25 MOST INFLUENTIAL PEOPLE IN EDUCATION & TECHNOLOGY

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THORNBURG CENTER FOR SPACE EXPLORATION FOUNDER

DAVID THORNBURG

David Thornburg is Out of This World

BY VICTOR RIVERO

The alarm has caught everyone's attention *on the ship. Control panels are showing alerts and an urgent video link from the Earth-based Space Weather Service at NOAA reports that a massive solar storm has ejected a huge blast of particles headed toward the class B interplanetary spaceship at a million kilometers per hour. As crew members are checking the shields, they realize that their current magnetic radiation protection may not be strong enough to keep them from all being killed in a few days when the storm reaches them on their journey to Mars. Teams quickly form to design new electromagnetic shields that have to be tested and installed quickly! Fortunately, a solution is found by the crew and the mission proceeds safely.*

This is not a scene from a science fiction movie, it is an event happening with Middle School students taking a simulated trip to Mars in search of evidence for extraterrestrial life. These students are in their school but instead of being seated in rows in a traditional classroom, they are in a special room, the Educational Holodeck. This room's function is determined by special computer software to create a fully interactive and immersive environment in

which children apply their knowledge and skills to the solution of problems that break traditional disciplinary boundaries. The design of shields requires them to learn about the behavior of charged particles, the design and operation of electromagnets

"Have you ever seen a scientist at the supermarket?"

BRAVE NEW CLASSROOM. The Educational Holodeck has arrived and inventor David Thornburg wants it to catch on worldwide.

they will build themselves, along with other topics that cut across typical math and science classes. They do not ask why they need to know this stuff—their life, and the success of their mission depends on it! Engagement is complete.

We recently had the chance to interview the inventor of the Educational Holodeck, Dr. David Thornburg, at his facility in Recife, Brazil where the world's first installation is in progress. David splits his time between the U.S. and Brazil and is active in educational projects in both countries. His current project is a large undertaking that just may change the face of education for many children.

Victor: Why did you create the Educational Holodeck?

David: The Educational Holodeck is a direct response to two things: First, traditional full-frontal education has never worked for everyone. Part of the reason for this, I think, is that traditional classroom layouts are designed to make people "believe," not to make them "think." As a result, many students are unengaged with the content. This has several consequences. First, they forget much of what the learned after the final exam is given. Second, they grow up with fragmented ideas about disciplines that show a lack of understanding about people who work in the fields of their studies.

We (and others) have asked kids questions—"Have you ever seen a scientist at the supermarket?" The common answer is "No." When asked why, many kids see scientists as old men with very thick glasses who wear lab coats all the time. Ask them about mathematicians, and the answers are even more revealing—many kids either think that all mathematicians are accountants, or they have absolutely no idea what mathematicians do on a regular basis. Even popular shows like Num3ers have done little to fix this problem.

Educational Holodeck: An almost empty room that can be configured to be almost anything for the purpose of letting children take part in educational missions.

One of the causes of this challenge comes from children only having a partial epistemic frame through which to view activities or professions. The theory of epistemic frames, developed by David Shaffer at the University of Wisconsin, states in essence that any professional embodies five attributes: the knowledge, skills, identity, values and epistemology (way of thinking) associated with their profession. On a good day, K-12 education can address parts of the first two of these, but it is the rare teacher who explores them all. The Holodeck was created to address this challenge. First, when students are conducting a mission in this special room, they not only apply their knowledge and skills, they start to develop the remainder of their epistemic frame as well. Also, the Holodeck missions are designed to embrace subjects in a interdisciplinary fashion—science, math, engineering, technology are all integrated and creativity is paramount in conducting a successful mission. The Holodeck looks completely different from a traditional classroom, and the computers in it are used in very different ways as well.

FUTURE NOW. Futurist David Thornburg is the inventor of the much-anticipated "Educational Holodeck."

Victor: What does the name mean?

David: As with many of today's technologies, the Holodeck owes its existence to science fiction—in particular the TV series *Star Trek: The Next Generation*. The spaceship contains a special room that can be configured to be anything you wish, all by changing the program in a computer. In the fictional Holodeck, objects appear real—they can be picked up, etc. This vision has captured the imagination of many. In our case, we realized that a version of this room could be built at fairly low cost using existing technology and some custom software. I like to compare the fictional and actual Holodeck this way:

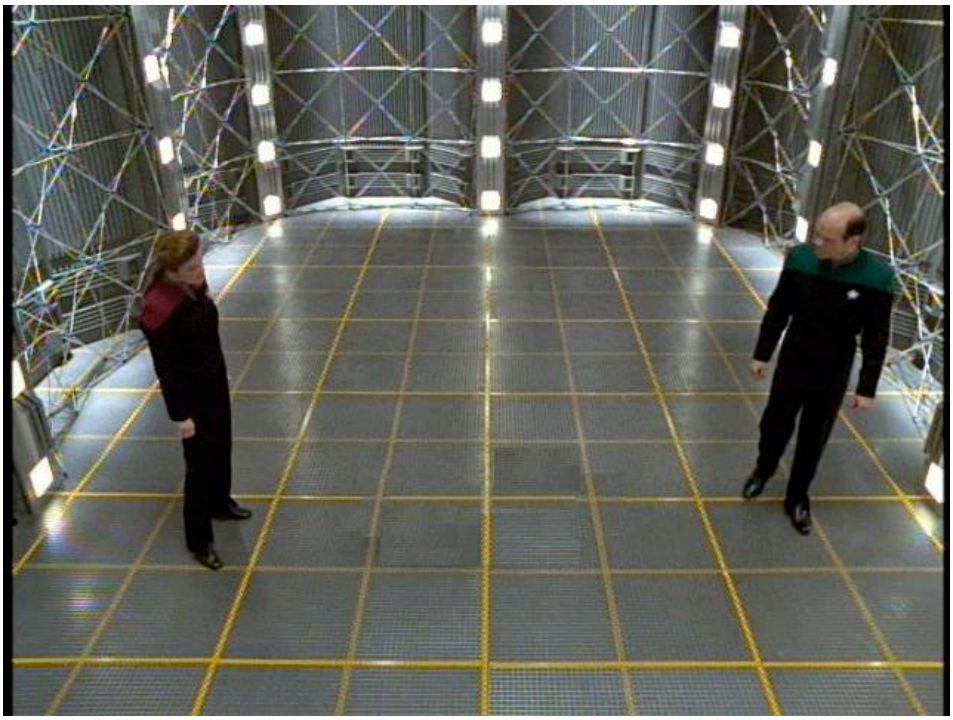
Holodeck (fiction): *An empty room that can be turned into anything under the control of a computer program.*

Educational Holodeck *(non-fiction): An almost empty room that can be configured to be almost anything for the purpose of letting children take part in educational missions.*

As with the fictional Holodeck, when you enter the educational room, it has bare walls and a bit of furniture.

Once the computer system is turned on, the walls become alive with fully interactive control panels, a huge viewport out the front of the "vessel"—basically, everything you need. The room is a fully immersive and interactive environment. There are no passive observers. Everyone in the room has a role to play and rules to follow. Imagine a (physically) large role-playing game based on reality, not fantasy. I think of the deck as a "theater without an audience." It is impossible for a teacher to give a lecture in the room, because there is no audience!

"It can be a time machine heading back to the Middle Ages. It can be a microscopic vessel exploring the interior of the human body."



FROM STAR TREK TO REALITY. Gene Roddenberry brought it to our living rooms, now David Thornburg wants the holodeck for our schools.

Victor: Who created it?

David: The Holodeck concept and early prototyping was done by myself. It has now grown to a project of sufficient size that others have joined the team. Renato Santos heads up the Brazilian delegation and is playing a critical design role of the room itself. (The first Educational Holodeck in the world is being built in a school in Recife, Brazil.) As of this writing, I am part of a team of eight people whose skills range from content to project-based learning (a central pedagogical model used in the deck) to hardware and software development.

Victor: What does it do? What are the benefits?

David: Because the room is as bare as possible without he computers being turned on, the Educational Holodeck can be used for all kinds of missions. It can be a spaceship heading to Mars in search of extraterrestrial life. It can be a time machine going back to the Middle Ages. It can be a microscopic vessel exploring the interior of the human body. Basically, you can explore just about anything you want in this environment, as long as you have the right software. Our first mission,

based on interplanetary travel, is nearing completion and we are talking with developers in other mission areas at this time.

One of the huge benefits of the Holodeck is that academic subjects are explored in context. For example, if a solar storm threatens the spacecraft (as is likely during the next two years), students can experiment with magnet designs to act as partial shields for the radiation. This involve physics and math. Looking for life by examining dirt samples from Mars not only merges geology with life sciences, but introduces awareness of the need to protect ourselves from possible alien pathogens. It even involves the ethical issues of how we can collect samples without risk of contaminating Mars! As a result, science, math, etc, no longer exist in the students' minds as stovepipes, but as fully integrated disciplines. This understanding reflects the real view of professionals in the field.

This brings up another important topic in mission design. Our rule is that the problems people encounter during a mission reflect the real kinds of challenges that people might experience if the mission were real. Also, we break as few laws of nature as possible. (The exception in space travel is the need to travel at hyper-luminous speeds, or the mission would take a year or more to complete!)

"We use educational technology to do completely new things—not to do old things in new ways."

Victor: How is it unique from other similar products/ services? What companies do you see as in the same market?

David: At this point, there is no one to my knowledge building anything remotely similar to the Educational Holodeck, although companies like Google and Disney are known for creating immersive interactive environments (For example, Google's Liquid Galaxy project shown at TED this year). Our room accommodates 30 students at a time, with students forming disciplinary teams—geology, life sciences, etc., but also working across disciplines as the need arises.

Another unique part of our project is that we use educational technology to do completely new things, not to do old things in new ways. For example, interactive whiteboards are almost always used a replacements for blackboards. In this case, we have taken a powerful new tool and turned it into a replacement for a technology that comes from the distant past. Our use of interactive boards is quite different—they become the canvas on which interactive control panels are projected. When students push on the projected buttons, they respond as if they were real. The technology in this case, fades into the background, revealing only the mission itself!

Victor: When was it developed? What is something interesting or

relevant about its development history?

David: The Educational Holodeck concept is about a year old, but has really gained traction in the past six months. The development history is interesting. For more years than I can count, I have spoken at schools and districts about the need for real transformation of education, worldwide. While audiences were generally enthusiastic, nothing much was getting done. Then it hit me that the physical structure of normal classrooms was actually antithetical to learning. It is a miracle that the dropout rate in the US is only 25 percent—this testifies to the extreme dedication of teachers who try to do magic in a room designed for other purposes in the Middle Ages. Some people ask if this project is a response to the needs of the so-called "digital natives." In fact, no. While it may be true that school sucks for many of today's youth, it has always sucked. I spent many hours as a kid letting my mind wander into truly interesting areas while my teacher droned on about something in a lockstep curriculum. The symptom of this kind of education is seen whenever a child asks, "Why do I need to know this?" or, "Will this be on the test." We have done an amazing job of stripping context and engagement from truly fascinating subjects. I think we could stop teen pregnancy overnight by requiring all students to take a lecture-based textbook-driven course on sex. Celibacy would be the norm overnight!

"The training for educators in Holodeck-equipped schools is absolutely essential."

While procreation is not one of our planned mission topics, the others we are designing are created to fully engage students in the solution to very challenging activities representative of the kinds of things professionals in the field of the mission do (or will do in the future).

Victor: Where did it originate? Where can you get it now?

David: While the original idea was developed in the U.S., and a small prototype was demonstrated to teachers in Indiana a few months ago, our first large-scale opportunity came from a school in Recife—where we live part time. This school was an existing client for other projects, but when they heard about the Holodeck, they wanted one for themselves. As a result, the world's first Educational Holodeck is under construction in Brazil.

Since word got out that I wasn't just making this stuff up—that it was becoming real—we have been receiving more interest from some schools in the US. The US focus on STEM education may make projects like this easier to fund.

Each Holodeck is built in consultation with the client, and I can be contacted at dthornburg@aol.com if anyone is interested.

Victor: What training is required?

David: The training for educators in Holodeck equipped schools is absolutely essential. It involves several components. First, exploring the subject matter resources needed for any mission. Second, educators need to learn to be comfortable in an inquiry driven, project-based model of education. Lectures, worksheets and textbooks have no place in this environment. Third, the staff needs to know how to run a mission, including assessments, software use, maintenance, etc. Our team provides all this training, typically starting with a week long workshop, followed by online support and periodic site visits.

Victor: How much does it cost? What are the options?

David: The cost of the room depends on how much technology a school already has that can be devoted to the project. Starting with nothing but the room itself, a deck can be built for $25,000 or so—maybe even less. This includes all the equipment, locally contracted installation, etc., because the room can be used for many different kinds of missions, and even used as an A/V room when not used as a Holodeck, the cost is quite reasonable. The staff development cost varies and interested schools should contact us directly. We are huge fans of "train the trainer" models, which allows ongoing staff development to be done by the school's own staff development team.

"I had a hard time in school. My life before high school was a living hell."

Victor: Who is it particularly tailored for? Who is it NOT for?

David: This project was initially designed for students in Middle through High School. That said, there is nothing to keep projects for younger children from being developed. Our goal is to reach children who are starting to get a deeper exposure to (for example) STEM subjects and helping them see what these subjects are used for!

Victor: What are your thoughts on education these days?

David: Education, world wide, is in trouble. When I was young, High School dropouts could still get good jobs and rewarding careers. That is no longer true. It has nothing to do with test scores. In fact the romance with measurement is hurting education in my opinion. Students should be learning things because they find them useful and engaging, not because they are on a test.

Victor: What sort of formative experiences in your own education helped to inform your approach to creating the Educational Holodeck?

David: I had a hard time in school. My mind wandered, I asked "What if?" If the teacher told me the capital of Illinois was Springfield, I would ask "Why? Why Springfield and not someplace

else?" The teacher didn't know because that wasn't in the book. So my school life was (before high school) a living hell. Home was a different story. My father owned a clinical laboratory and was a first-rate bacteriologist (in fact he named a very nasty bug after me— thanks Dad!) My mother was a member of the Bauhaus movement when it moved to the U.S. where, as an artist, she also developed an interest in the use of machine tools! By following these two around, it is little wonder I ended up getting a Ph.D. in the sciences. But this interest was developed in spite of school, not because of it.

Most children do not grow up in the environment I had, and are thus deprived the opportunity to develop a deep love of creativity, science and engineering. Because I went to what was then known as a vocational High School (Lane Tech in Chicago) I was able to use my hands and my brain at the same time.

"Their education is a key to their success in shaping the world in which we all live—a world that will soon expand to reach other planets."

These experiences surely helped inform my desire for a new educational environment accessible to all children, and the Educational Holodeck is the result.

Victor: What is your outlook on the future of education?

David: Children in school today will include those creating the first colonies on the Moon and Mars. They will invent technologies we can't imagine today. They will hunt down and find cures for dread diseases. They will contribute to a better life for all as we address environmental challenges.

Their education is a key to their success in shaping the world in which we all live—a world that will soon expand to reach other planets.

Victor: What else can you tell educators and other leaders in and around education about the value of the Educational Holodeck? What makes you say that?

David: If it does nothing else, the very existence of an Educational Holodeck shows that the traditional classroom *can* be replaced by something more effective. Whether people choose to adopt or reject this notion is their decision to make. I am in no way suggesting that the Educational Holodeck is the *only* way to address this challenge, but it is one way to do it, and the technology for it exists today. etd

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