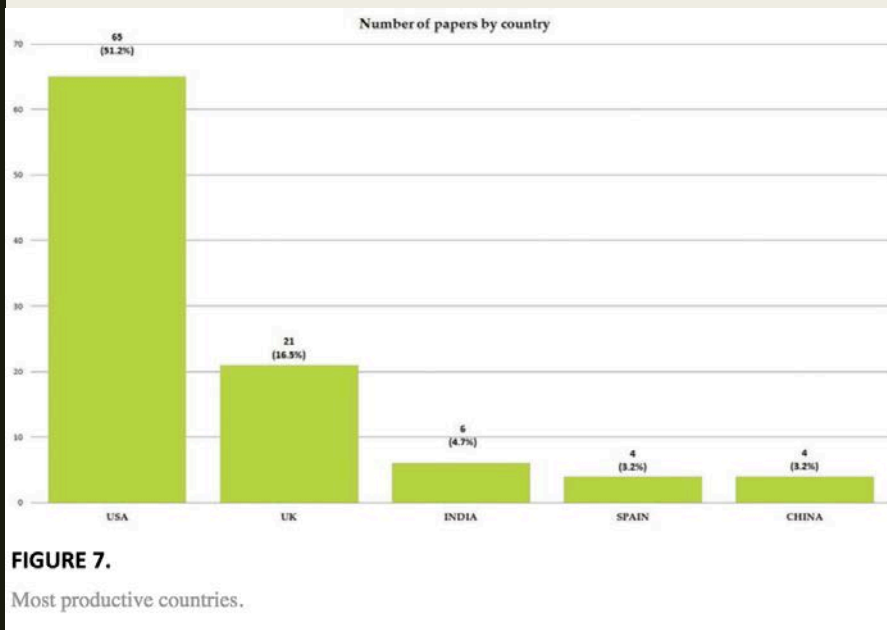


FIGURE 7.

Most productive countries.

- One aspect of technology and computers that have been shown to help are HMDs and VR:
 - *Make mistakes without real-life consequences*
 - *Learning/developing/testing social skills*
 - *Alongside: developing confidence*
 - *Communication*
 - *Collaboration*
- **Real-world generalisation**



Strickland et al. (1996)

- The next study to examine HMDs used by autistic groups?

- **2015** (Cheng et al., 2015) and **2016** (Newbutt et al., 2016)

- ~20 years
- In this time Facebook purchased Oculus (VR HMD developer)
- In between there was lots of keen interest and propositions; mainly in/from the press!
- However we sought to address the potential of HMDs and VR used in autistic populations by....
- Asking a sample of this population their views and experiences
- Would they be willing to wear a HMD? If so, how would they experience the VR environment? Would they feel sick...? How would they like VR to be applied?





Why?

- Low cost (relatively)
- Easy to use
- Wearable (outside labs and in the home or school)
- Enables the same affordances as VEs; as previously mentioned
- However, perhaps more immersive and therefore ecologically valid?
- Offering a very real and immersed ability to test an endless variety of situations
- Programmable (like VEs) and so operators can control the interface and media therein
- Very early days in terms of development and large-scale uptake

What we found

- Results revealed:
 - Willingness to wear equipment
 - Use input and navigate basic scenes
 - Use bodily interactions in response to the VE
 - Self-reported high level of presence, immersion and feeling natural in the space
 - Low level negative effects
 - Both higher/lower (respectively) than more traditional VE interfaces
 - Anxiety not increased as a pre-post test after HMD VRT experience

- A recent review (2018) related to VR, HMDs and education found very little evidence:
- “Whilst there are some grounds for optimism, **more research is needed on the use of this technology within educational settings to ensure robust recommendations can be made on the implementation, use and sustainability of this approach**”
- “One of the main criticisms in this field has been the lack of involvement from practitioners in research on educational approaches for autistic populations (Parsons et al., 2011) and the gap between research and practice in real-life settings ...”

Autism and virtual reality head-mounted displays: a state of the art systematic review

Ryan Bradley and Nigel Newbutt

Abstract

Purpose – The use of virtual reality (VR) technologies in the education of autistic children has been a focus of research for over two decades. It is argued that this form of technology can provide authentic “real world” contexts that target social and life skills training in safe, controllable and repeatable virtual environments. The development of affordable VR head-mounted displays (HMD), such as Google cardboard and Oculus Rift, has seen a renewed interest in their use for a wide range of applications, including the education of autistic individuals. The paper aims to discuss these issues.

Design/methodology/approach – A systematic search of electronic databases focussing on empirical studies on the use of VR/HMD for children and adults on the autism spectrum was undertaken.

Findings – A review of the literature identified a limited number of studies in this field characterised by differences in the type of application, technology used and participant characteristics.

Research limitations/implications – Whilst there are some grounds for optimism, more research is needed on the use of this technology within educational settings to ensure robust recommendations can be made on the implementation, use and sustainability of this approach.

Originality/value – This paper is the first to consolidate the evidence base for the use of VR/HMD technology to support the needs of the autistic population.

Keywords Autism, Assessment, Learning, Education, Virtual reality, Head-mounted display

Paper type Literature review

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Introduction

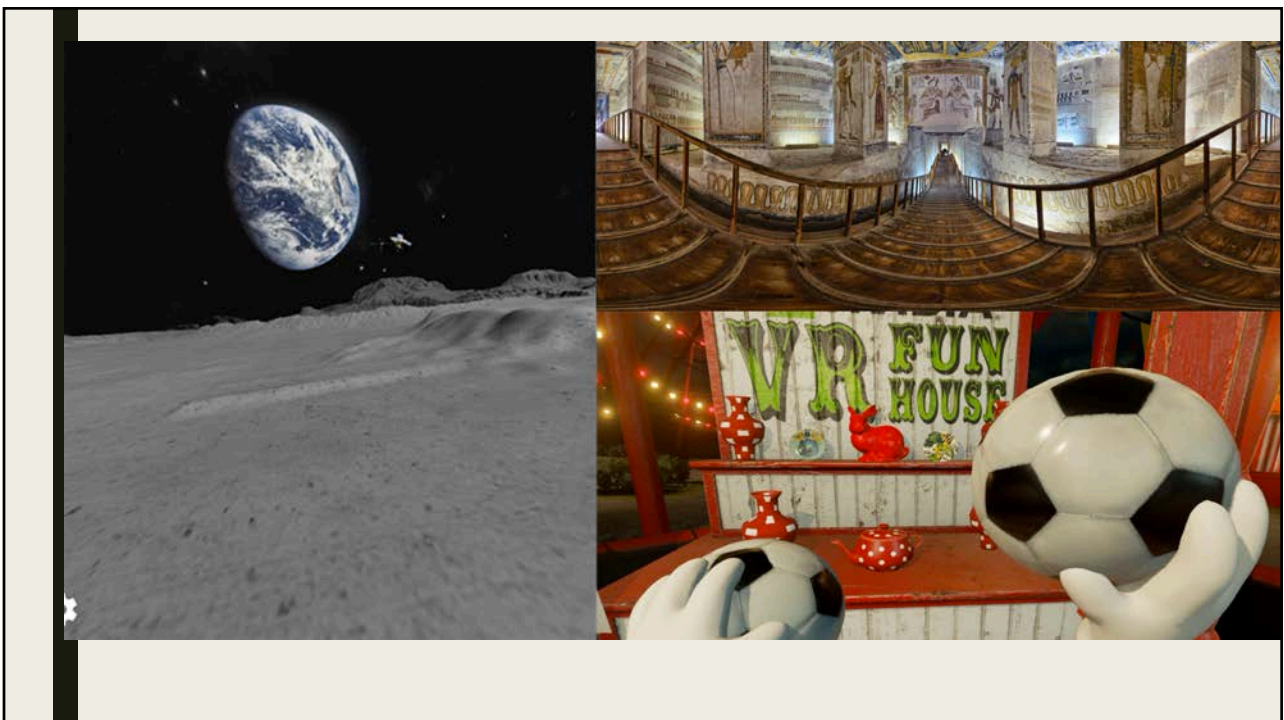
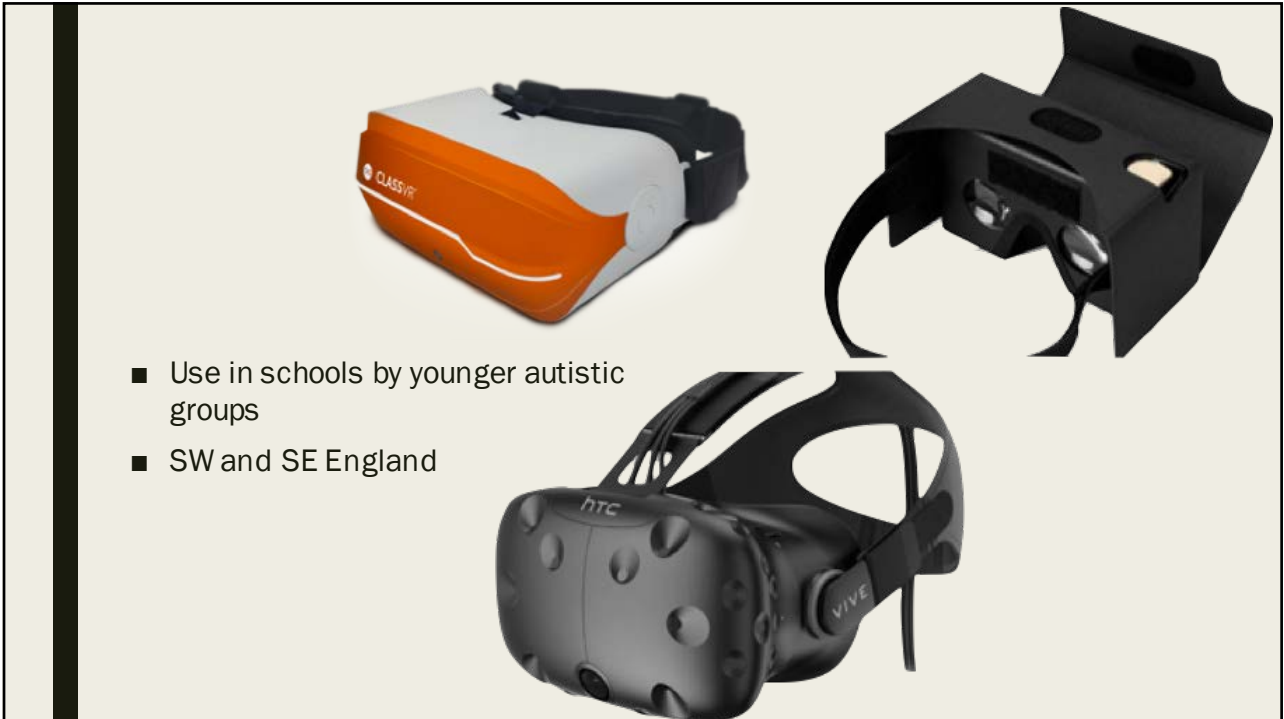
Despite nearly twenty years of research, the potential of VR for autism education still remains an aspiration rather than a reality (Parsons, 2016, p. 1).

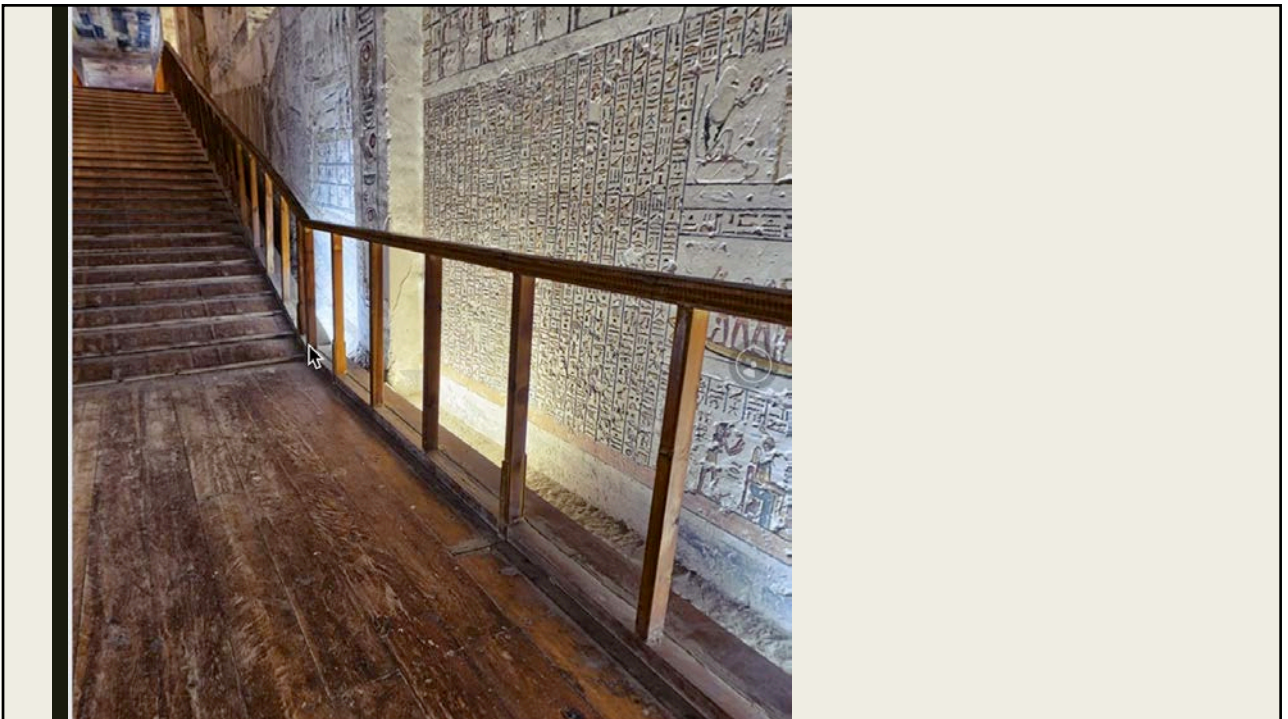
Autism or autistic spectrum disorder (ASD)[1] is a neurodevelopmental condition characterised by core differences in social communication, interaction and repetitive behaviours across a variety of contexts (American Psychological Association, 2013). The last few decades (1990s–2010s) have seen an increase in educational and health-based application studies designed to identify effective support for this population (Fallico et al., 2014). Despite this research, the academic, social-economic and mental health outcomes for children and adults on the autistic spectrum remain poor (Eaves and Ho, 2008). As a result, finding more effective ways to improve outcomes for autistic individuals through effective, and appropriate, applications and approaches remains a research priority for individuals and their families (de Bruin et al., 2013). With approximately 1 in 100 children in the UK (Bugha et al., 2012) and 1 in 66 in the USA (Bao, 2014) receiving a diagnosis, this remains an important issue that needs addressing by a range of stakeholders; education being just one.

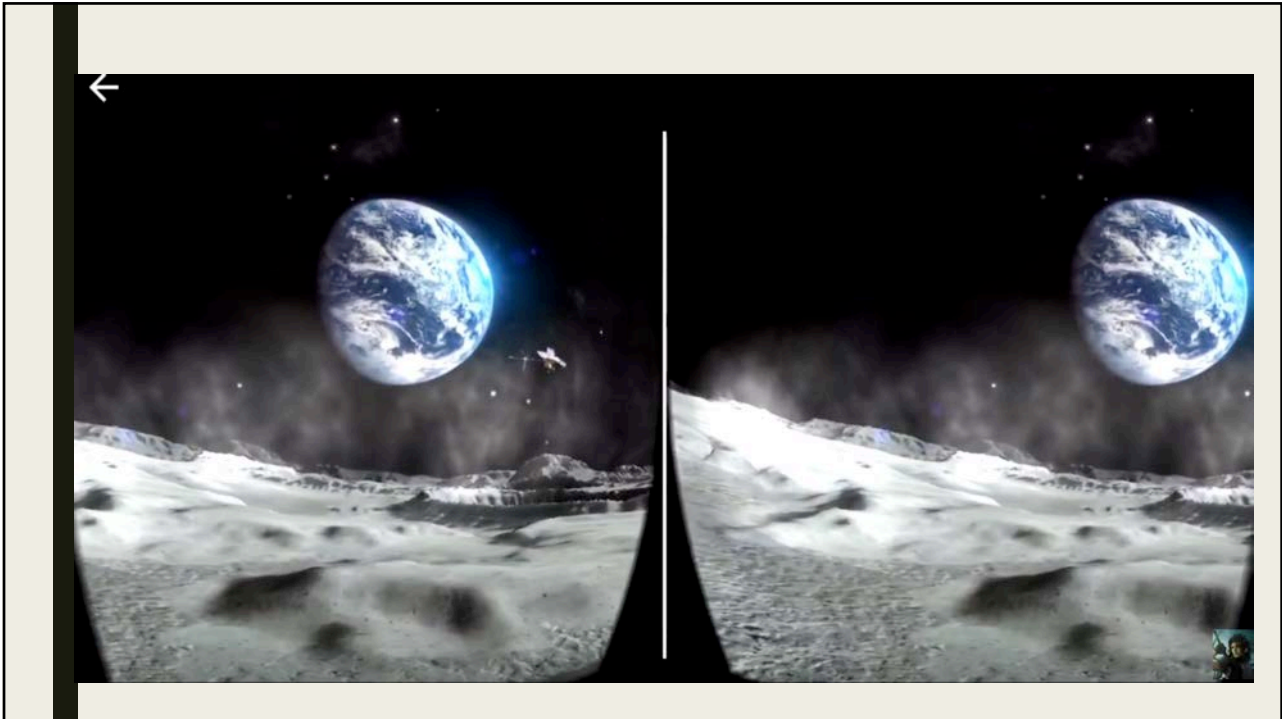
Virtual reality (VR) and education

The rapid growth in the development of VR technologies over the last ten years has seen a strong argument made for its use as an educational tool for children, young people and adults (Newman and Scurry, 2015). Virtual environments (VE) enable users to experience

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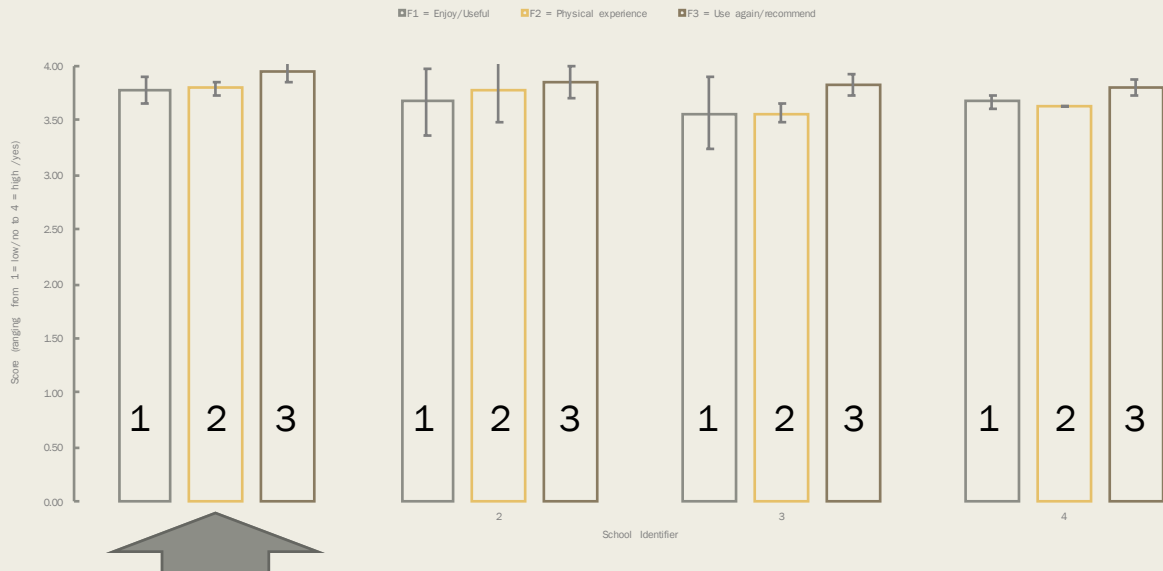
	School A	School B	School C	School D
School Status	Special Educational Needs (TMS)	Mainstream	Mainstream	Special Educational Needs
School Type	Free School - Special	Voluntary Aided School	Academy - Converter Mainstream	Independent School
Education Phase	Primary, Secondary and 16 to 18	Primary	Secondary	Secondary and 16 to 18
Age Range	4 to 19	5-11	11-16	9-18
Number of pupils in whole school	85	89	550	54

	School A	School B	School C	School D	Total
Total (n=) cohort	12	7	16	8	43
Age Range	8-16	6-10	11-14	13-16	6-16
Mean Age	12.4	8.7	12.2	14.5	12
Male (n=)	10	4	9	5	28
Male (%)	83%	57%	56%	63%	65%
Female (n=)	2	3	7	3	15
Female (%)	17%	43%	44%	38%	35%
ASC	100%	43%	50%	100%	73%
TD	0%	57%	50%	0%	27%

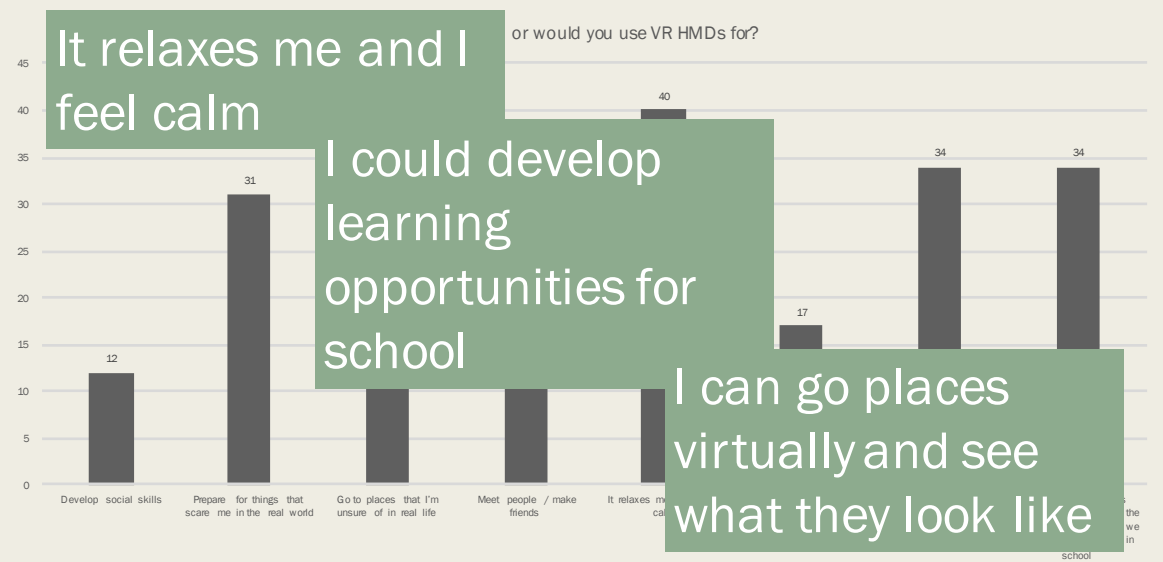


What we found...

Mean reported scores across factors 1 - 3 in the four schools



What we found...



Teacher(s) viewpoint – the good

- “Interactive experiences, tours of visits before the real visit happens, immersive and interactive social stories”
- “...this is the technology pupils have a grasp of and get excited about. We have a duty to include this into their learning experiences”
- “I was amazed at how pupils who don't normally speak to each other began supporting each other and communicating positively toward each other”
- “In subjects like history you would be able to experience the places that might be talked about in order for children to relate more”
- “I think VR would be fantastic for showing autistic children things like school trips before hand or subjects like history and geography”
- “To engage students in their work and make lessons more interesting”
- “Children could learn in a therapeutic environment”

Teacher(s) viewpoint – the challenges

- “Could be difficult to get some students off VR?”
- “Appropriate space in classrooms”
- “Class sizes and experience [ICT experience of teachers]”
- “If it needs to be plugged in it might become more difficult and kids in the classroom might become distracted by it”
- “Costs”

Why is all this important

- It tells us that there is a potential 'good fit' between HMDs, VR and autistic groups – from **their, and their teachers**, perspectives
- That ecological validity is high; as is presence and immersion (ref. links to generalisation)
- Negative effects remain low (ethics, health and safety)
- Excitement and want to used HMDs is very high among autistic groups
- Therefore, the potential for education, life-long skills, access to services are all in urgent need of further investigation
- But how...?

VR and Museum Tour

- Use of a 360 degree VR tour of a local (Bristol) museum tour
- Low-tech and accessible
- Used for the reasons previously outlined (i.e. affordances)
- Help to assess if the VR app could:
 - *Support a visit to a new/unusual space for autistic children*
 - *Be applied / used in a classroom before a real visit to the museum*

VR and Museum Tour



- Bristol VR Lab (300k LEP funding, among others)
- Collaborated with Bristol VR Lab resident
- GoVirtually (SW-based)
- A pilot study

VR and Museum Tour



VR and Museum Tour



VR and Museum Tour

- 11 autistic children in a school setting
- Age ranged from 10-14 (with a mean age of 12.4)
- **Process involved:**
 - Answered questions related to their experiences of visiting museums/cultural spaces (2-3 mins.)
 - They had the chance to experience the museum tour using a VR 360-degree app (using cardboard googles) (5-10 mins.)
 - Completed follow up questions about their experience of the VR app (2-3 mins.)
 - 4 days later visited the same museum in real life (4 hours)
 - The next day completed a post museum visit questionnaire related to their experiences (5 mins)
- At all points the participants were checked for any signs of 'cyber-sickness' or negative effects (feeling unwell, eye strain, etc..) when using the VR app. Teachers helped to ask the questions and performed the post-questionnaire survey

VR and Museum Tour

Question asked	Mean score	SD
Did you enjoy the VR app?	3.5	0.53
Was the app relaxing to use?	3.9	0.32
Did the VR app help prepare you for your visit?	3.5	0.53
Has the app helped you to understand what to expect?	3.8	0.42
What was the physical exp. of wearing the HMD like?	2.8	0.79
I feel less worried about visiting now?	2.7	1.06
Would you like to use the VR app more?	3.3	0.95
Might the VR tour help before you visit the place?	3.1	0.99

VR and Museum Tour

Question asked	Mean score	SD
I enjoyed visiting the museum?	3.6	0.52
I found it to be loud and distracting?	2.2	1.14
I found it to be confusing and I got lost?	1.7	1.06
Having used the app before I knew where things were?	3.6	0.70
Using the app first helped me to visual the space before I visited?	Yes=9, N=1	
Using the app first helped me to feel more relaxed?	3.5	0.71
The VR app helped me to enjoy the visit more than if I hadn't	Yes=8, N=2	

VR used to support a museum visit

- Interesting points included?
 - *Using the VR app helped to **calm** and **relax** the children*
 - *Using the VR app seemed to help the children know **what to expect** before they visited the real world museum*
 - *The VR app might have helped to **alleviate issues of confusion** when visiting in real life*
 - *The VR app was reported as helping the children to **visualize the space** before visiting in real life*
 - *Reports of museums being **distracting** were similar before and after the visit (but can perhaps be managed)*

Overall and using VR in schools

- The use of low-tech options **could** prove useful
- Experiment by downloading some free content that links with curriculum (i.e. history, geography, English, visits)
- Using a smartphone with a £5 'Google' cardboard option has proven to be useful, meaningful and reported as comfortable to wear
- Consider using VR for calming/reducing issues in the classroom/a change of sensory experience

“How can I use VR in my school... What do I need to know...?”

- You'll need some space, time and chance to 'try' things
- Using a cardboard HMD is fine / adequate
- We've found very limited (if any) reasons to believe using a HMD would be in any way negative (although do be careful)
- Using a Youtube app (360 VR content) coupled with a smart phone (and cardboard HMD) can be a great combination to start with (moving to bespoke VR apps later)
- Trying a range of content (i.e. history, science, geography, social scenes, etc...) have worked well in classrooms in our projects
- Finding a selection of 'relaxing' content is advised (and trying this to support autistic students)
- You (teachers/facilitations/TAs) will need to invest some time researching what content is best/most suitable for your students – there is currently no one-size-fits-all yet (or recommendations for what to use when and with whom)

“Bridging the gap – getting VR into schools”

- Identify the/a need – what do you want to use it for?
- Identify what you're currently doing – are you doing anything about it and how effective is it? (i.e. travel training)
- Researching the available and appropriate options – costs and working with other schools /wider VR community (schools, universities, developers)
- Bid for equipment; training needs and benefits to pupil community (trial)
- Staff training and commitment to using and deploying
- 5 year cycle in terms of “results” – continue training and “stick with it”
- Cost issue; For academy trusts – how can the costs be split; to promote collaboration and further development

Moving the field forward – and quickly?

- We need **collaboration**; sounds obvious, but is something this area can't grow, scale and have impact without!
- We need **evidence**; evaluation of the work ahead is vital
- We need **content**; hardware is freely available and can be used in classrooms/centres/the home, but content is lacking
- **Aligned** to evidence; we need to ensure that content is aligned well to evidence. If VR can be beneficial; how, where, when, what, etc..
- **Involve autistic** communities and groups; why would we not?
- **Access**; placing tech in the hands of the users... (funding and scaling)

- Thanks for the invitation to speak today
- Questions...?

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