Virtual Reality and Engaged Learning

"Today, in most industrial countries, most people are doing jobs that did not exist when they were born. The most important skill determining a person's life pattern has become the ability to learn new skills, to take in new concepts, to assess new situations, to deal with the unexpected. This will be increasingly true in the future; the competitive ability is the ability to learn."
-Seymour Papert

Across the nation, there is a growing concern that traditional models of learning are not aligned to the education needs of the 21st Century (Jones, Valdez). Engaging, technology-based student learning is essential in better serving the unique educational needs of at-risk children. If we expect wholesale change in the lives and education of at-risk students, we must undertake fundamental and comprehensive change (Smith and O'Day, 1990).

The **"engaged" learning vision** (Means, Olson et al, 1995; Jones, Valdez, 1995) is one which will inspire greater performance in at-risk students, of which the status quo and scores of other learning methodologies have previously failed. At its core, the "engaged learning" model has student involvement in complex, meaningful projects through new learning technologies.

Advances in **cognitive psychology** have shaped our understanding of the nature of high-level intellectual performance, and give us a solid foundation in designing environments which allow for more sophisticated learning. There is now widespread agreement among educators and psychologists (Collins, Brown, Neuman, 1989; Resnick, 1987) that the advanced skills of comprehension, composition, reasoning, and experimentation are developed not by the passive reception of facts, but by the active processing of information, as in the "engaged" learning model. Means says that "educational reform calls for a shift away from organizing instruction around short blocks of time devoted to lecture or practicing discrete skills in specific academic disciplines towards an emphasis on engaging students in long-term, meaningful projects."

A major rationale for using the approach is the idea of **realistic, complex environments for inquiry**. Means reports "teachers can draw on technology applications to simulate real world environments and create actual environments for experimentation, so that students can carry out authentic tasks as real workers would, explore new terrain, meet people of different cultures, and use a variety of tools to gather information and solve problems."

"Authentic tasks" are described as the ordinary practices of the culture that engage students in sustained exploration. With simulations students can get involved with problems through visual media which provide integrated contexts and help students more easily comprehend ideas (Hasselbring, Goin, Zhou, Alcantara, and Musil, 1992). Authentic tasks are almost always more complex

than the task assigned with a traditional skills approach. Complex tasks permit students to take a more active role in defining their own learning goals and regulating their own learning. Students explore ideas and bodies of knowledge, not to recite verbal "formalizing" on demand, but to understand phenomena more deeply and search for information. (Means).

"Will public education lead the way or, as in most things, will the change first enhance the lives of the children of the wealthy and powerful, and only slowly and with much trouble find its way into the lives of other children?"
-Seymour Papert

In a hearing before the Senate of the United States, the General Accounting Office testified that "schools in central cities and those with a 50-percent or more minority population were more likely to have more **insufficient technology elements** than other schools." Schools without sufficient technological infrastructures are "not providing even a roughly equal opportunity to learn." Jones and Valdez state that the danger is that many poor schools will be precluded from engaged learning activities because, 1) schools don't have the funds to buy needed technology, 2) curricula and assessment programs focus on low-level skills even when technology is applied, 3) teachers do not have the support necessary to develop instructional strategies, and 4) the private business community is not active in poorer schools.

The problem is exacerbated by large differences in access to computers at home (Means, Blando). When youth are not sufficiently mentally stimulated in the home, schools become additionally burdened. This is where "youth" become "'at risk' youth." When the majority of a school's population is filled with children in this situation, it is imperative that new means of engaging these types of children are developed.

One of the most powerful and promising learning technologies ever created is **virtual reality**. Virtual reality is an immersive technology that allows students to step through the computer screen into a three-dimensional, interactive environment. By putting on a special headset and glove, it places students inside of a simulated environment that looks and feels like the real world. Through virtual reality, we are convinced we're in another world experiencing some event, and doing things that don't physically exist.

A helpful analogy to better understand the educational promise of virtual reality is that of a child exploring a forest for the first time. A child will best learn about the forest not from reading about it or listening to a teacher lecture, but by walking into it and becoming a part of it. The child is free to **explore** the forest any way she likes. Self-guided **discovery** and **experience** becomes the best teacher.

To date, virtual reality technology has been used primarily in the military and training. Now, however, the means to produce immersive, interactive virtual

environments have developed to the point where it is feasible to use virtual environments in schools to help students learn. (Furness, Winn, 1998)

Virtual reality is a departure from traditional computer use. Most "educational" computer programs are merely slews of text and graphics thrown onto a computer screen. The Human Interface Technology Lab at the University of Washington concluded, "virtual reality allows students to create their own experiences, the type of knowledge that has so far been possible only through direct experience with the world, never through computer interfaces or any of the third-person experiences that predominate in school."

Virtual reality, in contrast to existing computer methodology, puts students *inside* of their subjects. From their own point-of-view, students have their own self-guided personal experience with their studies. They step inside (literally) of Independence Hall (in 1787) while studying the Constitution, or travel through a computer to learn how it operates. They become a part of what they are learning, which can happen only in virtual reality. "Virtual reality creates learning environments that cannot be created using traditional strategies, and it is this quality that makes it superior to other kinds of pedagogical method (Winn, 1996)."

To date, virtual reality-supported engaged learning has "already seen practical use in an estimated twenty or more public schools and colleges, and many more have been involved in evaluation or research efforts (Youngblut, Institute for Defense Analysis, 1998)." The Human Interface Technology Lab at the University of Washington reports that "research has shown that students are capable of learning curriculum content by interacting with objects in virtual reality and that they learn more in interactive environments than in non-interactive ones. All results indicate that learning in immersive virtual reality leads to a better conceptual understanding of the subject (as compared to recall of facts) than learning in other ways."

Virtual reality-based engaged learning has the potential to profoundly influence the education of at-risk youth. Students who are labeled "**at-risk**" often are better served by teaching styles which are more visual and experiential, and virtual reality is more aligned with these non-traditional teaching styles. This is a dramatic difference for all students, especially those "at-risk" (Byrne, 1996).

When material is presented in non-traditional forms such as virtual reality, at-risk students have responded positively and showed up for school. In pilot studies, students saw interaction with virtual reality as a natural extension of their interests and were eager to continue (Bynes, Holland, Furness, 1997). The Human Interface Technology Lab states, "we have concluded that virtual reality offers new ways to learn that may help students who do not learn well in traditional ways."

Virtual reality-based engaged learning will raise the educational standards at at-risk children. At-risk children are commonly assumed not to have the capacity to learn sophisticated ideas, further adding to the cesspool of chronic academic and personal underachievement. NASA's Software Technology Branch says, "by using multi-sensory virtual reality in education, many researchers believe that complex, abstract material now considered too difficult for many students and taught even to advanced learners only at the college level could be mastered by most students in middle school and high school." Students accept multi-sensory learning very quickly, and this fact is increasingly true of at-risk students who have been bombarded with images from television, movies, and videogames.

Traditional teaching methods have often not been effective in the goal of seizing these students' attention, often relegating them to a passive role in the classroom. This is contrary to the wisdom that learning is much more effective when it is an active discovery process. Reporting a **1998 Chicago Public School Pilot study of virtual reality**, Sykes and Reid report, "using virtual reality in the programs was an effective response to pressing educational needs. First and foremost, students, especially at-risk students, must become more involved with their studies. To many students today, school is boring."

Similarly, new teaching methods and technologies must be pioneered to relieve teachers of the growing burden placed upon them by the today's classroom and its changing role in society. From a teacher's perspective, virtual reality creates a structured environment that focuses students on specific learning objectives, similar to good teaching. Using an engaged approach to learning greatly heightens the relevance of traditional teaching techniques such as student classroom participation and reading textbooks.

One of the main barriers to classroom learning in at-risk schools is antisocial behavior. Children from broken-homes and impoverished environments often use schools as a place for "lashing-out," expressing adjustment problems, creating barriers for other children to learn. Teacher's jobs are made harder because they often have trouble controlling the learning environment. These problems become apparent by the time students are ten to twelve years old, the middle-school period. Fortunately, many of these problems can be minimized. When students are immersed in the virtual reality-based engaged learning environment with a headset, there are no distractions to learning. Students are totally focused with no unruly behavior. (Sykes, Reid, 1999).

Finally, virtual reality programs greatly extend the resources of schools. Most students today learn in an environment that is far from modern. Most schools cannot support a wide spectrum of learning experiences necessary in engaged learning because of high costs. Virtual reality education software enables students to have access to wide range of experiences and explore new active learning environments.

Means has specified eight indicators for engaged learning, all of which are supported by the virtual reality-based engaged learning model.

Variables of Learning and Instruction	**Indicators for Engaged Learning and Reform Instruction**	**Role of Virtual reality (VR) Technology In Engaged Learning**
Vision of Learning	Responsible for Learning Strategic Energized by Learning Collaborative	VR is based on self-directed learning (Brown, Mikropoulos, Kerr, 1997). Student motivation is greatly increased when learning is supplemented by VR (HIT, 1997).
Tasks	Authentic Challenging Integrative/ Interdisciplinary	Stuart and Thomas (1993) report the age of television has bred passive and disengaged students with short attention spans. VR captures student attention (Byrne, et al, 1994, Sykes, Reid, 1999).
Assessment	Performance-Based Generative Seamless and Ongoing Equitable	VR learning focuses students on specific learning objectives, and is easily integrated into existing curricula (Sykes, Reid, 1999).
Instructional Modes	Interactive Generative	VR supports true learning-by-doing. Students actively control the environment and directly experience resulting behaviors (Dede, 1997).
Learning Context	Collaborative Knowledge Building Empathetic	VR offers the facility for shared-experiences between students and teachers (Brown, et al).
Grouping	Heterogeneous Equitable Flexible	The VR lab structure allows flexible grouping arrangements (Sykes, Reid, 1999).
Teacher Roles	Facilitator Guide Co-learner	VR greatly eases teacher burdens, becoming learning facilitators as students explore and learn in VR. Teachers guide students' self-discovery process and assist in building ideas (Osberg, 1995; Sykes, Reid, 1999).
Student Roles	Explorer Cognitive Apprentice Teacher Producer	The exploratory quality of VR provides a capability that is fundamental to the learning process (Dewey, 1916;Brunner, 1962; Silberman, 1970; Papert 1980; Byrne, et al 1995).