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A Digital Tech Frontier, L.L.C. White Paper

Augmented Reality

An Educational Catalyst

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Benefits of Augmented Reality

This technique is called Augmented Reality (AR) because a view of the real world is being augmented with virtual, 3D objects. Virtual Reality is a similar concept, but differs in that it places the user in a completely virtual world with no indication of reality. Many people prefer AR because the connection to the real world is retained, which has many benefits. These, and other benefits of AR over VR include

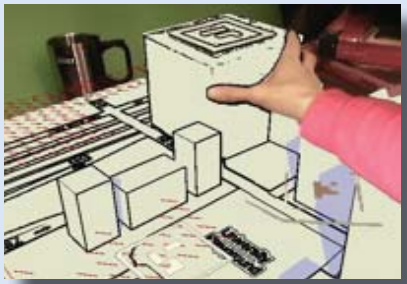
- AR is easier to use because the user feels like they are working with real, everyday objects and the connection to reality reduces sensory confusion which leads to motion sickness. With VR, you either have to use 2D interaction devices (like a mouse or keyboard), which is very unintuitive, or you have to buy expensive hardware, which means that the number and length of student experiences is reduced.

- Collaboration is enhanced, as users can see both virtual objects and their colleagues at the same time, which aids in visual communication.

- Placing a virtual object in the context of the real world can deliver more meaningful and more memorable experiences. Examples of Contextual Learning include: a student understanding how large their heart is by holding a (to scale) virtual heart up to their chest; a user holding an AR Maori Patu (hand club) in their hand, imagining how heavy it must be and understanding how it would have been held in combat.

Why Use Augmented Reality?

AR excels at conveying spatial and temporal concepts - especially through virtual objects whose real counterparts are too expensive, dangerous or fragile to be exposed to a large volume of students. These can be placed in context to other virtual objects or in context to the real world in order to maximise impact, contextual awareness, engagement and interaction. AR is also described as a tangible interface – which refers to the ability to touch and manipulate real objects that control the virtual objects. This makes it a very easy, intuitive interface, as all of us are very familiar with rearranging objects in our everyday life. This also means that AR can be very appealing to kinaesthetic learners, and can provide a high degree of engaging, self-paced interaction. In addition, it can simultaneously present information as text, still images, video, 3D animations, narration and through sound effects and music, which caters to all learning styles, maximises impact and maintains interest.



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A tangible interface.

"Minority Report"
© 2002 20th Century Fox

- AR is cheaper. Both AR and VR need to use 3D tracking to find where real objects are in the world and render virtual, 3D objects over them. AR does all of its tracking by analysing the video from a small webcam – this only costs about $100. VR relies on magnetic or inertial trackers which are more expensive (can be $1000) and can be unreliable (inertial sensors drift over time) or subject to interference (magnetic sensors are disrupted if metal is nearby).

In addition, AR compares very favourably to more traditional educational software and can be an ideal complement to both traditional teaching methods and inquiry based learning. AR excels at conveying spatial, temporal and contextual concepts - especially through virtual objects whose real counterparts are too expensive, dangerous or fragile to be exposed to a large volume of students. These can be placed in context to other virtual objects or in context to the real world in order to maximise impact, contextual awareness, engagement and interaction. AR is also described as a tangible interface – which refers to the ability to touch and manipulate real objects that control the virtual objects. This makes it a very easy, intuitive interface, as all of us are very familiar with rearranging objects in our everyday life. This also means that AR can be very appealing to kinaesthetic learners, and can provide a high degree of engaging, self-paced interaction. In addition, it can simultaneously present information as text, still images, video, 3D animations, narration and through sound effects and music, which caters to all learning styles, maximises impact and maintains interest.

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Benefits to Schools and Community (a shorter summary)

As our culture becomes more immersed in visual and multimedia content, our children respond less to static text and images. To make a lasting impact, educational content has to not only match what children are familiar with on TV, computers and video games, but it has to exceed it. ARDL not only exceeds their expectations and grabs their interest, it also excels at conveying spatial and temporal concepts - especially through virtual objects that are too expensive, dangerous or fragile in reality. Even so, it is very easy to use, and can be used by multiple children at once, actually encouraging children to work with each other to make the object interact. This results in a high level of engagement with the content in a form that is innately playful and explorative. AR is also described as a tangible interface – which refers to the ability to touch and manipulate real objects that control the virtual objects. This makes it a very easy, intuitive interface, as all of us are very familiar with rearranging objects in our everyday life. This also means that AR can be very appealing to kinaesthetic learners, and can provide a high degree of engaging, self-paced interaction. In addition, it can simultaneously present information as text, still images, video, 3D animations, narration and through sound effects and music, which maximises impact to a broad array of learning styles and maintains interest.

Educational Research Regarding Augmented Reality

The 2010 Horizon Report (http://wp.nmc.org/horizon2010/) featured an entire section on Augmented Reality. The Horizon Report is an ongoing, well respected resource for educators. It is created by The New Media Consortium - an international 501(c)3 not-for-profit consortium of more than 280 learning-focused organizations dedicated to the exploration and use of new media and new technologies.

Back in 2003 I was project manager of the eyeMagic project. One of the project's deliverables was a report called "Augmented Reality and New Literatures: the child as a performing agent within the text" by John McKenzie and Doreen Darnell, that was presented and published in the proceedings of the Australasian Children's Literature Association for Research conference (Sydney 14-17 July 2004). The report is available here.

Both reports are enthusiastic about the potential of Augmented Reality, but found the offerings of the time fell short. We believe ARDL has addressed these shortcomings and is delivering on the exciting educational potential of Augmented Reality.

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Educational Research Trends Applied to Augmented Reality

Below is a selection of general educational research trends, and how they apply to Augmented Reality:

- Multimodal learning increases student retention by a) stimulating multiple modes of a single student, and b) ensuring more students have their primary mode stimulated. Augmented Reality offers a very broad range of modes, including textual, visual, audible, kinaesthetic and contextual, and can also support teacher presentations, prescribed worksheets and activities, and teamwork.

- Increasing student involvement increases their understanding. Well captured by the Chinese proverb (popularised by Benjamin Franklin) "Tell me and I forget. Show me and I remember. Involve me and I understand". This is being implemented by teachers moving from "sage on the stage" to "guide at the side". Augmented Reality supports teachers through that transition, by allowing teachers to use it to show, or by enabling student involvement through consumption or even creation of their own educational content.

- Student engagement is closely correlated to learning. In essence, you need to capture and hold their attention, which is getting increasingly difficult in a world crowded with things that are competing for attention. Augmented Reality creates engagement through innovative interaction and activities, exemplified by reports we have had of students wanting to come back and use Augmented Reality in their lunch breaks.

- Research is beginning to fully appreciate how much children learn through play activities, and is endeavouring to incorporate more play into higher learning. The concept of 'the state of flow', developed by Csíkszentmihályi, shares many characteristics of play, and can be applied to play and learning, and can be thought of as a more adult, applied version of play. Like play, the flow state is an optimal state of intrinsic motivation, where a balance must be struck between the challenge of the task and the skill of the performer. Augmented Reality enables play and flow, buy providing open-ended challenges that scale to the skill of the performer, encouraging discovery, exploration and creativity.

With social networking becoming mainstream, awareness is increasing around the educational benefits of students sharing their work online. When students agree to have their work seen by more people than just themselves and their teacher, their accountability and dedication increases, resulting in higher quality work. The ARDL Builder allows students to upload their work to an online server in just two clicks, and to then take a unique web-link to that work and share it to as few or as many people as they desire (via email or social networks, etc). Recipients can view the work in full Augmented Reality, for free, in just 3 clicks.

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Why is Play-Entertainment Important for Education?

From a presentation made by Eric Woods, 2007.

I once heard a very good keynote which made a strong case that almost all baby mammals play to learn. They start with very little knowledge, and once mature, know how to function in their world. In that time, they spend a lot of time playing. Looking at it from an evolutionary perspective, there must be a good reason for so many resources to be invested in playing. Many experts believe that this playing is teaching and training them to function in the world.
Too look at it from another perspective, you could say that playing is the most effective way that mammals have found to learn. So if it is good enough for other mammals, it should be good enough for us right? A lot of what humans learn now goes beyond basic life skills, but that doesn't mean it can't be with some elements of play in it.

So what is it about play that is so effective?

Play is quite a complex topic:

- It is often considered to be separate to learning, however it can be part of learning (vice versa).
- It is closely related to entertainment, whereas, both are pursued to achieve pleasure. Both can involve learning.
- However, entertainment is often considered to be a structured, (often packaged and sold) version of play

Four entertainment techniques (using computers):

- **Stories:** plot + character
- **Games:** skill + competition
- **Puzzles:** game + solution
- **Toys:** inventive

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Open Mind Theory

My pet theory is that an 'open' mind is like an open hand - you can more easily grasp what is thrown at you.

If your mind/hand is closed, you have no chance of grasping anything. Many teachers are throwing knowledge at students, only to have it bounce of closed minds.

By 'open mind' I mean more than the traditional 'open to new ideas' - I mean that they are ready and hopefully even willing to learn.

When over 100 New Zealand teachers were asked "what is the one thing you would like to change about your job", over 75% responded "the students". This problem is not limited to New Zealand - teachers understandable want their students to want to learn. But sadly, many students are just going through the paces.

Unfortunate boredom culture emerges from primary to secondary as younger kids look up to older kids and older kids portray it is cool to be disinterested.

Boredom is a compound problem because, it closes the mind which also means many things are more interesting (even someone walking past a window) may results in distraction.

Tips: The right tool for the task.

- Do NOT use technology simply because its 'technology'.
- If you are not careful, you can use more complex technology that offers little or no added benefit.
- Sometimes any added benefit can be lost in it being harder to use or introducing other de-motivational factors.
- Be aware that the task is not only to memorise XYZ - it is also important to motivate, entertain and inspire.
- Tools include: books, video, 2D, 3D etc.
- Simpler is fine as long as it still achieves the objectives (i.e. with compelling concepts, content and interaction).