



## Using VR for Human Development in Africa

**Dave  
Lockwood  
and Erik  
Kruger**  
*The Naledi3d  
Factory*

**M**ost VR practitioners probably don't think of Africa as being at the forefront of technology innovation. Some might even regard Africa as an exotic holiday destination; to others, it's a continent characterized by poverty and hunger, to be avoided. Within this context, what role, if any, can VR play in human development in Africa?

Depending on your viewpoint, VR either has a great future, or it's a technology that can under deliver on many of its promises. Some exciting VR applications exist, such as the British Museum's visualization of Egyptian mummies, showing them as they've never been seen before; trips to far-off galaxies at the Hayden Planetarium in New York; and visits to ancient worlds at the Hellenic World in Athens. In general though, some people still view VR as a high-cost technology with low direct financial returns. This can change when other intangible measures are included in the cost-benefit equation—vehicle design in the automotive industry, product and shelf design in retail industries, or ocean prospecting for oil and gas reserves being examples where indirect benefits make the use of VR attractive. Because multinational companies usually undertake these tasks centrally in Europe or the USA, this leaves fewer mainstream opportunities for VR practitioners in Africa.

The picture changes, though, if social returns are also included—VR can open many opportunities for developing poorer communities, particularly in skills development, education, and training.

Over time and through many projects at the Naledi3d Factory, a South African company that explores ways to use VR as a social development tool, we have regularly seen just how VR can offer high returns in basic human (social) development. Most decision-makers in Africa initially also see VR as a “first world” technology, but are pleasantly surprised to learn how easily it can make a big difference to people's lives. More important, people in target communities are equally surprised to find just how easy it is to learn through visually interactive media. Let's take a closer look at the Naledi3d Factory's use of VR.

### Why and where it all started

In 2000, the Naledi3d Factory started to look at ways to make a difference through the innovative application of VR in basic social development. To many, the idea of using VR in less-developed, rural African communities might appear strange and unlikely. However, VR's powerfully interactive and visual nature—and its ability to transfer knowledge and skills by showing, as opposed to telling—made this vision worth exploring.

Low literacy levels pose a significant challenge to education not only in Africa but elsewhere in the world. Traditional text-based education can't readily address the needs of functionally illiterate communities, yet text continues to be used extensively. Language provides another barrier: English, French and Portuguese are commonly used in training, despite the fact that to the recipients, as African-language speakers, these European languages are often their second, third, or even fourth languages.

Being both intensely visual and interactive, VR easily overcomes the text-based and language barriers to learning in an engaging way and one that's also characterized by a high learning retention. Modern understanding of the human brain shows that the area of the cerebral cortex devoted to processing visual inputs is an order of magnitude more powerful than that responsible for text and speech.<sup>1</sup> Using VR to demonstrate concepts and show knowledge visually greatly enhances comprehension of many topics. Thus, we can easily offer effective skill development to those who are functionally illiterate.

Social VR, which I'll explain in more detail in the next section, emerged as a possibility when the technology migrated from graphic work stations with head-mounted displays and shutter glasses to the desktop PC. It's at this level that VR can make a real impact, whether that PC is in Zimbabwe, Ethiopia, Senegal, or Rwanda. A multimedia PC, a data projector, and a good facilitator can have a tremendous impact on knowledge and skills development at the local level.

## Social VR

The term “social VR” is often used to refer to social interaction as is often found on Web sites such as Second Life. However, in this context, the term takes on a much more fundamental meaning and is used to differentiate between VR that affects the development of poorer communities and those used in more mainstream VR applications.

### Addressing basic hygiene issues

Nakaseke, Uganda has a population of 36,000. In 2001, the United Nations Educational Scientific, and Cultural Organization (UNESCO) sponsored the development of a small VR simulation to teach villagers basic hygiene skills in a familiar rural setting (see Figure 1). The Naledi3d Factory installed the simulation on PCs in the local Multipurpose Community Telecentre (MCT), where locals could access it—and in fact, schools, clinics, and church leaders all did. In 2003, their feedback via UNESCO was inspiring; while informal, the feedback stated that the visual approach really worked for them, and that the local clinic had also noticed a drop in the incidence of dysentery and other endemic diseases. Since then, the simulation has also been seen in other community centers in Kenya. Interestingly, the Nakaseke MCT brochure also noted in 2003: “It has also been one way of encouraging locals that were originally intimidated by the Centre to participate and use the computer equipment in the MCT.”

### Avoiding malaria

Malaria kills more than 1 million people every year—90 percent of those infected live in sub-Saharan Africa where there are more than 300 million clinical cases per year.

Again with the support of UNESCO, the Naledi3d Factory developed a simulation to help people better understand malaria—how to avoid infection (for example, by using bed netting as shown in Figure 2), how to recognize its symptoms, and how to treat it effectively. The simulation places users in a rural village where they can move around the village and explore. By clicking on objects or characters, they learn about all aspects of the disease.

### PC literacy

Many in the Western world take PCs for granted and seldom consider that there are many people in Africa who have never seen a PC before. However, many African governments and donor agencies have recognized that greater access to ICTs and the Internet is a powerful way to develop local economies and increase the potential for wealth creation. In this example, VR helped people better understand PCs and thus remove much of the



Figure 1. The Nakaseke basic hygiene main screen. Users can explore and discover focused learning or use the optional menu to go straight to points of interest.



Figure 2. Mosquito nets. Nets are a very simple way to avoid being bitten but they are also often misused simply because of a lack of understanding.

mystery that many people experience when they first encounter them. Several separate simulations explain the basic functions of various PC components, peripheral devices, and elements of data communication by taking users inside these items so that they can explore and better understand a PC’s inner workings (see Figure 3, next page).

### What do users say?

Ultimately, it’s the feedback from those who use the material that counts! In 2004, the Naledi3d Factory surveyed 280 African students and 32 educators from secondary schools and MCTs in



Figure 3. Building a PC. After installing the main components into the PC case — in the right sequence — the user can go inside the case, take a walk around, and see how it all fits together.



Figure 4. How to build a VIP(ventilated, improved pit) latrine. In this simulation, the VIP latrine is built step by step and explains the importance of the ventilation pipe facing the equator. This is the most important design feature that has led to several “ahha” moments with audiences.

Uganda and South Africa to assess the potential impact of interactive 3D simulations on their learning. Questions covered four main areas:

- Does VR enhance the understanding of the topic being taught?
- Does VR enhance learning retention?
- Does VR influence motivation towards learning?
- Can users apply what they’ve learned after viewing the simulation

The responses and results of these surveys were encouraging (you can read more at [www.naledi3d.com/Articles/Statistical%20Analyses%20Summary\\_v3\\_final.pdf](http://www.naledi3d.com/Articles/Statistical%20Analyses%20Summary_v3_final.pdf)). Students felt that the computer visu-

als made learning easier, the topics easier to understand, more enjoyable and easier to remember than traditional teaching approaches. The visuals also fit in well with other lesson material and helped students to revise topics. Almost 95 percent of the students rated the VR lesson as “good to excellent” and 74 percent felt “confident to very confident” about the learning obtained from the visual 3D material.

One strong correlation between teachers and students was that both groups felt that VR-based material was enjoyable and easy to integrate into lesson material. Teachers rated the usability, layout, academic content, and attainment of learning objectives as “good to excellent” and all believed VR was a good way to teach.

Such feedback is encouraging. Coming as it does from people who can directly benefit, it shows that interactive, visual learning definitely has a place in education in Africa.

### Inventing Interactive3d learning objects

By 2004, at the Naledi3d Factory, the “interactive3d learning object” (i3dlo) concept began to emerge—as a marriage between interactive 3d simulations and the educational concept of the learning object. Conceptually, i3dlos are efficient 3D knowledge modules that can be used in different ways, adapted to suit local needs and even easily translated into local languages. Such VR file localization can be a relatively simple process using freely available tools such as WinRar ([www.rarlab.com](http://www.rarlab.com)) or Gimp ([www.gimp.org](http://www.gimp.org)). Based on the company’s philosophy of open content, local communities can easily translate the simulation, without the need for the original VR authoring tools.

Working with learning object domain experts in South Africa and Finland, and teams in Mozambique, Sudan, Senegal, and Ethiopia, the company refined the i3dlo concept and piloted it in a UNESCO-funded project that created learning material about water and its importance. One i3dlo for example, looks at how to build a VIP (ventilated, improved pit) latrine, which has been used in Mozambique and now in Zimbabwe (see Figure 4).

### Bridging the knowledge divide

Creating interactive 3D learning material has little point if the material isn’t readily available to target users. Although e-learning material is often sold in Africa and elsewhere, this perpetuates the so-called knowledge divide when e-learning becomes unaffordable. In affluent parts of the world, easy access to knowledge can help people to help themselves; whereas in poorer areas, the lack of access to the same knowledge has the opposite effect.

In the case of i3dlos, the target user groups are mostly African communities living at or near the poverty line, typically earning less than US\$1 per day (as typified by Nakaseke in Uganda; see Figure 5). For this reason, we have developed an alternative approach to implementation. By sourcing donor or Corporate Social Responsibility funds to cover the development of new material, it's possible to then make this material freely available via the Internet for general use (see [www.naledi3d.com/i3dlhome](http://www.naledi3d.com/i3dlhome)). This site's download section currently contains more than 50 i3dlos under several headings, including water and sanitation, information and communications technologies for development, agriculture, health and energy use and conservation. For example, a UK-based Non Government Organization recently downloaded several i3dlos for their upcoming workshops in Kenya.

Although it's in its early days, an informal network of institutions is also evolving that's able to "localize" existing visual material and use that material in local implementation – in Senegal, Sudan, Uganda, Zimbabwe, Mozambique, Ethiopia, Kenya, Rwanda, and the Solomon Islands.

### A current case study

Zimbabwe has recently been in the news, but not all its problems are political. Across Southern Africa, poor land management is leading to fertile topsoil being washed into the ocean at an alarming rate, slowly undermining Africa's ability to feed its growing population. To help tackle this issue, the Naledi3d Factory and World Links of Harare in Zimbabwe are working together on a two-year agricultural skills development program. Supported by the WK Kellogg Foundation, this intervention builds on an earlier project that teaches bee-keeping skills (Figure 6), also used in Zimbabwe.

This project aims to empower smallholding farmers (small commercial farms that support a single family) in Zimbabwe to better cultivate agricultural land, and looks at water and soil conservation, pest, and weed control as well as selected crops such as sorghum (see Figure 7). The project also aims to incorporate the African concepts of "Dare" and "Ubuntu" (concepts of community often summarized as "humanity toward others") to develop life skills in a way that farmers can build on their own (traditional) knowledge base and adopt practices that modernize, without having to necessarily westernize their farming practices.

A range of i3dlos are being developed, and facilitators from World Links in Harare are training extension workers in Zimbabwe to in turn work with facilitated groups of local farmers.



Figure 5. Nakaseke's Main Street. This is one of our typical target communities. While electricity is supplied, water is carried in from a local stream using the yellow barrels.



Figure 6. Beekeeping and hive location. Users walk around a small rural farm and select which locations are best, or worst. The farm also provides links to many other learning areas.



Figure 7. Surveying fields to conserve soil. It's important to plough along the contour line to minimize water run-off, which can carry away lots of soil.

## Looking to the future

Being passionate about a cause when there are no manuals to consult has its rewards, but also its challenges. The Naledi3d Factory has worked for more than seven years to get socially-based VR recognized in Africa as the powerful learning tool that it is—and there is still much to do. We believe that this can only be achieved through solid partnerships with like-minded organizations. Currently, we're working closely with UNESCO and the WK Kellogg Foundation to map the road ahead for i3dlos. This is a logical alliance given that both organizations share a philosophy of freely available, open, educational learning content, a model that reflects an underlying knowledge paradigm viewpoint, which we also share.

We aim to take the i3dlo concept from the present ad-hoc project environment to one based on a broader four-to-five-year program of integrated activities. This would enable us to work toward our ultimate vision of building a library, or portal, of 2,000 to 3,000 i3dlos, each localized via a Pan-African network of partners into 15 to 20 African languages. This freely accessible resource of visually interactive learning objects would cover many areas ranging from general education to adult-based training and from technical to life skills.

**A**s a parting thought from the southern tip of Africa, in this article, we have examined one innovative, real-world application of VR that is beginning to have an impact in one of the poorer regions of the world. However, we're also coming to realize that a similar approach can similarly impact other more affluent countries—including those in North America and Europe. For example, in the USA alone, the number of functionally illiterate people has been estimated as upwards of 40 million. Many of our achievements to date have benefited from us working with local implementation partners, and to date, these have come from within Africa. We're also looking for other partners that can help take these ideas into Europe and North America. ❏

*Contact the author at [dlockwood@naledi3d.com](mailto:dlockwood@naledi3d.com).*

*Contact the department editors at [cga-vr@computer.org](mailto:cga-vr@computer.org).*

---

### Reference

1. UNESCO, *Evaluation of Virtual Reality in Africa, An Educational Perspective*, Ref.CI-2004/WS/1, 2004. [http://portal.unesco.org/ci/en/ev.php-URL\\_ID=15953&URL\\_DO=DO\\_TOPIC&URL\\_SECTION=201.html](http://portal.unesco.org/ci/en/ev.php-URL_ID=15953&URL_DO=DO_TOPIC&URL_SECTION=201.html)