Position paper - the impact on future education of multisensory interfaces

With recent developments in sensory technology, it is easy to envisage a near future where education will adopt mixed reality solutions, overlaying the learning environment with digital augmentation and multisensory interfaces. This combined with the possibilities of creating interfaces for interaction with familiar objects in the Internet of Things, where having a conventional screen as a graphical user interface has become redundant. 'Often, the interface is seen as a connector, as a seamless rendering of interoperability, and as a way by which the web becomes accessible to us' (Ashton, 2009). What seemed impossible can become a reality. Imagine if a fire broke out around you, and the extinguisher, positioned in your environment senses it is an electrical fire, alerts you, speaking instructions to guide the user on how to put out the fire and at the same time alerts the fire station. The possibilities are endless.

Can there be too much reality? And are there unintended consequences of creating mixed reality learning environments that immerses the participant in a sensory world?

Children today are ever increasingly exposed to digital technology. A toddler throws a tantrum in public and a parent reacting by handing the child a smartphone - the 'digital pacifier' (Burke, 2017). A common event in a hectic world, that technology can substitute real human connection. Connection to technology can cause disconnection from self, others, nature and inner spirit. Rowan states that 'self-development and identity formation follow the occupational premise that 'you are what you do'. (Rowan, 2014) (p. 244). Excessive TV watching, playing video games and little physical social connection means this becomes the norm. VR and AR technologies are in plain sight in smart phones apps and browsers, Google 3D and as features of social media. They have become a part of today's digital communication. Going outside, wellbeing and mindfulness practices seem at odds in a digital age with the 'fear of missing out'. Digital habits continue into the adult life of millennials and Gen Zs, threatening an epidemic of psychological disorders. Popular VR solution provider Oculus recommend 30 minutes with a 10-15 minute break between sessions to prevent sensory overload (Oculus, 2020). In the privacy of a home, who controls usage time?

VR and AR technologies are being adopted in education, a natural progression and almost expected by students. My own organisation purchased ClassVR (ClassVR, 2020) sets in 2018 after a demonstration at BETT educational tradeshow, London. After a conversation with the IT Manager, ClassVR's ability to be controlled in sets by the teacher, allowing classroom management became the deciding factor. Oculus Rift was rejected as it could allow the unintended consequence of access to a vast array of online materials, outside the field of education! Alas the materials are still basic compared to the game modules. VR is not quite the 'go to' EdTech device and 'too much reality' has not become an issue - yet.

In 'Framework for affordance in Virtual and Augmented reality', Steffen notes 'VR's features also create disadvantages, the most prominent being the lack of haptic richness that the physical world provides, or "vividness" (Slater and Wilbur, 1997). If a certain experience requires high haptic richness and VR technologies struggle to recreate that, the sense of presence will suffer' (Steuer, 1992). Steffen looks to the future that the gap between the virtual and physical will be a less of a concern and that 'Perhaps VR's best uses are those where knowledge or experience gained outside

physical reality's context can later be used to bring benefit to the physical world, whether through some learned skill or through an improved emotional or mental state'. (Steffen, et al., 2019) (p.690)

The psychological implications are still a concern. Imagine being placed in a learning environment developed by others and there is no understanding of the participant's life history. Could it trigger unpleasant past experiences? What about the ethics if the developer's virtual reality is flawed or out of context for the participant's physical reality? In a simulation of dangerous environment such as a fire or accident is it possible to account for all the variables that can occur? Can commercial bias, persuasion or manipulation be an issue?

If the adoption is so beneficial yet the processing power and cost is prohibited – does a divide appear that some institutions or participants miss out on the opportunity. With the data analytics generated, there are questions on how participant reactions are traceable and the implications on their future life choices. And what if 'real' is good enough? In vocational training, having a trainer or teacher to question can be reassuring and fosters human connection as the learner develops skills. A simulated reality in an imagined multi-sensory environment may have the capability for external intervention. Dufva and Dufva point out that 'The programmable and reprogrammable nature of digital technologies, as well as the possibility to gather and analyse data, instils more agency into the digital technology. Furthermore, the flexibility and adaptability of code connects humans (Dufva & Dufva, 2019) (p. 17). What if this agency has commercial value and who benefits?

For Multisensory-Enabling Technologies (METs) to be developed effectively, the concept of 'Digi-grasping' should be applied as an approach to coding and the manipulation of the digital world. 'Digi-grasping is active, embodied sense-making and existing in the interface between the digital and physical worlds. We argue that by paying more attention to the modes of being and ways of acting in the digital world, it is possible to create a stronger ethical and aesthetic connection between the digital technologies and society'. (Dufva & Dufva, 2019) (p. 18). Although this is not directly in the context of the imagined MET, it may lead to foundations for future interfaces. Dufva and Dufva reference Merleau-Ponty's use of 'the term grasping to point to an activity that is intentional but not necessarily conscious. It is possible to grasp something before knowing it; through the body, humans comprehend not only the spatiality of position but also the spatiality of the situation' (Merleau-Ponty, 1945). METs of the future will inevitability be designed with the intention that 'the digital is invisible: humans are often not aware of the systems, their characteristics, their purpose, or the assumptions built into them, nor how these systems shape their behaviour' (Dufva & Dufva, 2019). Future developers should be aware that 'not only are we transformed by the way we use our tools; we are not aware of how we are being transformed, so we need all the more to try to make explicit what the Net is doing for us and what it is doing to us in the process.' (Dreyfus, 2008). In the development of METs 'Digi-grasping is not a measure of the rational knowledge of digitality but rather a concept for thinking about and analysing the embodied experience of digitality' (Dufva & Dufva, 2019) (p.23). This reinforces my concerns to what is presented in a future MET experience and developers must consider their responsibility to users.

Petit et al's research paper into Digital Sensory Marketing: integration into Multisensory Online Experience highlight how visual-enabling technology has the potential to build upon mental imagery. This is especially interesting if incorporated into future METs. 'The new visual-enabling technologies are likely to enhance this sensation of immersion. 3D images give the user the feeling of being able

to interact with the product itself, and thus stimulate mental simulations of product interaction' (Hairong, et al., 2001). However, the visual elements incorporated into future METs must be appropriate, and non-biased. Returning to the question of reality being too real, the user's own experience may influence their reaction. What if during a Health and Safety simulation, the participant encounters a mixed reality incident triggering Post Traumatic Stress Disorder? Would a future MET be able to monitor reactions to abort the simulation if the participant reacts adversely? Petit, Velasco and Spence's research into METs, includes haptic enabled devices and predict their addition to the consumer's online experience, the ability to feel a product reinforces an interest to purchase. There is no reason why this cannot be applied in a future MET. It follows thinking that 'Cross-modal mental imagery has been considered as a form of perceptual completion and might thus be used to fill in the missing features through the Internet (Spence & Deroy, 2013). (Petit, et al., 2019) (p. 51). Imagine a virtual reality of semantic congruency in which pairs of stimuli in different sensory modalities share common identity or meaning (e.g. woofing sound paired with a static picture of a dog) (Petit, et al., 2019). What if this pair of stimuli amplify sensory negative unintended consequences? 'Cross-modal correspondences and semantic congruency have been shown to influence performance across a range of different tasks (e.g., speed of detection, perceptual discrimination) that can be relevant to make decisions in the online environment' (Spence, 2011). What if there are unpredicted triggers within a future MET that create unexpected actions in different individuals – will these devices have self-regulation controls, machine learning or shutdown procedures build in?

In a personal suspicion of future METs and the potential 'realities' on offer; of all to be considered most worthy is the use of haptic technologies. This may open mediums of communication to those who would need an alternative way of engaging or understanding their environments. The importance of touch has been highlighted as a major factor in human connection during the current Covid pandemic and the rising issues mental health from social disconnection. The Touch Test: The Results on BBC Radio 4 reveals the results of joint venture with Wellcome Collection in January 2020. Close to 40,00 people from 112 countries took part to study attitudes to touch. The premise is that 'Touch is said to be the first sense to develop but is it also the most underrated?' (BBC, 2020). If this is the case the use of haptic devices, such as Ultraleap's Stratos systems (Ultraleap, 2020) will have a place in future METs. Mid-air experiences can be useful for those with visual impairment or some learning disabilities.

In Baragash et al's research, into Augmented Reality as an effective method of improving individual's participation of society, 'The findings indicated that AR could be implemented to support individuals with special needs by teaching them a variety of skills for different social, living, physical, and learning purposes' (Baragash, et al., 2020). Domains that were found to have seen benefits to individuals were as follows: *Social skills domain* – those lacking in intuitive comprehension, social situations, maintaining conversations were able to use innovative tools, and saw improvement in social skills development, positive behaviour, developing recognition of facial expressions, appropriate greetings. *Daily living skills domain* – helping to develop skills to control their environment possibly leading to independent living, although this was the lowest effect of all 4 domains. *Physical skills domain* – where body motion-related activities, helped those with cognitive and developmental disabilities. *Learning skills domain* - in using AR applications for maths, science and new words acquisition vocabulary learning found a significant improvement in motivation and

understanding. From a negative point of view current commerce AR applications for children such as 'Cosmic Clio' (Milk, 2019) with a fantasy character guiding the individual on a quest of reading and activities, may prohibit a child from using their own imagination. The fantasy is prescriptive and cliched. Personally I have not recovered from watching the first animated version (Watership Down, 1978) of Richard Adam's Watership Down (Adams, 1972) during the 70s as it destroyed my image of Hazel the rabbit!

The proposed OER, is not directly a critique of the future possibilities of sensory augmentation to mixed reality, it is designed to form a starting point to think about a future with enhanced interfaces in a near future. It is likely that some participants will not have encountered forms of VR or AR. There are some in plain sight, hidden on smart phones lurking behind the camera lens such as Google 3D. There are cheap solutions such as dump VR headset shells to slip a phone into to create a sophisticated VR headset.
Module one - The OER will start with a brief timeline of interactive technologies and some background reading. Via a Padlet activity will be the opportunity to share your experiences with using VR and AR.
Module two - will move onto several exercises using personal phones and a stretch and challenge of creating a simple merge cube. The purpose is to appreciate how powerful smartphones really are and step into AR and VR. Via a Padlet activity will be the opportunity to present some of the AR experiences you have created and upload them to show others. A discussion on how you can use a smartphone in an education setting to foster social-connectivism and constructivism.
Module three – will move on to talking about touch as sensation. There will be further readings and recording to listen to. Via a Padlet activity there will be the opportunity to reflect on the importance of building sensory interfaces into digital learning environments of the future.

References

Adams, R., 1972. *Watership Down.* London: Rex Collins.

Ashton, K., 2009. *That 'Internet of Things' Thing.* [Online]
Available at: http://www.rfidjournal.com/articles/view?4986
[Accessed 03 11 2020].

Baragash, R., Al-Samarraie, H., Alzahrani, A. & Alfarraj, O., 2020. Augmented reality in special education: a meta analysis of single-subject design studies. *European Journal of Special Needs Education,* 35(3), pp. 382-397.

BBC, 2020. *The Touch Test: The Results.* [Online]
Available at: https://www.bbc.co.uk/programmes/m000n5xx
[Accessed 04 11 2020].

Burke, J., 2017. *It's time to admit that screens are just digital pacifiers.* [Online]
Available at: https://thefederalist.com/2017/05/25/time-admit-screens-just-digital-pacifiers/

ClassVR, 2020. *Virtual Reality Health & Safety Usage Guide.* [Online]
Available at: https://www.classvr.com/health-and-safety/

Dreyfus, H. L., 2008. *On the internet (second edition). New York: Routledge..* New York: Routledge.

Dufva, T. & Dufva, M., 2019. Grasping the future of the digital society. *Futures,* pp. 17-28.

Hairong, L., Daugherty, T. & Biocca, F., 2001. Characteristics of Virtual Experience in Electronic Commerce: A Protocol Analysis. *Journal of Interactive Marketing, 15, 3.,* p. 13–30.

Merleau-Ponty, M., 1945. *Phenomenology of perception. Routledge.* s.l.:s.n.

Milk, C., 2019. *This 8-Minute Galactic primer is the Future of AR Education.* [Online]
Available at: https://www.wired.com/story/how-we-learn-augmented-reality-wonderscope/
[Accessed 04 11 2020].

Oculus, 2020. *Oculus Rift Health & Safety Manual.* [Online]
Available at: https://www.oculus.com/safety-center/rift/
[Accessed 04 11 2020].

Petit, O., Velasco, C. & Spence, C., 2019. Digital Sensory Marketing: Integrating New Technologies Into Multisensory Online Experience. *Journal of Interactive Marketing,* pp. 42-61.

Rowan, C., 2014. The impact of technology overuse on child sensory development. In: *Learning in a digitalized age.* Woodbridge: John Catt Educational Ltd, pp. 239-255.

Spence, C., 2011. Crossmodal Correspondences: A Tutorial Review. *Attention, Perception and Psychophysics,* 73(4), pp. 971-95.

Spence, C. & Deroy, O., 2013. Crossmodal Mental Imagery. In: *Multisensory Imagery.* New York: Springer, pp. 157-83.

Steffen, J. et al., 2019. Framework of Affordance for Virtual Reality and Augmented Reality. *Journal of Management Information Systems,* 36(3), pp. 683-729.

Steuer, J., 1992. Defining virtual reality: Dimensions determining telepresence. *Journal of Communication,* p. 73–93.

Ultraleap, 2020. *Touch is going virtual.* [Online]
Available at: https://www.ultraleap.com/haptics/
[Accessed 4 11 2020].

Watership Down. 1978. [Film] Directed by M Rosen. United Kingdom: s.n.