

# Interactive-3D LEARNING OBJECTS

A powerful new learning tool for Africa



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## VR

**What:** VR in African training & education

**Why:** Visually interactive  
Allows learners to explore in safety  
Overcomes language barriers  
Overcomes literacy barriers  
Show, don't tell

**How:** By taking advantage of the visual powers of the human brain and the principles of intuitive learning

*If a picture paints a thousand words why do we still focus on text as a learning medium?*

## Who are we?

The Naledi3D Factory (Pty) Ltd. of Pretoria, South Africa, focuses on the development of visual learning content.

We are a modern, innovative company<sup>(1)</sup> that develops computer based virtual reality (VR) content as a means of visualising objects, complex concepts or processes in a three dimensional, interactive environment.

*Our vision is to use the visually interactive nature of VR to communicate ideas and concepts and to visualise Africa's rich heritage; to address the training needs of our diverse communities; to overcome literacy barriers and hence, help people bridge the skills and knowledge divide.*



UNESCO - Nakaseke Rural Hygiene Project - Uganda

To realise this vision, we have developed strategic relationships with UNESCO; IICBA; Worldlinks as well as other educational stakeholders in Southern Africa.

Our track record to date is summarised in our document "Rising to the African Education Challenge".

[www.naledi3D.com/Articles/Naledi3DOverview04.pdf](http://www.naledi3D.com/Articles/Naledi3DOverview04.pdf)

## VR and Interactive 3D Learning Objects

VR - "a digital world where the user can view and change the contents of the environment" has huge potential for Africa. The visual nature of the medium is such that **language** and **literacy** (both being barriers to effective learning) are totally overcome. The combination of two concepts - VR and Learning Objects to create "**Interactive 3D Learning Objects**" is a powerful way to create new, exciting and engaging material.

<sup>(1)</sup> the Naledi3D Factory

"One of South Africa's most innovative companies" (Business Day - December 2003)

"... has a strong history in development projects in Africa" (Engineering News - October 2004)



ESKOM - Solar Collector and Sand Filtration Water Filter

Information resides in many different forms of media - graphics, audio, video, animation, 3D simulations, etc. A painting is information; a song is information. Perhaps the most exciting aspects of modern ICT's lies in its ability to capture knowledge in such a way so that it can be analysed, reused and shared with others - developing a spiral of more new knowledge creation.

Learning objects are akin to the concept of "just in time production" where the right amount of information flows to the right person at the right moment.

## Learning Objects - a new multimedia pedagogy

A Learning Object (LO) as an educational concept has been around for many years, but is still often also misunderstood. A LO can be described as<sup>1</sup>:

*"A collection of information objects (the smallest useful piece of information that can be used and re-used, such as an illustration, question, definition, procedure or sound) assembled using metadata to match the personality and needs of the individual learner."*

Templates for the pedagogical design of LO's include<sup>2</sup>:

- **Interactive image:** where the learner can click on a part of a picture (eg a human body) and get more information on that component (eg heart);  
*Thus, supporting explorative learning*
- **Visualisation:** which could be an animation, video clip or in this case, a VR model;  
*Describing procedural information that is hard to describe textually;*
- **Phases of a process:** describing the different stages or phases of a process in a way that the learner can



Bet Georgis - Lalibela - Ethiopia



HIV infection and stigma, Ethiopia

<sup>1</sup> Into the Future. A Vision Paper, H Wayne Hodgins, Commission on Technology and Adult Learning. Feb. 2000.

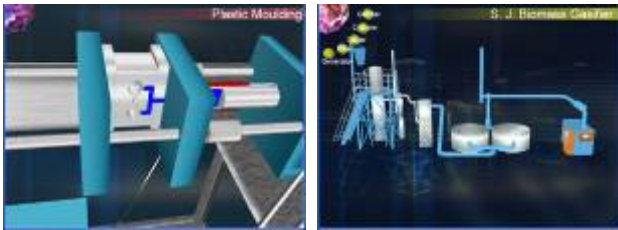
<sup>2</sup> Pasi Silander, Senior Researcher, Digital Learning Lab Häme Polytechnic, eLearning Centre Hämeenlinna, FINLAND



control and also navigate between them;

- **Interactive simulation:** enables the learner to test and try out two (or more) variables and how they influence the phenomenon / object presented; *Supporting Inquiry learning.*
- **Analogy-based presentations:** a very effective way of facilitating learning whereby an abstract phenomenon is presented via a concrete (familiar) phenomenon; *Supporting of pedagogical bridging.*

Multiple learning objects can also be grouped into larger assemblies or nested within each other to serve a wider range of purposes.



**ESKOM TSI Technologies: Single phase plastic-moulder & Biomass Gasifier**

**Interactive 3D Learning Objects** provide an engaging, interactive learning experience that can also be incorporated with audio, video and text to suite the learners' linguistic requirements. They can also be re-used in the teaching of several different subjects.

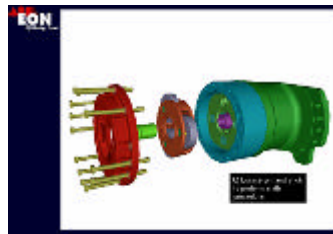
The basic building block of an **Interactive 3D Learning Object** is the visualisation component - an interactive 3D simulation that describes a single phenomenon - or a total process. For example, a simulation showing how the blood is pumped by the human heart, in a way that allows the learner to also experiment and see how two (or more) variables influence the process - *in real time.*

Over time a library of common, affordable, easily created simulations can also be published for almost any situation, subject area or task.

**Attributes of effective LO's**

To be effective, Learning Objects should have the following attributes (after Hodgins):

- **Accessibility** - learning objects should be accessible from one remote location and delivered to many locations;
- **Interoperability** - widely adopted common standards are a fundamental requirement, ensuring that components developed in one location, on one platform with one set of tools can be used on other platforms elsewhere;
- **Adaptability** - the learning is tailored to individual and situational needs;
- **Reusability** - learning components can be re-used in multiple applications;
- **Durability** - the learning objects can still be used (without redesign) when base technology changes;
- **Affordability** - to increase learning effectiveness whilst reducing time and costs.



To be of use and not just noise competing for your attention, learning must inform. Hodgins has coined the term "**Lernativity**" - defined this as "knowledge in action, a continuous spiralling conversion of tacit knowledge (know-how and experience) into explicit knowledge that can be captured, *shared* with others, *diffused* within groups, and *turned back* into new tacit knowledge through learning by doing. *Lernativity* is a way of continuously creating new, actionable knowledge"<sup>3</sup> and Learning Objects are one of the fundamental elements of this new pedagogy. Learning Objects are probably one of the most powerful learning tools available today.

**The Issue of language**

One major criticism of traditional VR models is that language elements cannot be easily changed by different individuals. This conflicts with the adoptability, "interoperability" and "reusability" attributes of a LO.

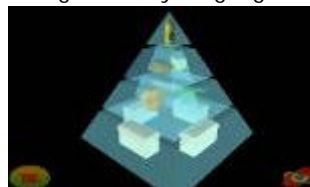
LO s should be created in such a way that they can be easily translated, changed and used in other languages.

Why shouldn't end-users themselves be able to effect language changes? There is a need to create a standard design process for VR models to ensure that educators can easily adapt text, audio and video components to local requirements - without reverting back to the development team.

The Naledi3D Factory's Interactive 3D Learning Objects are designed with exactly this in mind.

Our preliminary work shows how the concept of the LO can be applied in practice - and especially, how the language element can easily be changed.

In the example of the food pyramid below; both the textual and audio elements were changed without using the original VR authoring tool. Thus, the text and audio elements within the VR model (English) were changed to Sotho using WINZIP. In this way, language can be easily changed to any language on the planet!



**A Food Pyramid Learning Object** (developed in English with IICBA (Addis Ababa) and since changed to Sotho using WINZIP



<sup>3</sup> The Future of Learning Objects - Wayne Hodgins, 2000





## Interactive 3D Learning Objects in practice

**Interactive 3D Learning Objects** are extremely flexible and offer a very wide field of application, from explaining the function and structure of the enzyme ATP Synthase (cell biology); to the inner working of a fire pump and the impact of planetary rotation on the four seasons.

Almost any subject can be tackled and taught using **Interactive 3D Learning Object's**.

The following examples are some of the Learning objects that the Naledi3D Factory has created as components of larger projects.



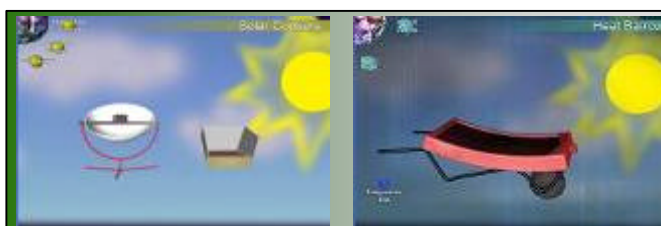
National Skills Fund & Dept. Labour - Lathe & Milling Machine



National Skills Fund & Dept. Labour - Measuring instruments

These images are taken from our Lathe and Milling Machine training simulation and are highly accurate interactive representations of a lathe and milling machine, a micrometer and measuring callipers.

As separate entities, these are designed to teach technical students how to use the equipment and also test their understanding of correct use.



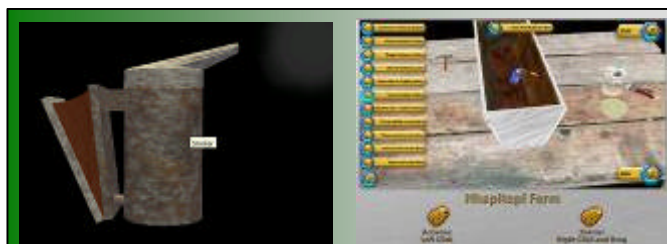
ESKOM TSI Technologies - Solar Cooker & Solar Wheel Barrow

Two of eleven simulations showing some of ESKOM TSI's new alternative energy technologies.

The Solar cooker provides a very effective way of capturing solar energy to cook food. The solar wheelbarrow effectively uses solar energy to heat up to 25l of water to a temperature of 60 degrees plus - plenty for cooking and washing.

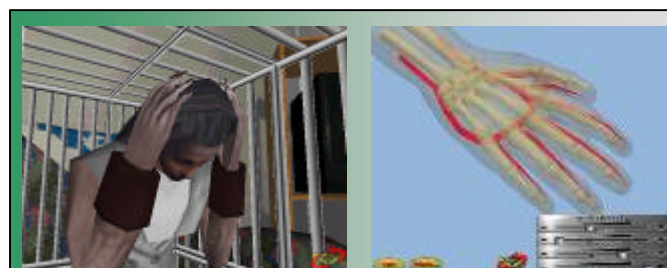
As **Interactive 3D Learning Objects**, both offer a new exciting way of teaching the principles of solar energy.

Any three-dimensional object can be recreated in virtual space allowing educators to focus on a specific learning object or component.



Bee-keeping for Zimbabwean farmers - Smoker & Kenya-Top Bar-Hive (Kellogg Foundation)

The smoker on the left explains how a light and use a smoker, fuelled by cow dung and which is used to calm the bees; the hive to the right shows the *Kenya Top Bar Beehive*. The interactive nature of this Object allows the learner to go through the building process step-by-step in the correct order.



IICRA - HI/AIDS Awareness - stigma and the virus

In these images, taken from HIV / AIDS learning content that looks at issues facing Ethiopian teachers, the left image addresses stigma using a cage as an analogy for isolation. The right image describes how the HIV virus enters the body and shows how it destroys healthy white blood cells. The sliders allow the user to change variables and to see the effect on other parameters.

It is clear that Interactive-3D Learning Objects can be used to address a wide range of learning areas.

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