

The New Dawn of Education: Exploring the Conceptual and Experiential Possibilities of Immersive Virtual Reality

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IMMERSIVE LEARNING STUDIO

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[about](#)

[highlights](#)

[events](#)

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**Australian
National
University**





'TRON' - WALT DISNEY MOTION PICTURES



c|net

A photograph of Mark Zuckerberg, the CEO of Facebook, wearing a dark suit, white shirt, and red tie. He is standing on a stage with a blue background and a banner that partially shows 'AP'. He has his arms slightly out to the sides.

INDY/TECH

MARK ZUCKERBERG SAYS VIRTUAL

REALITY IS BETTER THAN THE 'LIMITED'

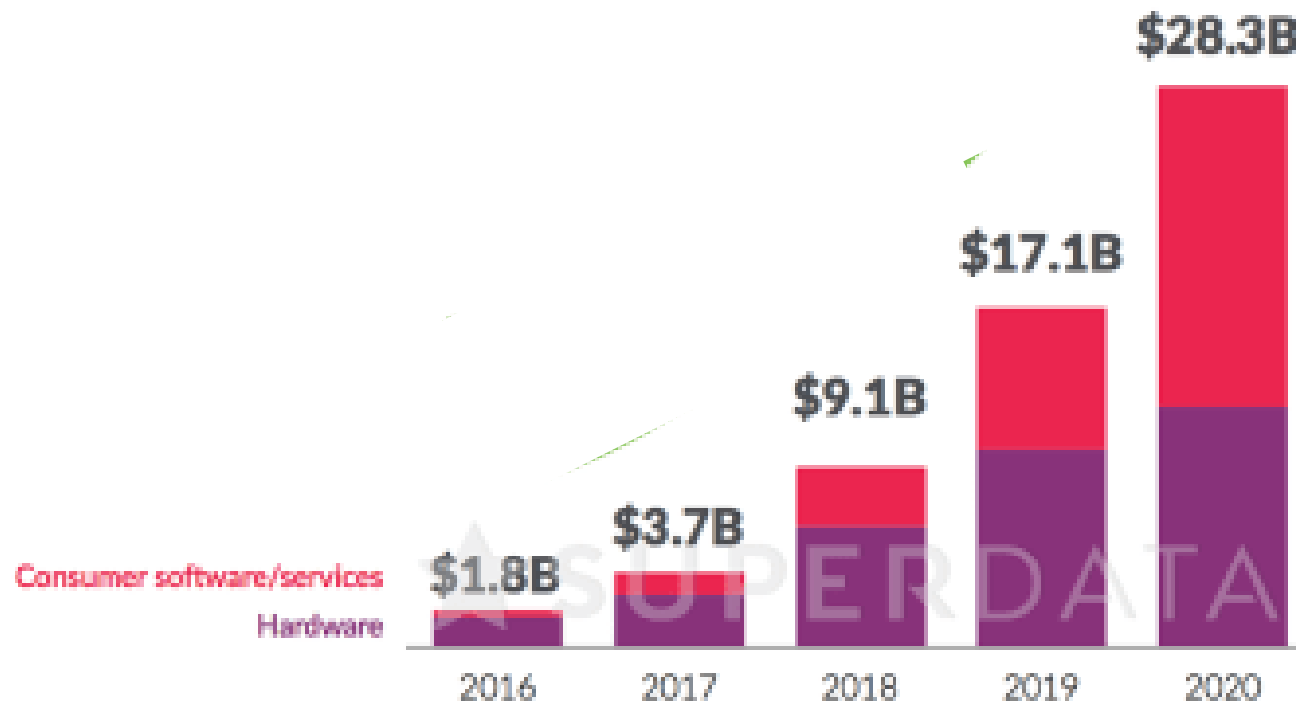
REAL WORLD

Ubiquitous?

The Virtual Market

Virtual Reality consumer revenue by segment: 2016-2020E

Billions of USD, worldwide



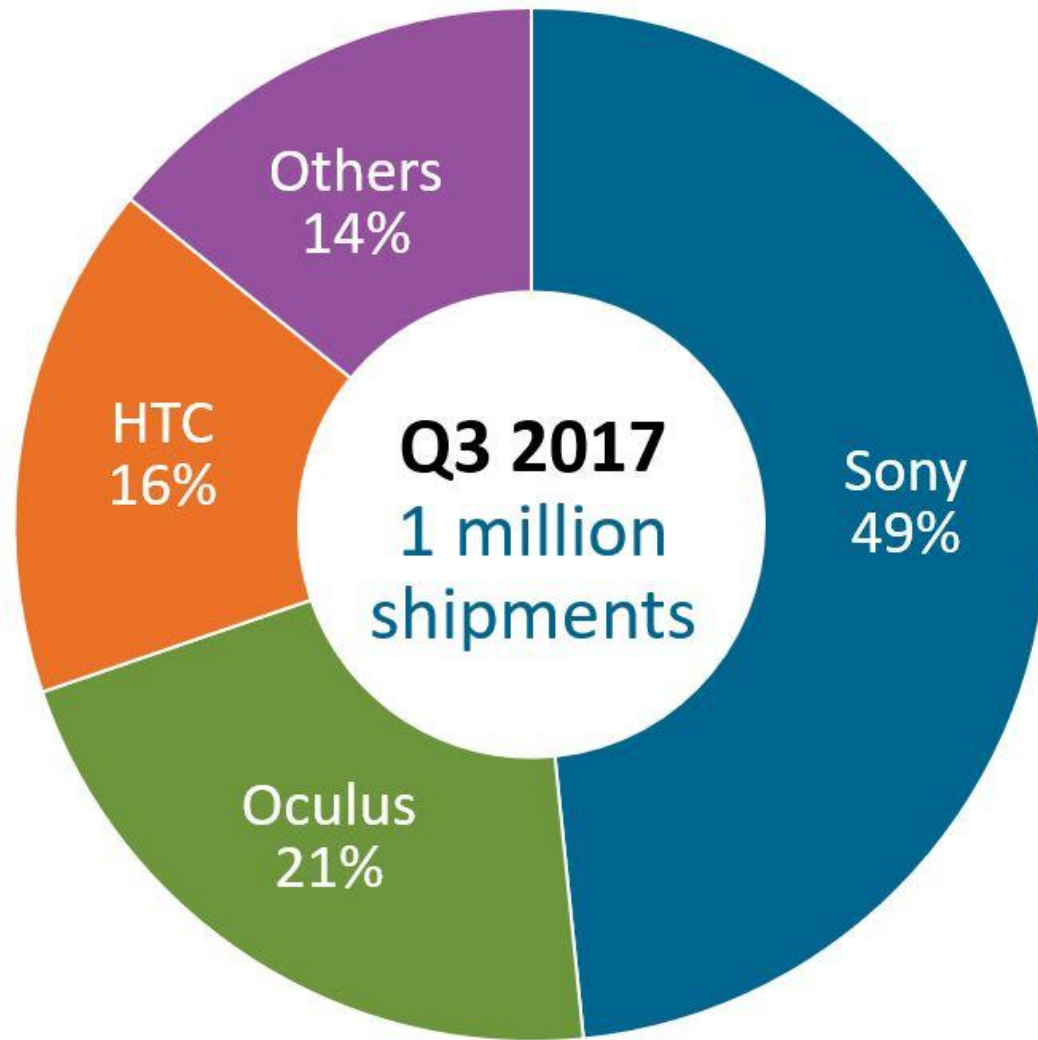
Total earnings will rise 106% from 2016 to 2017.

VR software revenue will reach \$16.1B by 2020, surpassing hardware earnings for the first time.

Barriers for VR

- Cost
- Awkwardness of the technology
- Lack of broad exposure
- Content

Strong demand for VR headsets after price cuts



Global VR headset market ranking



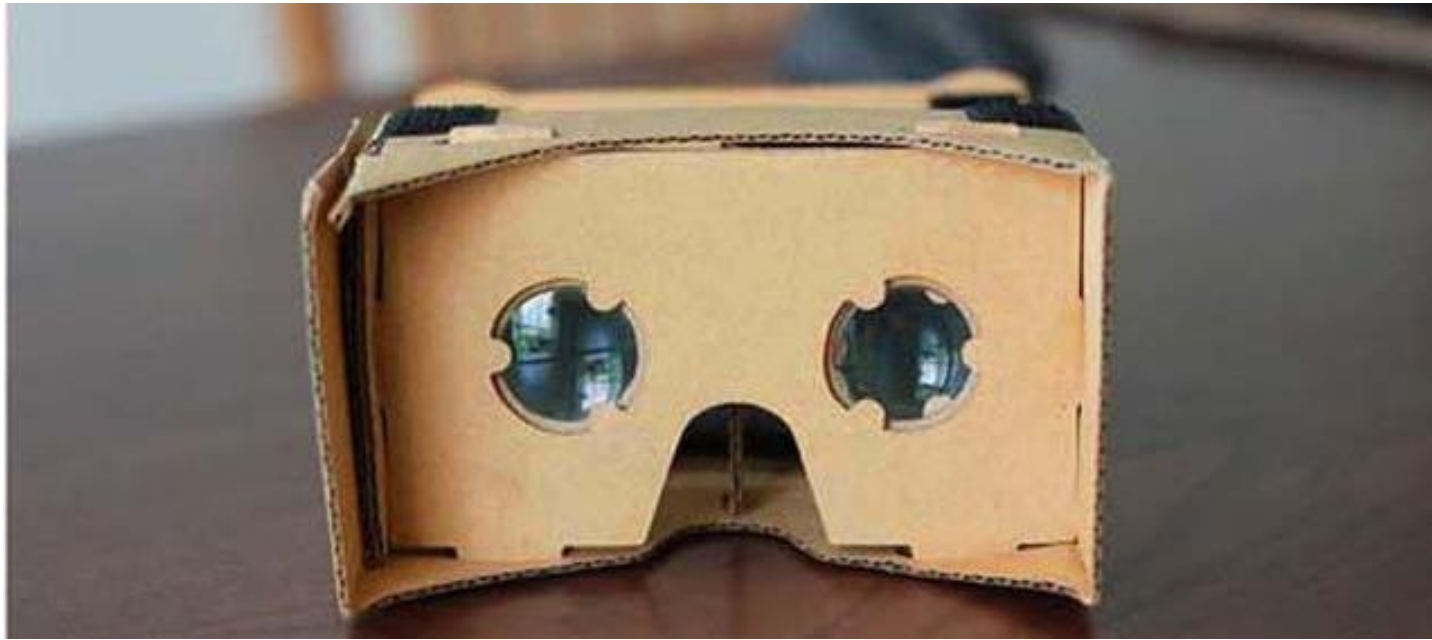
Q4 2017 VR headsets: new pricing



Source: Canals estimates, Virtual Reality and Augmented Reality Analysis, November 2017

*The US\$399 price now includes the PlayStation Camera, which was previously omitted





....low-end experiences like Google Cardboard are actually doing *way* more harm than good because to the uninitiated Cardboard seems a close approximation of VR but to the rest of us that know better, let's be honest, Cardboard is [insert poop emoji]

[Jay Kapoor VC @ LaunchCapital](#)



VR Content

- Variations on 360 Video
(Volametric video)
- Synthetic worlds









IKinema technology with raw data from 6 Trackers without ANY post production





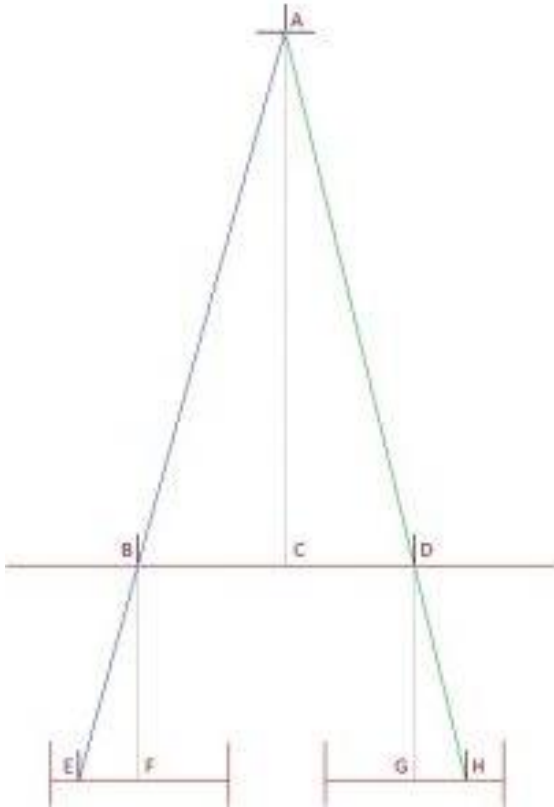


FORCE SENSITIVITY (EX. 2)



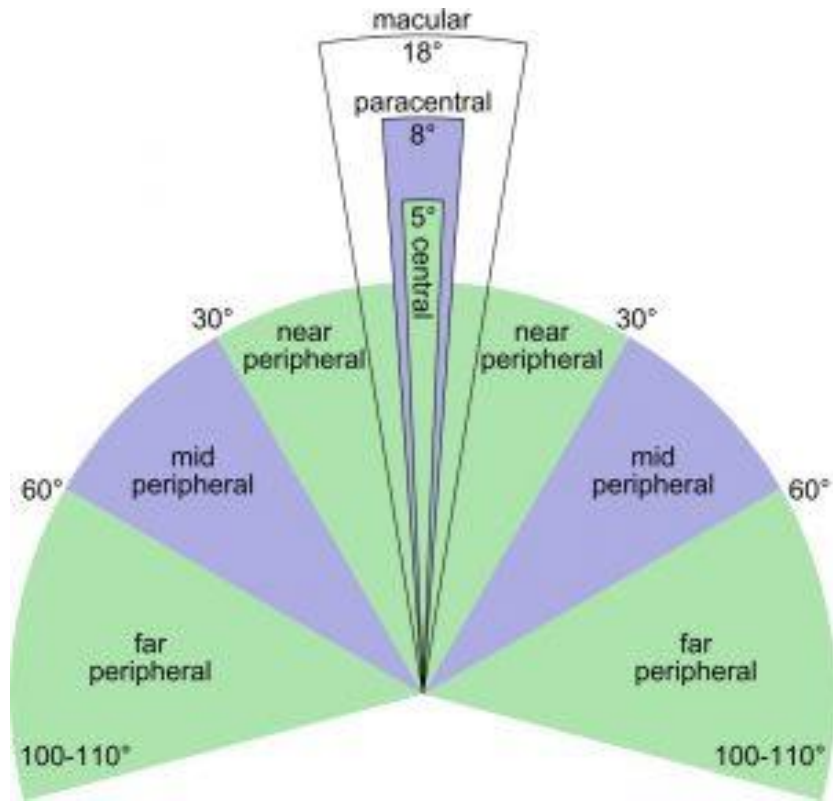
Social interaction: speech, movement, and emotional expression





Stereoscopic Vision

By Thepigdog (Own work) [CC BY-SA 3.0 <http://creativecommons.org/licenses/by-sa/3.0/>], via Wikimedia Commons



Field of View

CC BY-SA 4.0 File: Peripheral vision.svg
Created: 29 November 2014



Spatial Audio

Am3d. (n.d.). 3d_300x287 [Representation of 3d sound system]. Retrieved February, 2017, from <http://www.am3d.com/home-english/products/zirene%C2%AE-3d.aspx>

Proprioception



INFINITE REALITY

The Hidden Blueprint of Our Virtual Lives

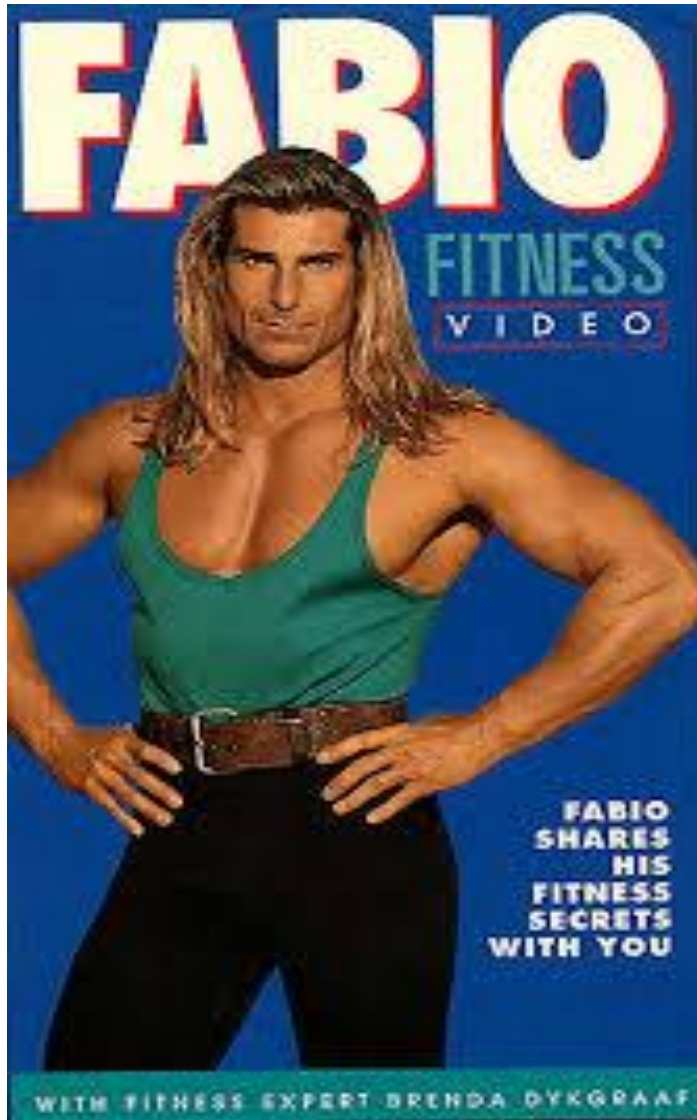
"An exhilarating book. . . Blascovich and Bailenson are ideally situated to write this guide to the new world. . . A must-read." — *Los Angeles Times*

JIM BLASCOVICH and JEREMY BAIENSON

UC-Santa Barbara

Stanford University

P.S.
INSIGHTS,
INTERVIEWS
& MORE...



Immersion & Presence

Csikszentmihalyi - Flow

Narrative (Qin 2008)

Interactivity

Immersion

“The combination of complete visual replacement and headphones isolated me from the outside world very effectively. The perspective vision has a very powerful effect but perhaps the key to the whole thing were the controllers which let me interact with the virtual world. Virtual hands were displayed in my visual field and the motion of them/the controllers matched my proprioception which had such a strong effect on the immersion. I found my engagement so strongly dependent on the smooth and accurate tracking of those controllers though.”

Consider the following VR experiences

- [experiencing the launch of the Apollo 11 mission](#)
- [experiencing autism](#)
- Why was it “engaging” or could be “engaging”?

How are immersive technology and cognitive capabilities reshaping teaching & learning?

- Experience (Immersive & Presence)
- Emotional elements of learning
- New cognitive models?
 - learning as an ontological process of “becoming” (cognitive development models)
 - Embodied cognition

Experiential Learning: (Kolb 2014)



- Learning is a Process
- Learning is Relearning
- Resolving Cognitive Dissonance
- Holistic Process
- Our Experiences Shape Us
- Learning is creating knowledge.

Learning is a Process

Learning is best conceived as a process, not in terms of outcomes. To improve learning in higher education, ... education must be conceived as a continuing reconstruction of experience ... the process and goal of education are one and the same thing.' (Dewey 1897: 79)

Learning is Relearning

Learning is best facilitated by a process that draws out the students' beliefs and ideas about a topic so that they can be examined, tested and integrated with new, more refined ideas.

Resolving Cognitive Dissonance

Learning requires the resolution of conflicts between dialectically opposed modes of adaptation to the world. Conflict, differences, and disagreement are what drive the learning process. In the process of learning one is called upon to move back and forth between opposing modes of reflection and action and feeling and thinking.

Holistic Process

Learning is a holistic process of adaptation. It is not just the result of cognition but involves the integrated functioning of the total person – thinking, feeling, perceiving and behaving

Our Experiences Shape Us

“Learning results from synergetic transactions between the person and the environment. Stable and enduring patterns of human learning arise from consistent patterns of transaction between the individual and their environment. The way we process the possibilities of each new experience determines the range of choices and decisions we see. The choices and decisions we make... determine the events we live through, and these events influence our future choices. Thus, people create themselves through the choice of actual occasions they live through. ”

Learning is creating knowledge.

Experiential learning draws on a constructivist theory of learning whereby social knowledge is created and recreated in the personal knowledge of the learner. This stands in contrast to the 'transmission' model on which much current educational practice is based where pre-existing fixed ideas are transmitted to the learner.

THE MANY EMOTIONS OF MISTER SPOCK

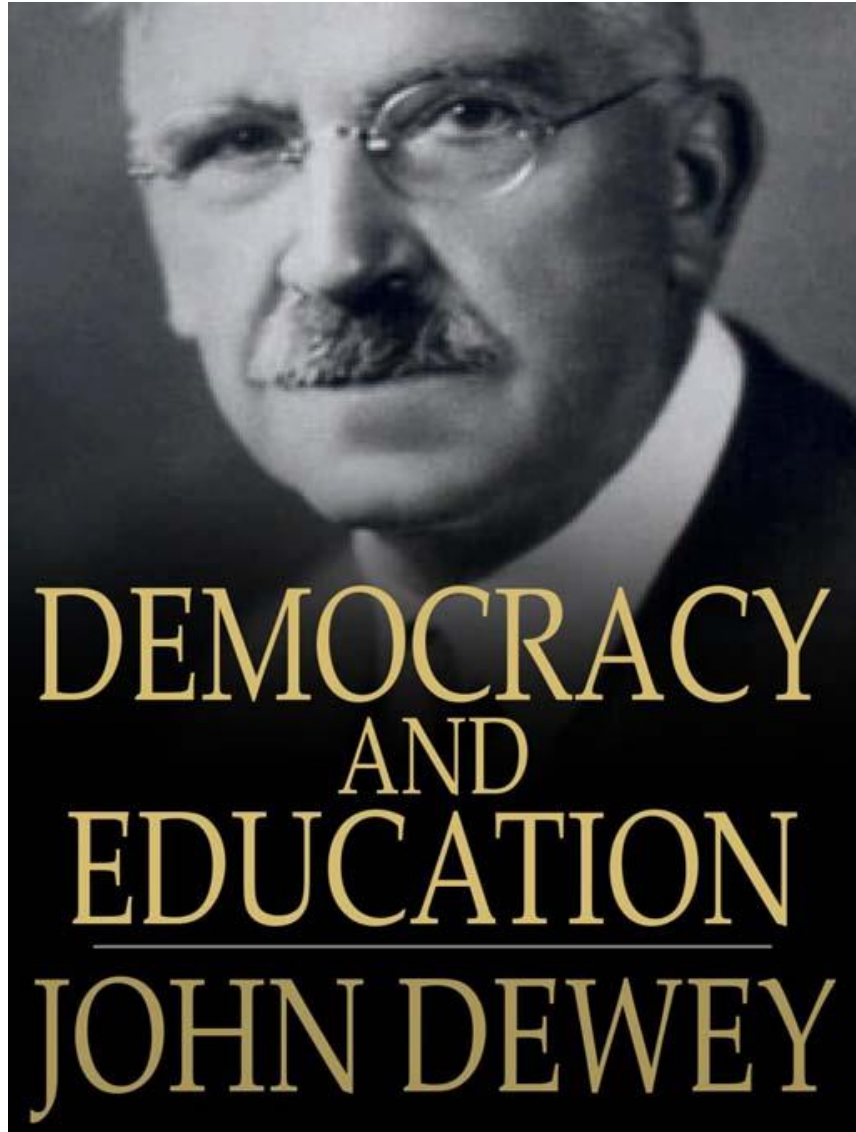


STAR TREK™

Tyng, C. M., Amin, H. U., Saad, M. N., & Malik, A. S. (2017). The influences of emotion on learning and memory. *Frontiers in psychology, 8*, 1454.

New Cognitive Models?





“Since education is not a means to living, but is identical with the operation of living a life which is fruitful and inherently significant, the only ultimate value which can be set up is just the process of living itself.” (John Dewey *Democracy and Education*, 1916, p. 239)

Pope Francis Shocks World, Endorses Donald Trump for President, Releases Statement

TOPICS: Pope Francis Endorses Donald Trump



THE NEW YORK TIMES BESTSELLER

THE FILTER BUBBLE

What the Internet is
Hiding from You



'Explosive'
Chris Anderson

'Astonishing'
Andrew Marr

ELI PARISER 



Individual
Choice

Individual choices more than algorithms limit exposure to attitude-challenging content in Facebook. (Baskshy 2015)

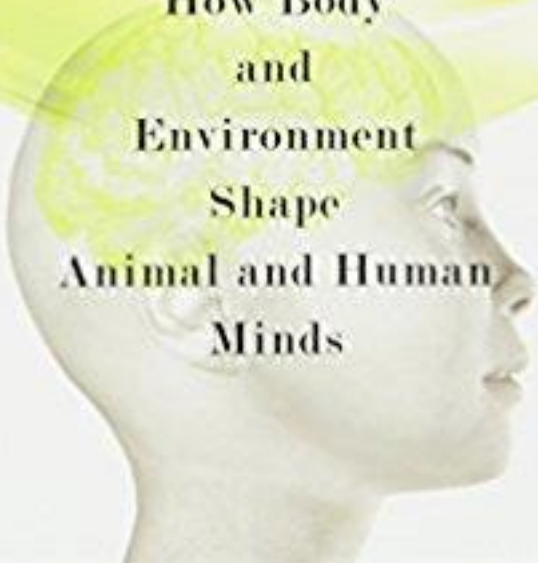
Embodied Cognition

- How we use our body influences how we think.
- Our sensory experiences appear to be regulated by multisensory modulations.
- The very structure of reason itself comes from the details of our embodiment. We can only know by doing.
- Our bodies think as whole, thinking is not a thing the brain does, it is an embodied action.

LOUISE BARRETT

BEYOND THE BRAIN

How Body
and
Environment
Shape
Animal and Human
Minds



PROSTHETIC MEMORY

THE TRANSFORMATION OF
AMERICAN REMEMBRANCE
IN THE AGE OF MASS CULTURE

ALISON LANDSBERG

3 MODELS FOR IMMERSIVE LEARNING

The Old: Skills Based

Teaching a skill based on a simulation of the practical activity itself.



The Current: Knowledge-Based

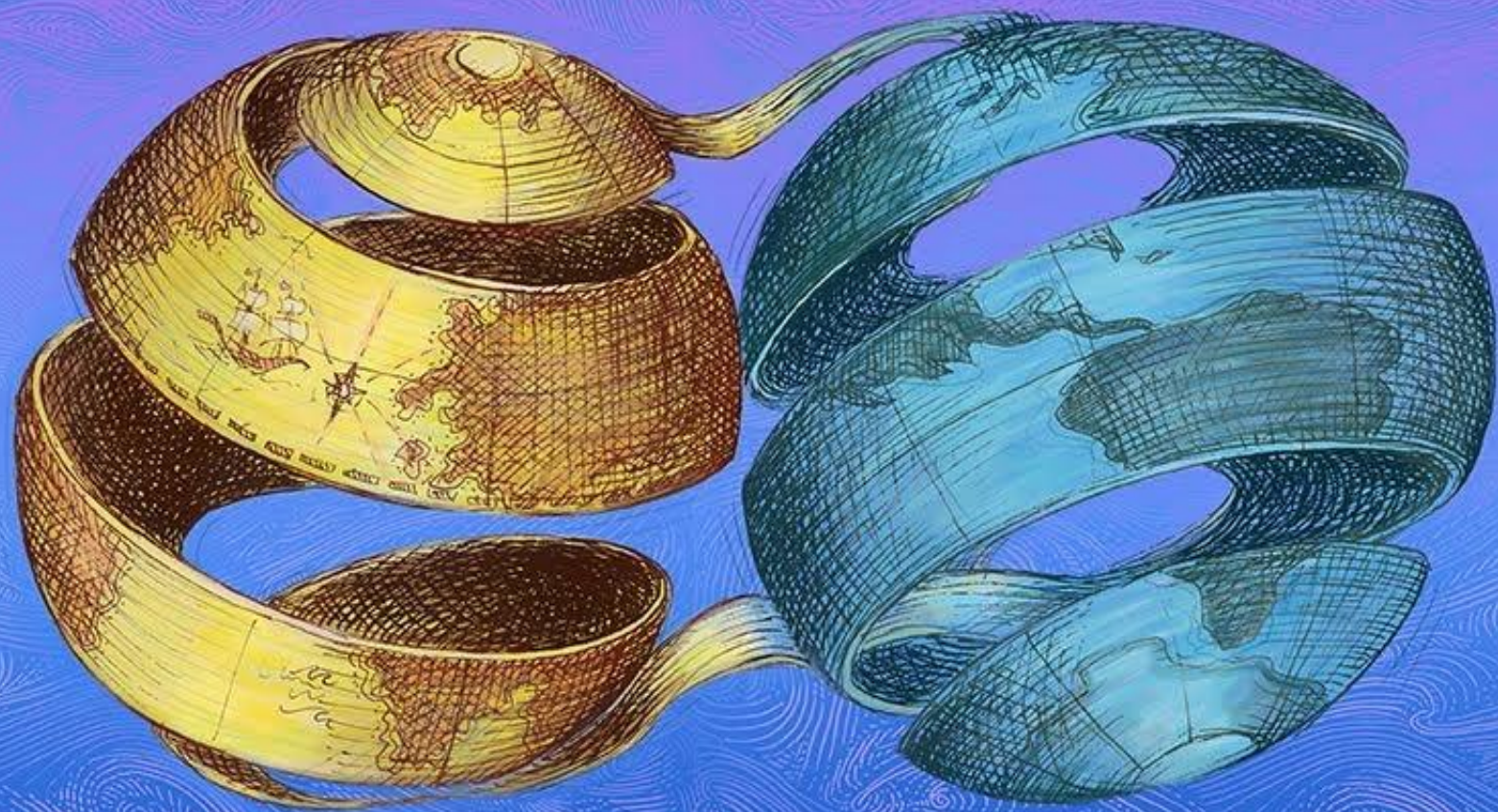
Making the user interact with knowledge represented spatially.



The Future: Behaviour-altering

Developing social skills through AI-powered embodied simulations.





Why did we explore VR?

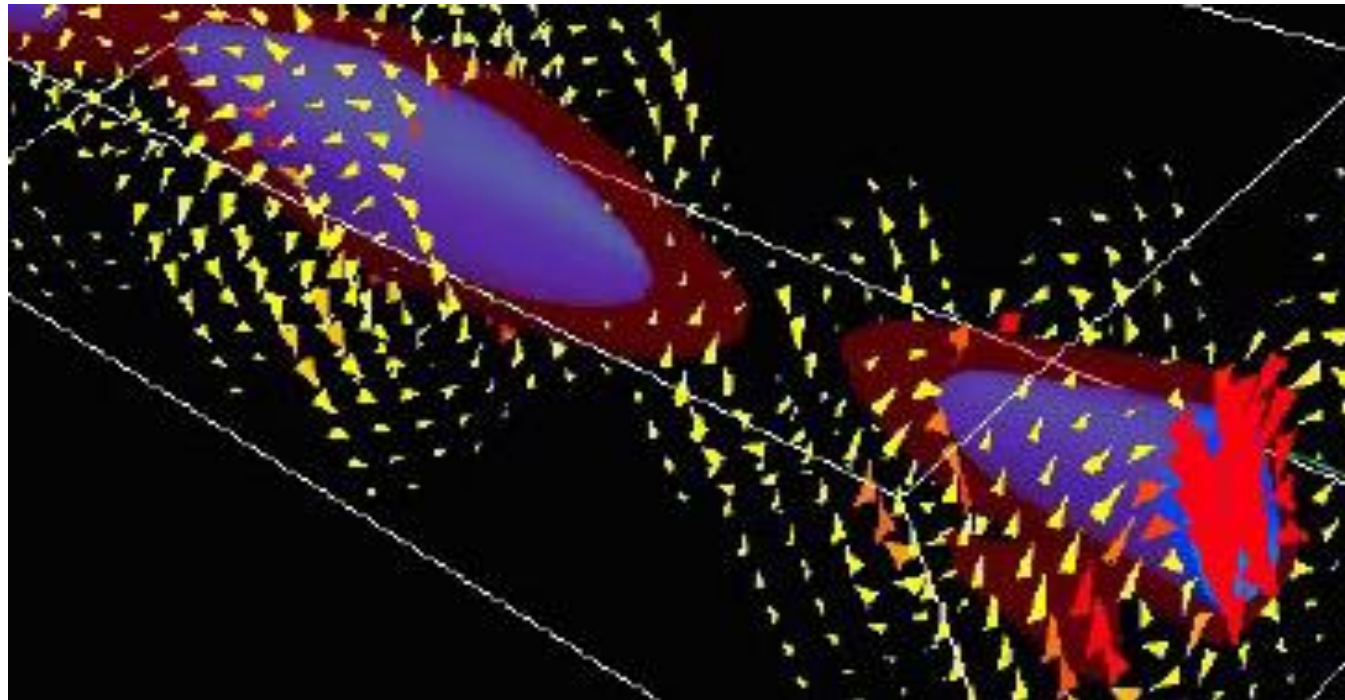
- Conceptual understanding of phenomena that is difficult for students to visualize.
- A place where students can see how their assumption/ misconceptions play out in a simulated reality.
- A new way to explore the representation, visualisation and interaction with big data.
- Equity – field trips

...merely providing an environment with a high degree of fidelity and user control, modelled on a real world system or a set of abstract concepts, will not necessarily facilitate the development of conceptual understanding.

An appropriate set of learning tasks need to be designed, with appropriate task support, to ensure that the activities that the learners undertake as they explore the environment do in fact require them to develop such an understanding. (Dalgarno, Hedberg, Harper 2002 p157)

Designing user experience in VR

- Linking conceptual understanding to a first order experience.
- The user is free to navigate, but the space is intuitive.
- Simplified models for concepts, avoiding the use of convoluted symbolisms.
- A capacity to allow a user to manipulate the virtual world.
- Transduction – representations of information which could not normally be perceived by the sensory system – constructing the reality to scaffold the students needs.
- Reification “feels” like a space that could exist even without the user’s presence.
- Scaffold within and outside the space – meaning of the experience.







References

- Bailey, J. O., Bailenson, J. N., & Casasanto, D. (2016). When does virtual embodiment change our minds?. *PRESENCE: Teleoperators and Virtual Environments*, 25(3), 222-233.
- Shin, D-H. (2017). The Role of Affordances in the Experience of Virtual Reality Learning: Technology and Affective Affordances in Virtual Reality. *Telematics and Informatics*
- Bertol, D., & Foell, D. (1997). *Designing digital space: an architect's guide to virtual reality*. John Wiley & Sons.
- Blascovich, J., & Bailenson, J. (2011). *Infinite reality: Avatars, eternal life, new worlds, and the dawn of the virtual revolution*. William Morrow & Co.
- Carlin, A. S., Hoffman, H. G., & Weghorst, S. (1997). Virtual reality and tactile augmentation in the treatment of spider phobia: a case report. *Behaviour research and therapy*, 35(2), 153-158.
- Csikszentmihalyi, M. (1997). *Finding flow* (Vol. 131). New York: Basic Books.
- Damasio, A. R. (2006). *Descartes' error*. Random House.
- Fowler, C. (2015). Virtual reality and learning: Where is the pedagogy? *British journal of educational technology*, 46(2), 412-422.
- Everhart, R., Elliott, K., Pelco, L. E., Westin, D., Briones, R., & Peron, E. (2016). Empathy activators: Teaching tools for enhancing empathy development in service-learning classes.
- Froese, T., Iizuka, H., & Ikegami, T. (2014). Embodied social interaction constitutes social cognition in pairs of humans: a minimalist virtual reality experiment. *Scientific reports*, 4.
- Schubert, T., Friedmann, F., & Regenbrecht, H. (1999). Embodied presence in virtual environments. *Visual representations and interpretations*, 20(5687), 269-278.
- Giraldi, G. A., Silva, R., & Oliveira, J. C. (2003). Introduction to virtual reality. *LNCC Research Report*, 6. <http://www.lncc.br/~jauvane/papers/RelatorioTecnicoLNCC-0603.pdf>
- Hamari, J., Shernoff, D. J., Rowe, E., Coller, B., Asbell-Clarke, J., & Edwards, T. (2016). Challenging games help students learn: An empirical study on engagement, flow and immersion in game-based learning. *Computers in Human Behavior*, 54, 170-179.
- Heilig, M. L. (1960). U.S. Patent 2,955,156. "Stereoscopic-television apparatus for individual use."
- Hill, D. (1988). Misleading illustrations. *Research in Science Education*, 18, 290-297.
- Kasl, E., & Yorks, L. (2014). Do I Really Know You? Do You Really Know Me? And, How Important Is It that We Do? Relationship and Empathy in Differing Learning Contexts.
- Kolb, D. A. (2014). *Experiential learning: Experience as the source of learning and development*. FT press

References

- Krznaric, R. (2014). *Empathy: A handbook for revolution*. Random House.
- Laver, K., George, S., Thomas, S., Deutsch, J. E., & Crotty, M. (2012). Virtual reality for stroke rehabilitation. *Stroke*, 43(2), e20-e21.
- Mayer Richard. E. (2014) *Computer Games For Learning: An Evidence Based Approach* MIT Press. Cambridge.
- McNerney, S. (2011, November 4th). A Brief Guide to Embodied Cognition: Why You Are Not Your Brain, *Scientific America* [web log post]. Retrieved July 3rd, 2017, from <https://blogs.scientificamerican.com/guest-blog/a-brief-guide-to-embodied-cognition-why-you-are-not-your-brain/>
- Mokey N. (2016, December 19th). We Have Virtual Reality. What's Next Is Straight Out of The Matrix, *Digital Trends* [web log post]. Retrieved July 7th, 2017, from <https://www.digitaltrends.com/features/dt10-we-have-virtual-reality-whats-next-is-straight-out-of-the-matrix/>
- Mikropoulos, T. A., & Natsis, A. (2011). Educational virtual environments: A ten-year review of empirical research (1999–2009). *Computers & Education*, 56(3), 769-780.
- Niaz, M., & Robinson, W. R. (1993). Teaching algorithmic problem solving or conceptual understanding: Role of developmental level, mental capacity, and cognitive style. *Journal of Science Education and Technology*, 2(2), 407-416.
- Pace, S. (2004). A grounded theory of the flow experiences of Web users. *International journal of human-computer studies*, 60(3), 327-363.
- Parrish, P., Wilson, B. G., & Dunlap, J. C. (2011). Learning experience as transaction: A framework for instructional design. *Educational Technology*, 51 (2), 15-22.
- Qin, H., Patrick Rau, P. L., & Salvendy, G. (2009). Measuring player immersion in the computer game narrative. *Intl. Journal of Human-Computer Interaction*, 25(2), 107-133. <http://www.tandfonline.com/virtual.anu.edu.au/doi/abs/10.1080/10447310802546732>
- Ruzic, F. (1999) The future of learning in virtual reality environments. In: Selinger, M. and Pearson, I, (Eds.) *Telematics in Education: Trends and Issues*, Amsterdam: Pergamon.
- Sanchez, A, Barreiro, IM. and Maojo, V. (2000) Design of virtual reality systems for education: a cognitive approach. *Education and Information Technologies* 5, 345-362.
- Salzman, M.C., Dede, c., Loftin, B.R. and Chen, 1 (1999) A Model for Understanding How Virtual Reality Aids Complex Conceptual Learning. *Presence: Teleoperators and Virtual Environments* 8, 293-316.
- Slezak, P. (2014). Appraising Constructivism in Science Education. In *International Handbook of Research in History, Philosophy and Science Teaching* (pp. 1023-1055). Springer Netherlands.
- Stevens, Jonathan A., and J. Peter Kincaid. (2015). "The relationship between presence and performance in virtual simulation training." *Open Journal of Modelling and Simulation* 3, no. 02 :41.
- Vince, J. (2004). *Introduction to virtual reality*. Springer Science & Business Media.