White Paper – Simulation Based Learning (SBL)

The Evolution of Knowledge Transfer

An organization's knowledge is one of its most valuable assets. In fact, many notable authors and researchers, including Peter F. Drucker, have asserted that knowledge alone can serve as an organization's most sustainable competitive advantage. Since the 1990s, an increasing number of organizations around the globe have become more active in their efforts to leverage the collective knowledge that already exists within their organizations.

One method that many organizations rely to increase the use of existing knowledge is "knowledge transfer." In 2000, researchers Argote and Ingram defined knowledge transfer as "the process through which one unit (i.e., group, department, or division) is affected by the experience of another." The researchers also found that the transfer of organizational knowledge (i.e., routine or best practices) can be observed through changes in the knowledge or performance of recipient units, and that the transfer of organizational knowledge, such as best practices, can be quite difficult to achieve.

Factors that make knowledge transfer so complex are the different sources from which knowledge transfer can occur (i.e. organizational members, tools, tasks and their sub-networks), and the reality that most knowledge within an organization is difficult to articulate. However, the challenges associated with knowledge transfer are far more complex than simply improving the internal communications within an organization. If it were only a matter of communication, the problem could be solved through a memo, e-mail or staff meeting.

In the past, organizations have relied on tools such as traditional blackboard outlines, physical demonstrations including mock-ups, and video to promote the transfer of existing knowledge within their organization. Over the past decade, however, interactive three-dimensional (3D), or computer-based virtual reality (VR) content, has emerged as a means for visualizing objects, complex concepts and/or processes in a three dimensional, interactive environment. Today, government agencies, educational institutions and private sector organizations are all leveraging the power of i3D technology to communicate products, ideas and concepts.

Interactive 3D (i3D) is perhaps one of the most powerful communication and learning tools available to any organization. The purpose of this white paper is to introduce the concept of i3D as a valuable tool that can enable organizations to effectively transfer knowledge among workers, despite cultural or educational barriers. The reader will learn why i3D can help audiences and users gain a better understanding of a concept, more quickly; remember that concept for longer periods of time; and make faster decisions based on the knowledge they have gained. The reader will also learn how i3D solutions, such as those offered by EON Reality, can help engage audiences more quickly in order to foster improved communication and collaboration, which can ultimately accelerate the transfer of knowledge.

The Role of Communication in Knowledge Transfer

Regardless of its purpose, the intent of all communication is to effectively transfer a message, and knowledge transfer is no different. In order to ensure that the information included in a message is retained, and that the person on the receiving end of that message comprehends its value, the message must be supported by data that is both cohesive and cognitive. It does not matter whether the sender is demonstrating functionality of an object, describing a scenario, teaching a concept, or relaying a confusing and complex procedure, the desired result is for the recipient to understand, remember and act on the information that has been delivered. When this occurs, effective knowledge transfer has been achieved.

Leveraging a Cognitive Approach to Communication and Learning

Language and literacy are barriers that can delay or prevent effective learning and understanding. In order to increase the "Learn-a-tivity" factor, a cognitive approach should be used when creating a method of communication, program of instruction or demonstrative point, to ensure the highest levels of user retention, recall, application and transfer. The chosen dialogue for all communication, instruction and demonstration should be interactive and bi-directional, with no separation between the communication and the transaction. Concepts and ideas should not be delivered using lengthy text. I3D allows for the creation of a notion called “learn-a-tivity” – a way of continuously creating new, actionable knowledge that is achieved through the experiential learning of interactive 3D. Learn-a-tivity also is known as “knowledge in action,” which be captured, shared with others, diffused within groups and turned back into new tacit knowledge through the process of “learning-by-doing.”

Today, research shows that individuals and organizational effectiveness depends on learning better, faster, smarter and through the consistent application of learning, combined with creativity, flexibility, and paying close attention to the right things. Following instructionally sound methodologies while utilizing thinking, reasoning and remembering methods for comprehension, users of i3D (interactive 3D) will: understand faster; remember longer and make decisions more quickly. i3D is one of the most powerful communication and learning tools available today.

i3D and Learning Objects are one such method to create a new, exciting and experiential way of communicating concepts, ideas and instruction. Because information today resides in many different forms of media, including graphics, audio, video, and animation, one of the most exciting aspects of using i3D lies in its ability to blend all these forms into a singular delivery method that it can be analyzed, reused and shared with others – developing a spiral of more new knowledge creation.

i3D also can be displayed in immersive presentation formats, such as large 3D walls that use stereo glasses or transparent holographic displays. These formats can aid in creating a “first observer’s” perspective for an entire classroom in a learning environment and/or aid in motivating the learner based on a more intuitive presentation of the data. For example, a recent study conducted with 5th grade science students in Illinois found that these students spent 30% more time with the content when it was presented in interactive 3D, which ultimately improved grade levels across the board.

Understand Faster, Remember Longer, Decide Quicker

Studies have shown that when organizations follow instructionally sound methodologies while utilizing cognitive (thinking, reasoning, remembering) methods for comprehension, audiences and users of i3D will: Understand the message up to 33% faster; remember the message 37% longer and make decisions in 48% quicker time. The queue time in effective knowledge transfer is reduced through a more natural medium: i3D.

i3D 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. Combining i3D with the proven Learning Object concept is an important methodology for knowledge transfer.

A Learning Object can be described as a collection of information objects, or as the smallest useful piece of information that can be used and re-used, such as an illustration, question, definition, procedure or sound. Learning objects are assembled using metadata to match the personality and unique requirements of the individual learner. Some existing templates for the pedagogical design of Learning Objects include:

- An interactive image that enables the learner to click on a part of a picture (e.g. a human body) and get more information on that component (e.g. heart), thus supporting explorative learning;
- Supporting visualization through animation, a video clip or an i3D model;
- Visualization of procedural information that is hard to describe textually;
- Describing the different stages or phases of a process in a way that the learner can control and also navigate between them;
- Interactive simulation that enables the learner to test and try out two (or more) variables and how they influence the phenomenon and/or object presented;

- Analogy-based presentations which are a very effective way of facilitating learning whereby an abstract phenomenon is presented via a concrete (familiar) phenomenon.

Multiple Learning Objects also can be grouped into larger assemblies or nestled within each other to serve a wider range of purposes. With Interactive 3D, scenarios can be developed that are engaging, experiential and exciting, and that include audio, video and text can be developed to suit specific learners' linguistic requirements. These same scenarios also can be re-purposed to teach several different subjects. The basic building block of an i3D Learning Object is the visualization component – an i3D simulation that describes a single phenomenon, or a total process. One example of this is a simulation that illustrates blood being pumped by the human heart, in a way that also allows the learner to experiment and see how two (or more) variables influence the process, in real time.

Over time, a library of common, affordable and easily created simulations also can be published for almost any situation, subject area or task. I3D objects are:

- Accessible from one remote location and delivered to many;
- Interoperable and use widely adopted common standards;
- Developed at a single location, on one platform, with one set of tools but can be used on other platforms elsewhere;
- Adaptable and can be tailored to individual and situational needs;
- Reusable – 3D and Text components can be re-used in multiple applications;
- Durable – the 3D objects can still be used (without redesign) when base technology changes;
- Affordable – to increase message delivery effectiveness while reducing time and costs.

Communicate, Collaborate, Accelerate

Empirical studies that focus on the impact of 3D visualizations on learning are to date, rare and inconsistent. According to the *ability-as-enhancer hypothesis,* high spatial ability learners should benefit particularly from 3D visualizations as they have enough cognitive capacity left for mental model construction. In contrast, the *ability-as-compensator hypothesis* proposes that low spatial ability learners should gain particular benefit from explicit graphical representations as they have difficulty mentally constructing their own visualizations. In other words, i3D should help those with greater cognitive capacity to excel at a greater pace. For those users less inclined with spatial abilities, it should raise them to a higher level. Studies have yielded a variety of outcomes, and fundamentally those results that have yielded poorer than expected outcomes, because 3D typically failed to create a framework that was predictable and blended.

A predictable and blended framework for i3D can be accomplished, however, within parameters that follow the simple instructional method of TELL, SHOW, DO and ASK. Allowing the user to randomly wander a virtual show room or the abyssal plains in an i3D environment will yield about as much predictable and consistent discovery as if you were to drop that same user into a real showroom absent of a sales person or marketing materials. The same holds true if you were to place that person in a submarine without reference material and a map, and allow them to wander the ocean. While undoubtedly there would be some discovery returned, one could argue that sitting on the couch at home with a book or manual would be less resource intensive and yield better results.

When using i3D for any kind of communicative delivery, i.e. training, technical manual or discussion, it is important to create a blended delivery where the audience engages in a just-in-time experience, learning enough to do enough. Directing the flow of information toward the broader audience using a CRAWL–WALK–RUN delivery method, provides for the demonstration of, participatory practical application and tracking of the interaction with immediate and remedial feedback resulting in effective and measurable knowledge transfer.

Debunking the "Myths" of 2D and 3D Technology

The concept of i3D is not without its critics. Among the most common "myths" that prevent many organizations from adopting it as a method for delivering a cognitive approach to communication and learning, are:

- **3D costs too much.**
  While 3D authoring systems are more expensive to purchase than 2D, the cost of eliminating a single costly event, reducing the time to understand a product, and receiving a single order value, or reducing the instructional period for educational content shortening curriculum, often pays for the system.
- **Humans think in 2D not 3D.**
  As they mature, children actually think in 3D. The ability to draw something in 2D is not inherent, and is instead a learned behavior. "Learning" to design in 3D is actually more natural, because it is part of the process of unlocking what we, as humans already know. By applying a 2D-to-3D hybrid approach to design, 2D thought processes are applied to 3D problems, encouraging 3D learning during the process of accomplishing the design task.
- **2D is faster than 3D for making drawings and videos.**
  At on time, 3D systems were unable to perform at optimal levels when creating 2D drawings. This is no longer the case. Today, enhancements to system architectures and automated methods allow 3D users to create 3D models and their associated drawings faster than expert 2D users can create drawings alone – thus making the benefits of 3D essentially "free." For example, shooting and editing video may be faster in the short term, but there is always a good chance that the video will need to be re-shot and edited due to product or technology changes, poor quality, and the need to meet other organizational requirements. In addition, large file sizes associated with video, and the need to protect the date from improper use or theft, presents additional challenges. With 3D technology, changes can be made on the fly, the simulation is delivered in small file chunks that are streamed globally, and more importantly, while viewing a simulation that is acting like a movie, the user can change the view, perspective or event – something impossible to do with video. With a growing number of data points available through real geometry, 3D technology supports more than 130 formats that can be imported at the click of a button.
- **3D is hard to learn.**
  Many people have already made the transition to 3D using EON Reality because of its simple PowerPoint delivery system. Not only is the user interface and the applications designed to help 2D users learn 3D, but also real world demonstrations and tutorials bring a practical approach to learning. With the EON Reality step-by-step system of evolving to 3D, most former 2D users are using 3D within their presentation in a matter of days.

The EON Reality Approach

One other major criticism of traditional i3D or VR models is that different individuals cannot easily modify language elements. EON Reality believes that end users themselves should be able to effect changes to i3D or VR presentations. As such, the company has identified a need to create a standard design process for i3D models that provides engineers, marketers and educators with the ability to easily adapt text, audio and video components to local requirements – without reverting back to the development team.

Using EON Reality's technology and **Simulation-Based Learning (SBL)** approach, any 3D object can be recreated in virtual space allowing content creators to focus on a specific object or component. With recent advances in Really Simple Syndication (RSS) technology, proponents and users can quickly and easily syndicate their changes, comments or results to a global community in a matter of minutes and still use the same 3D object.

EON SBL uses real-time, interactive, photo-realistic visualizations to present subject content to any learner. The learner sees a real-time visualization of the subject, i.e. a car engine or something like the body's cardiovascular system. The learner interacts with the visualization to accomplish a learning task. The method usually involves a demonstration of the task, real-time interactive completion of the task by the learner, and real-time feedback of the learner's work. This interaction greatly stimulates the interest of the learner and accomplishes up to 40% greater retention of the subject content with the learner.

The EON SBL solution is a simulation/virtual reality-based training solution that also is extensively used as a tool to build simulation-based 3D distance-learning applications. Bringing the power and versatility of advanced, high-end simulation technology to the PC platform and the Internet, the EON SBL approach effectively moves users from static "e-learning" to a robust SBL e-learning environment.

The main application area within SBL e-learning is basic skills training where, for example, an assembly or maintenance sequence can be learned or re-freshened over the Internet instead of training on the actual product. Also hazardous training and service areas such as nursing and banking have been successfully implemented using EON SBL. Besides the i3D component EON SBL also gives a superior tracking functionality for what the student is actually doing within the training environment compared to traditional computer based training solutions.

Experience has proven that the "game-like" training environment EON can increase the engagement of students significantly, when compared to traditional training methods motivating the students to perform and learn faster.

With EON Reality SBL solutions, organizations will realize a significant competitive advantage through lower product-related training, maintenance and support costs. For example, with EON-based applications:

- **Redundant FAQs are automated** – Senior technical support staff are no longer needed to answer redundant questions and issues
- **Training costs are reduced** – EON trains employees on new product features and maintenance
- **Maintenance information is available 24/7** – Customers and support staff can use EON to access user-directed maintenance and repair instructions that can describe and visually demonstrate all-important information
- **Customer support requirements are reduced** – Interactive visual images with full product functionality provide assembly instructions and product use information, reducing reliance on customer service personnel
- **Product returns are reduced** – EON helps to ensure that customers order the right product, and the right configuration

EON support and training applications include:

- **Customer Training** – Interactive manuals and training applications
- **Internal Training** – Maintenance personnel, assembly procedures, sales force and support training
- **Service and Support** – Scenario-based problem solving and on-line support that interacts with digital products

With EON support and training applications, organizations will experience:

- Reduction in time and costs when compared to classroom training
- Reduction in time and costs when compared to on the job training
- Increase in retention and skills transfer when compared with classroom training
- "Close to real" experiences as opposed to theories
- Repetition and assessment

- Safe and realistic hazardous situation training
- 24/7 accessibility

The EON Reality solution also provides enhanced features for creating interactive training applications, both for instruction, practice and assessment. Simulations can contain a high level of interactivity giving the learner a realistic experience. Organizations that have adopted SBL technology solutions include Caterpillar, PeterBilt, Boeing and Intel, as well as many colleges, universities and educational institutions, such as the Kentucky Community and Technical College System, the Southeastern Institute of Manufacturing and Technology in South Carolina (located on the campus of the Florence-Darlington Technical College), Honolulu Community College, University of Alabama, University of Hawaii, University of Kentucky and Fayetteville Community College in North Carolina (the beginning of a statewide infusion of training of veterans for developing SBL and i3D content). The visualization technology solutions being implemented through Simulation Based Learning offer a totally new and effective interactive methodology that is changing the way people learn and ultimately will change tomorrow's workforce.

What are some of the functions of a Simulation Based Learning environment?

❖ Digitized content development creators for community college systems, exponentially expanding the 3D experiential learning offerings for classrooms and e-learning for organizations.
❖ Self-sustaining technology environments (created over a three- to five-year plan) whose revenue would be generated through contracts with business and industry for custom digital content development, or resale of already developed content assets, thus enhancing the economic growth of various states.
❖ Simulation Based Learning environments that will provide for each learner's talents and interests, not a one-size-fits-all approach, that will engage the learner, are compelling, provide for greater retention and recall and will provide for a better trained workforce.
❖ Demonstration and faculty development sites for colleges and universities, thus developing the momentum to change the way people learn through the utilization of 3D, interactive visualization technology solutions (Simulation Based Learning).

Case Study: The Application of EON Reality at KCTCS

EON Reality recently partnered with the Kentucky Community and Technical College System (KCTCS) to develop an Interactive Digital Center (IDC). The new center is part of the KTCSC statewide strategic plan for integrating visualization technologies through KTCSC, and provides a platform to develop i3D applications for education and industry and a simulation technician-certified curriculum.
The center is a component within the global IDC Consortium dedicated to establishing a de facto standard for real-time visualization solutions worldwide. EON Reality, NVIDIA, Hewlett-Packard and Christie Digital are the founding members of the consortium, with Microsoft serving as a technical provider. The innovations that make the IDC possible are based on EON Reality's i3D visualization software and solutions.

By partnering with EON Reality, KCTCS can provide students with the resources, training and programs to enable their success in tomorrow's highly competitive marketplace. Students and industry benefit from:

- **Enriched Experience**: The multi-modal approach of simulation-based learning (SBL) improves knowledge transfer and retention as users view, touch, hear, interact with and sense reactions to digital objects in real-time, creating a memorable visual, auditory and tactile experience.
- **Life-like Virtual Presentations:** An immersive presentation immediately grabs users' attention and generates interest, which enhances communication and understanding and accelerates learning and sales processes.

The relationship between EON and KCTCS has already yielded significant results:

- A training application to instruct miners on the proper maintenance and use of the CSE SR-100 self-rescuer using large-scale 3D presentation technologies is under final development for the

Kentucky Coal Academy to provide a specific safety training application that is more in-depth for new and incumbent underground coal miners.

- In collaboration with the University of Kentucky, a unique simulation education was delivered for the TRY-IT (Translating Research to Youth through Information Technology) Program. A program designed to expose 7th grade students to research experiences with the human brain, heart and mouth and the application of technology to present their research findings through use of 3D visualization technology.
- A project highlighting the new X2 Excavator from LBX was completed and presented in February of 2007 to support a business and industry client with visualization technologies.

Since its inception in 1997, KCTCS has become the largest provider of postsecondary education and workforce training in the Commonwealth. The system, which comprises 16 colleges located on 65 campuses across the state, provides a seamless path from high school to postsecondary education and the workplace by providing quality and affordable education in a structure that allows students to move easily from class to class, program to program, and college to college.

Conclusion

Today there are commercially viable applications for 3D interactive virtual reality technology, and industry thought leaders are championing the advancement of such experiences and providing as evidence that the technology convergence of virtual reality, artificial intelligence, Web and search, and digital content is now enabling people to experience more in their daily lives by blurring the distinction between their physical existence and digital reality.

Futurist Dan Lejerskar, chairman of EON Reality Inc., points to the realization of commercially viable applications for 3D interactive virtual reality technology, and the position of industry thought leaders in championing the advancement of such experiences, as evidence that the technology convergence of virtual reality, artificial intelligence, Web and search, and digital content is now enabling people to experience more in their daily lives by blurring the distinction between their physical existence and digital reality.

About EON Reality Inc.

EON Reality, Inc. is the world's leading interactive three dimensional (3D) visual content management software provider. Its powerful, breakthrough technology enables users to experience more by revolutionizing the way companies leverage their digital assets throughout the product lifecycle. With EON's software tools and applications, including Interactive Product Content Management (IPCM), Simulation-Based Learning (SBL), Augmented Tele Presence (ATP) and Rich Media Publishing (RMP), users are able to create realistic and authentic product experiences based on i3D visualization technology, delivering versatile productivity to the aerospace, automotive, manufacturing, retail, defense, education and medical sectors. Organizations including Cornell, University of Philadelphia, Texas Tech, KCTCS, SIMT, Suzuki, Siemens, John Deere, Atlas Copco, Toyota, Tetra Pak, Boeing, Bombardier, Intel, Peterbuilt, Lexus, Whirlpool, Honeywell, GE Healthcare and Stryker use EON solutions to enhance the interactive user experience to effectively increase sales, better communicate product functionality and decrease the cost of service, training and technical support.

EON Reality is the global leader in providing the most visually rich, interactive and reusable 3D experience through software and technology solutions. Its framework enables i3D content delivery from traditional virtual reality to large visual display solutions. EON Reality creates and delivers the leading i3D platform that enables companies and organizations to effectively visually communicate, visually collaborate and visually accelerate knowledge transfer while optimizing business information ranging from procurement, marketing, sales, operations, training and maintenance.

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