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Virtual Reality Learning Environments
An Emerging/Impending Innovation in Education

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Abstract: In this paper Virtual Reality is discussed in the context of technology enhanced learning and Immersion as the key added value of Virtual Reality, cognitive variables are connected to immersion. The use of Animation and Multimedia for learning is now further extended by the provision of entire Virtual Reality Learning Environments (VRLE). VRLEs simulate the real world through the application of 3D models that initiates interaction, immersion and trigger the imagination of the learner. Some case studies for the purpose of Education and Simulation are described. These applications show that VRLEs can be used to enhance, motivate and stimulate learners in understanding of certain events. Especially in a Country like India, where there are plenty of resources for learning and for which the traditional notion of instructional learning has proved inappropriate, difficult or even expensive at times, if the learner is in a different part of the country and wants to be able to learn from the best resources. There are a number of systems now available to manage and deliver learning content online. This paper presents research in this area and the resulting development of a Learning Environment with Virtual Reality, it's limitation and implications.

Keywords: virtual reality; virtual reality learning environment; e-learning; education; experiential learning; experience; immersion; teachers; learners; professionals; educators

I. INTRODUCTION

"Give the pupils something to do, not something to learn; and the doing is of such a nature as to demand thinking; learning naturally results." – John Dewey, Democracy and Education: An Introduction To The Philosophy of Education, 1916.

Some materials are easier to learn when they are visualized and when the learner can interact with it. Virtual Reality (VR) provides ways to use 3D visualizations with which the user can interact. During situations where the physical counterpart may not be available, too dangerous or even too expensive in some cases VR plays an important role. E.g., Flight simulator where pilots safely teach and learn how to fly a plane in various different and difficult circumstances. VR also has proved to be extremely useful in the domain of medicines, e.g., to study various parts of human body in detail and simulate operations on them. Virtual worlds are complete 3D computer environments containing 3D (and possible also 2D) objects in which the user can navigate and interact with the objects. These virtual worlds are also called Virtual Environment (VE) [1]. In collaborative environments, such as Second Life, users can also meet each other and socialize [4].

The skills professionals and experts need in order to accomplish success in today's economies require a different approach to teaching. Educators and theorists after months of research have concluded that young and old learn best through "**experiential learning**,**"** an approach that allows learners to explore facts and figures by bringing them to life. It is proved that seeing a tiger in the zoo is much more memorable than reading about it in a book or watching it on television. Since augmenting traditional learning with a rich curriculum of experiential learning, through industrial visits, science labs, practical etc., is usually impractical and expensive. However, a Virtual Reality Learning Environment has the potential to overcome those challenges. Imagine a single application that can be your access to different places, it helps bringing the experiential learning to all students regardless of geographic restrictions.

However, the richness of such a Virtual Reality Learning Environment (VRLE) can also become its weakness. The learner may be overwhelmed or get lost in the VLE, not knowing what to do first or next, or may be distracted too much and not be able to focus on the actual learning task. For people, not familiar with VEs (novice users), the time required to get acquaint with such a VRLE (i.e. learnability) may be long and therefore their short-term satisfaction may be low. On the other hand, youngsters used to play video games, may spend their time in activities not very much related to the learning activities, especially if they have low motivation for learning. This then results in a low effectiveness.

II. VIRTUAL REALITY LEARNING ENVIRONMENT

This topic is further divided into 4 sections, 1st Section discusses the technicalities of Virtual Reality and what makes Virtual Reality unique. The 2nd Section discusses about how or what can be done in order to overcome the limitations or challenges that are presented by VRLEs. 3rd Section talks about the various things that are needed to be considered while developing VR applications and the 4th Section presents our research in this area and the resulting development of M-Educate's learning application.

A. The Technology Behind VRLE

The various properties of VR that enable a unique user experience are –

- Immersion: the experience being so compelling and immersed that you forget about other things and lose track of time while you are at it
- Presence: when the body and the mind is tricked into believing that the person has entered the virtual environment and responds as if they are there (even if the brain knows that in fact it is not)
- Empathy: to create a deeper and a more emotional connection with the objects seen in the virtual environment than the type of connection one has by just reading or hearing.
- Agency: the decisions or actions that you make directly affect the output of the virtual reality experience.

Teachers, parents and professionals have concerns about VR, since it is an isolating experience where the kids are completely glued to the VR device and that too for longer periods of time. However, it's observed that there is somewhat a contrary phenomenon, the kids are excited about what they see and based on that they exchange observations and opinions with one another, which gives rise to the idea of a social VR application. At educational institutes, teachers and professors report that after travelling to a far-off place via the Expeditions application, kids want to discuss what they saw and experienced with the class. It is important to have a compelling experience when developing a VRLE application, which motivates the kids to share their experience with parents, teachers and friends [7].

B. Challenges Implementing VRLEs

There are various factors to be considered while developing VR applications which provide an immersive and unique experience for the kids.

- Immersion is the key: Immersion is the core for providing truly a great VR experience. When designing experience, we should take particular care in making kids feel like they're a part of the story. Removing distractions and allowing them to engage all the senses. The Mandarin Lesson can be used as an example for this, where VR provides an immersive experience in an educational exercise that often involves immersion and teaches students a new language. It also has enabled subtitles to provide a context of the conversation so that students immerse themselves in the learning process.
- Giving them control: Students want an interactive experience while learning, which could directly impact them. Like game experiences, interactive elements enhance the engagement by the students and in return helps them retain that experience for a longer period of time.
- Give a playful experience: Students are driven by curiosity. Adding or giving them a playful experience can go a long way since it deepens the user engagement for the application. Whether it is the core element of the experience student wants or just by making the user interface more fun. This behavior is aptly explained by San Shepherd,

  "Kids want to throw a ball rather than click a button. They want to wave a magic wand rather than point a laser. They want to have fun. So, design for interactions that are more playful than simply clicking a button"

  -- San Shepherd, Co-Founder of Escapist Games

Always keep your audience in mind when developing products, Re-evaluate the interactions and the core elements of the application from a student's perspective. E.g., user onboarding and tutorials that are useful for adults learning about the functionalities of your application may not work with students or kids, since they have a smaller attention span, the thing that keeps them connected with an application are smooth animations and playful interactions, by breaking complex concepts into smaller more understandable pieces would help students remember them more easily and the retention period will be longer [5].

- Collaborative Experience: Group studies surely weren't much productive but they were the reason why we remember those mathematical concepts more accurately, since collaboration allows students to communicate about the same topic effectively and in return it supports learning and helps strengthening the relationship one has. This can also be done inside a virtual world, by merging the experience of the virtual and the physical world together. The best e.g., for that is the Into the Labyrinth by Mattel, which

is a cooperative VR game where one player is lost inside the VR labyrinth and is given a task to complete with the help of a teammate who is outside VR, the other player who is outside the VR is given a physical map and guides which has symbols and clues. This provides a sense of collaboration by the teammates in order to solve the puzzles and eventually win the game.

C. Building VRLEs

"Virtual Reality is justified when the real-world experience is too expensive, too dangerous, impossible, or counterproductive."

Jeremy Bailenson, founding director of Stanford's Virtual Human Interaction Lab

When building a VRLE the most important thing to remember is does it truly need or could it be any better in VR? Can the best experience be conveyed through different forms of media which is just reimagined in VR? Or just by putting a light of VR layer over the boring educational application, would do it. Since travelling to the bottom of the deepest ocean or on the top of the highest mountain peak is too dangerous and impractical for almost everyone, and in a country like India, to get the best education is also a struggle for some. This can be a reason for companies in these sectors trying to come up with various solutions for providing best teachers a platform to teach students who are unable to get this basic amenity. A report from Touchstone Research said that around 64% of the kids want to use VR for visiting another country, 58% would like to travel back in time and about 56% would fly like a bird. Kids like to explore, create, their interests certainly don't change with the advancement of technology. We can at least try to build a great experience for them to help them achieve that [10].

D. Startups Working with VRLEs

There are various factors to be considered when developing for VR application, since VR basically is 3D stereoscopic rendering with a headset, where the phone is going to render two images, one for each of the eyes and the headset lens will allow you to see 3D in stereoscopy with full effect. Technically our eyes see the world with two point of views, and the delta between those two things is how your brain sort of detects the depth of the object. That's the effect that we get when using VR headsets. Other technologies that add to the illusion are the sensors such as accelerometer and sensing where the gravity is allows us to know when somebody is turning his/her head. So, we can change the 3D perspective based on the person's head position which is what gives the effect of virtual reality. At M-Educate, we have built a VR Learning application, with an in-depth understanding about the various aspects of Virtual Reality to allow students from different parts of the country to have an immersive learning experience sitting at home. It is a project made for the Educational Institute Home Revise, who provide animated and fun videos for students, making learning an interesting affair.

III. CASE STUDIES

Borrowed Light Studios is an independent, virtual reality focused game studios that have come up with an interesting experience for learning the Van Gogh's art called A Night Café. The art becomes much more memorable and insightful when looking at it from a completely different view point.

On 17th of November, The University of Melbourne introduced their students from art, education and engineering to take part in a work shop. It was a two hour "Behind the Scenes" work shop about making the Massive online open courses in virtual reality. The interested students took part in it [11].

inMediaStudio has developed a platform for teachers and students to access an inCloud environment where they can send and create homework, view statistics and study digital books. Using these platforms, it can be concluded how the transformation has happened in class management before and how it is done now.

Google's Expedition program is also a good example, which enables teachers to bring their students on virtual trips to places like underwater, outer space, top of a mountain range, etc. There is a collection of content or supporting materials that are used alongside existing curriculum. These trips are a combination of 3D and 360 degree panoramas. The Google Cultural Institute museum partners to create this educational content and provide students this exceptional experience [12].

IV. CONCLUSION AND FUTURE WORK

E-Learning is one of the emerging needs of the information age. Access to education is going to become crucial for the success of our information society, Virtual Learning Environment is a good solution for modern teaching and learning. Except improving VRLEs materials, Virtual Learning form is also an important factor related with learning effect. We at M-Educate have proposed an immersive Virtual E-Learning platform where students from different parts of the country can learn from the best resource available, a proof of concept is ready as well [8]. The system has good immersion and interaction ability. The immersed E-Learning system

can maintain student's interest and keep them engaged and motivated in their learning. One of the future works is researching on how to combine and enable Second Life for E-Learning and adding it to the Virtual Community.

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