Three-dimensional video is coming soon to education; here's what you should know about this emerging trend

Learning in 3-D

The automobile, moving pictures, personal computers, cell phones, and social networks—all of these technologies, once considered frivolous, have made such a huge impact on our culture that our daily lives would change dramatically without them.

Could 3-D video be next?

It's a question made relevant by new improvements (and falling costs) that soon could make 3-D video commonplace in theaters, homes, and even schools.

Owing to rapid advances in technology, 3-D video already is taking cinema by storm—and mainstream use of 3-D video in the home and elsewhere isn't far off. What's more, advocates of 3-D video say it has the potential to revolutionize the way students learn.

"It's not something you watch," says director James Cameron, who's filmed his new movie Avatar in 3-D. "It's a reality you feel you could step into."

Poised for mainstream adoption

Approximately one in every three digital theater screens in the United States is equipped for 3-D video, according to the report "3-D TV: Where Are We Now and Where Are Consumers," by David Wertheimer, CEO of the Entertainment Technology Center at the University of Southern California, and Shawn DuBravac, adjunct professor at the George Mason University School of Business.

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3-D video glossary

To help you better understand the terms and technologies associated with 3-D video, eSchool News has crafted this 3-D glossary.

Types of 3D technology

- **Active shutter:** This technology requires glasses that electronically open and close liquid crystal lenses over each eye, synchronized with a 3-D video display. When this display presents a left eye image, the glasses cover the right eye so only the left eye sees the display, and vice versa for the other eye. This process is repeated more than a hundred times per second and is virtually undetectable to the user. Although movies in active shutter 3-D are extremely rare, the technology is often used for PC games in 3-D and 3-D education projection.
- **Anaglyph:** This is a very old 3-D technology that was once very popular in movie theaters. It creates the illusion of depth by having the two images (left and right eye) filtered in the color spectrum. By wearing the appropriately colored glasses, the eyes see the corresponding left or right eye image, and the visual cortex in the brain translates the difference in those images as depth. Anaglyph is a relatively inexpensive way to view 3-D video, but because images are composited into a single image from the original left and right eye information, they can appear washed out, because the process removes some of the color. Anaglyph 3-D can be viewed on any computer monitor or TV, and while it is most commonly used for home viewing of 3-D movies, some PC games also can be found in anaglyph.
- **Passive polarized:** This technology is most commonly found in theaters today. It requires light from the projector to be polarized so that it is filtered in a very specific way that does not alter the color. The light projects onto a screen that preserves this filtering upon reflection. Then, glasses with special lenses either block the polarized light or allow it to pass through, depending on the type and degree of polarization. By wearing these inexpensive, plastic glasses, each of the viewer's eyes sees full-resolution, full-color 3-D images from the corresponding (right or left) projector. Some of today's more advanced flat-screen technology incorporates a film layer that can polarize light in a similar manner as a theater projector and screen.

Key terms

- **DLP Link:** This is a communication protocol that uses the DLP chip inside DLP TVs and projectors. The DLP chip sends a flash of light in the transition between left and right images, and the glasses—recognizing this encoded white signal—sync to the image. These glasses do not require an emitter. The glasses work with Mitsubishi and Samsung DLP TVs and with 3-D-ready projectors.
- **Hz:** The hertz is a unit of frequency. In video parlance, it refers to the number of complete frames per second of video.
- **Stereoscopic:** Any technique capable of recording 3-D visual information or creating the illusion of depth in an image.
- **XGA, SXGA:** The Extended Graphics Array (XGA) refers to a display resolution of 1,024 x 768 pixels. The Super Extended Graphics Array (SXGA) refers to a standard monitor resolution of 1,280 x 1,024 pixels and is a step above XGA.

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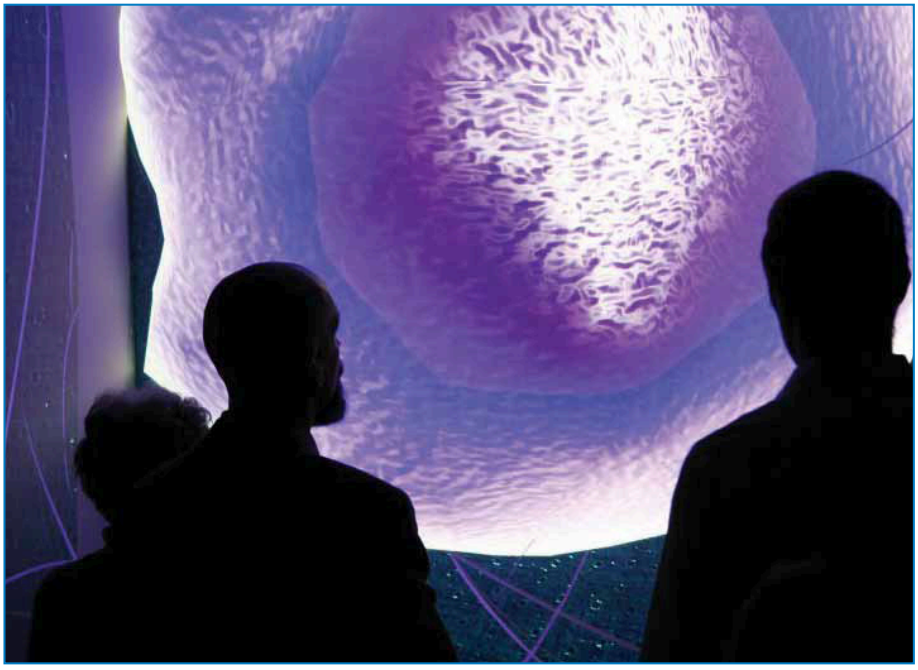
According to the report, once given a taste of 3-D video, "consumers show significantly higher interest in viewing additional movies in 3-D and potentially buying and viewing 3-D in their homes." Of those who have seen a 3-D movie in the last year, 60 percent are willing to spend more on a 3-D television for their home, and 19 percent are willing to spend up to 25 percent more, the report says.

3-D video is on the cusp of becoming mainstream, says the report. And with mainstream adoption imminent, education is soon to follow, says Phil Lelyveld, program manager for the Consumer 3-D Experience Lab at USC's Entertainment Technology Center.

But such high-end 3-D applications typically cost several hundred thousands of dollars. Now, Texas Instruments (TI) has developed a 3-D chip that works with standard Digital Light Processing (DLP) projectors, bringing 3-D technology to the masses—and at prices that are comparable to those of other XGA and SXGA projectors.

That has many people excited about 3-D's potential to facilitate teaching and learning.

"As educators, we all too often are required out of necessity to make students take three-dimensional concepts and try to learn them in a two-dimensional perspective. This disconnect creates a gap in learning between those who naturally can map back to three dimensions and those who can't," said Stan Silverman, professor at the New York Institute of Technology's School of Education.



The Virtual Cell application in Iowa State's C6, a six-sided immersive virtual-reality system.

3-D video isn't actually new to education; for years, it has been used in advanced research projects at colleges and universities, such as immersive virtual-reality environments. Iowa State's Virtual Reality Applications Center (VRAC), for example, has been on the leading edge of 3-D technology since 2000.

That year, the VRAC opened the C6, the first six-sided immersive virtual-reality system in North America. The C6 is a 10-foot-by-10-foot room in which computer images are rear-projected onto soft vinyl screens on all four walls, the floor, and the ceiling.

To meet the VRAC's resolution requirements and support stereoscopic viewing, four projectors are stacked vertically for each surface, reaching about 10 feet high. Images from two of the projectors blend together to make up a 4,096-by-4,096-pixel right-eye image, and the other two projectors provide the left-eye image.

To get the full immersive experience, users of the C6 use active-shutter glasses to see the images in 3-D, and they interact with the virtual world by using gloves, wands, and a variety of haptic devices. These devices are linked to the system via wireless communications.

So far, biologists have used the C6 to "shrink" themselves down to cellular level and experience a 100-million-pixel virtual cell simulation, partially funded by National Science Foundation (NSF) grants. The military also uses the C6 to train for combat.

The new generation of 3-D-ready projectors "is a long-awaited innovation that will greatly change the way students learn," Silverman added. "Now, all students can better grasp spatially related concepts—and the visual impact of all education content is likewise enhanced."

How 3-D projection works

3-D video creates the perception of a differential between two slightly offset images when viewed by each of two eyes. By presenting each eye with a slightly offset or different image, a projection system or display can create the illusion of depth.

The 3-D images seen in today's movie theaters typically rely on separate projectors for the left-eye and right-eye images. The polarized light from these projectors is filtered and projected onto a special screen that preserves this filtering upon reflection. Viewers wear inexpensive, "passive" glasses that either block the polarized light or allow it to pass through, depending on the type and degree of polarization.

TI's new 3-D technology uses just a single DLP projector, and no infrared emitters, polarizers, or special screens are required. Viewers wear special "active shutter" glasses, which electronically open and close liquid crystal lenses over each eye, synchronized with a 3-D

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video display.

Through a communication protocol known as "DLP Link," the DLP chip in the projector sends a flash of light in the transition between left-eye and right-eye images, and the glasses—recognizing this encoded white signal—sync to the image. So when a left-eye image is presented, the lens over the right eye closes, and vice versa. This process occurs more than a hundred times per second and is virtually undetectable to the user, resulting in a seamless image that appears in 3-D.

So far, roughly 15 projector manufacturers have adopted TI's 3-D technology. There are 35 projector manufacturers that use DLP technology in all, and TI's DLP division shares its technology, which includes 3-D capabilities, with all of these companies.

One of the manufacturers that now offers 3-D-ready projectors is BenQ.

"The problem used to be the technology, which was very costly and unstable," said Juan Alvarez, U.S. education director for BenQ. "But with this DLP chip, we can afford to offer 3-D-ready projectors with absolutely no digital premium. Education list prices for this 3-D projector are the same as for a regular XGA projector—roughly $649 for the end user. You're basically future-proofing the classroom at no extra cost."

Alvarez said 3-D-ready projectors are a wise investment for educators.

They are "good for learning spacial issues," he said. "Imagine learning about a human cell. But it's not flat on a page—it comes alive in front of your eyes. You don't have to guess or imagine, because it's right in front of you."

Chicken and the egg

Although the projectors themselves are available for purchasing now, 3-D content for the classroom is another story. As of press time, there was only a limited amount of K-12 educational content available in 3-D, though content developers are working on producing more.

"It's the chicken and the egg story," said Jim Hirsch, associate superintendent of technology for the Plano Independent School District in Plano, Texas. "Content made specifically for K-12 hasn't been created yet, because content creators are waiting until more classrooms are 3-D capable. However, educators aren't jumping on 3-D yet because there's not an abundance of 3-D content."

Hirsch, a tech-savvy leader whose district is near the forefront in technology and achievement, said that while there is some 3-D content available now—all of it high quality—it's sparse and mostly deals with high school science subjects.

Tim Beekman, president of SAFARI Montage, a supplier of on-demand educational videos, said 3-D content providers are working to develop science and math content, but 3-D video created solely for education has many characteristics that need to be thought through, and this will take some time.

"Right now, [SAFARI Montage] is looking into roughly eight to 10 content providers who are developing 3-D content, and in the future, we hope to partner with many 3-D content providers," Beekman said. "The thing is, there are many different formats available for 3-D content, and the education sector needs to work with 3-D content providers to figure out which format works best for what type of classroom. Also, how will the content be displayed? On SMART or Promethean boards? Will it be still images? Motion? What kind of motion? Rotation? And will the content be sound enough to enhance learning?"

Beekman explained that content can't be rushed, because the quality needed to create educationally relevant classroom materials can't be compromised.

"What we're hoping to do at this point is to piggy-back off content created for higher-ed projects and other science, technology, engineering, and math projects," said Hirsch. "We figure there's good 3-D content being created, and why can't education use that content, too?"

Beekman, however, takes a more cautious view of 3-D's role in education.

"I see it as a vertical market, because there's just so much that has to be in place for 3-D to go right, such as glasses, glasses maintenance, high-end laptops with high-resolution graphics cards, new projectors, specialized content, and specialized lighting. My guess would be that only specialized tech science labs would use 3-D heavily, and it might be another two years before this happens," he said.

Preparing for the future

Still, with so much potential for 3-D video to help students learn, and with prices for 3-D projectors no more expensive than comparable 2-D models, educators have nothing to lose by "future-proofing" their classrooms, projector makers say.

That's just what Colorado's Boulder Valley School District has done, purchasing more than 1,000 3-D projectors from Vivitek Corp. for mounting in every classroom.

The district, which spans 500 square miles and has 28,000 students in 51 schools, has always been an early adopter of technology, according to Len Scrogan, director of instructional technology.

"We always have extensive planning—we take our time, consider what really matters, and then we make investments in what matters when it comes to technology and our district," Scrogan said. "We live stream [video], we have many internet projects, and we plan on distributing 3-D [video] as part of our technology backbone."

A key argument for investing in 3-D projectors now, despite the scarcity of K-12 content so far, is that 3-D projectors using TI's DLP Link technology also function normally as 2-D projectors without any image distortion.

"Educators can switch from 2-D content to 3-D content automatically, from the same projector," Alvarez said. "The content tells the projector how it's formatted, and the chip goes from 2-D to 3-D, or back again, seamlessly."

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3-D projector models

Here are some of the many 3-D capable DLP projectors on the market today.

BenQ Corp.

BenQ offers three 3-D DLP projectors for the education market: the MP626, MP670, and MP772ST.

Intended for small and medium-size classrooms, the MP626 features XGA resolution, 2,500 ANSI lumens, a 10-watt speaker system, Ethernet-based asset management, and a lamp life up to 4,000 hours. It is priced at $649 for education.

Built for larger classrooms, the MP670 includes the same features as the MP626, except it's brighter, at 3,000 lumens. It sells to schools for $899.

The MP772ST is a short-throw projector that can cast an 82-inch diagonal image from only 3.3 feet. It features XGA resolution, 2,500 lumens, two 5-watt speakers, Ethernet-based asset management, and a lamp life up to 4,000 hours. It costs $749 for education.

http://www.benq.us

Mitsubishi Digital Electronics Corp.

Mitsubishi's XD600U is a 3-D-ready micro-portable projector with XGA resolution, 4,500 lumens, a contrast ratio of 2,000 to 1, a 10-watt speaker system, RJ-45 connectivity, built-in support for closed captioning, instant shutdown, and an estimated lamp life of 5,000 hours. Contact Mitsubishi for pricing.

http://www.mitsubishi-presentations.com

Optoma USA

Optoma's 3-D projector models include the TX542i, a network-ready projector with XGA resolution, 2,800 ANSI lumens, a 3,000-to-1 contrast ratio, and a 10-watt speaker system. The TX542i also includes remote management and control via RS-232 or RJ45 connectors, a built-in security bar and control panel lock, built-in closed captioning, and an eco-friendly standby mode that uses less than a watt of energy. Contact Optoma for pricing.

http://www.optomausa.com

ViewSonic Corp.

ViewSonic's 3-D models include the PJD6211, PJD6221, PJD6251, and PJD6381.

The PJD6211 features XGA resolution, 2,500 ANSI lumens, a contrast ratio of 2,000 to 1, and built-in closed captioning decoder. The PDJ6221 features XGA resolution, 2,700 lumens, a 2,800-to-1 contrast ratio, a 2-watt speaker system, and RJ-45 connectivity for remote network control.

The more advanced PDJ6251 offers XGA resolution, 3,700 lumens of brightness, a contrast ratio of 2,000 to 1, two 5-watt speakers, RJ-45 connectivity, and a filterless design for lower total cost of ownership. And the PDJ6381 is a short-throw projector that can produce a 50-inch diagonal image from just 27 inches away. It, too, features RJ-45 connectivity, two 5-watt speakers, and a filterless design, as well as XGA resolution, 2,500 lumens, and a 2,400-to-1 contrast ratio.

Contact ViewSonic for pricing.

http://www.viewsonic.com

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Hirsch's district has been using the same DLP projectors since 2000. Plano has 2,100 projectors in classrooms throughout the district, and, according to Hirsch, in the last nine years only seven projectors have broken and needed maintenance.

"Projectors are a 10-year minimum investment," he said. "But if someone came to my district and said, 'I will sell you 3-D ready projectors for only $25 more than a regular projector,' I'd have to seriously consider it—because being 3-D ready is worth it."

An audience uses 3-D glasses to watch a three-dimensional video projection.

Hirsch added: "By [purchasing] a projector that's 2-D and 3-D capable, if the content never comes, well, at least you still have a great 2-D projector. But if the content does come, and 3-D is really the next big way students learn, then you're ready, and for a low cost. Being ahead of the curve is something education could benefit from."

What schools will need

TI's DLP division provides a graphic for educators, showing what it calls "The DLP 3-D Classroom Ecosystem." The ecosystem consists of everything a teacher will need to take advantage of 3-D video in the classroom: a computer, 3-D projector, active-shutter glasses, and 3-D content from providers such as EON Reality, RM Education, NEOTEK, SAFARI Montage, Discovery Education, and Promethean.

So far, the available content includes frog dissections, a walk-through of famous architectural structures, animations of the human body in detail, topographies, and a fly-through of the universe.

Sound Video Systems, maker of the AVRover brand of portable audio-visual systems, has partnered with BenQ to release the AVRover 3DSVS24, which the company says is the "first fully integrated 3-D Stereoscopic Educational System." The product is a portable and rugged 3-D AV system with all components securely mounted inside. It features a powder-coated, scratch-resistant steel console, as well as a 3-D projector from BenQ and sequentially numbered active-shutter glasses, storage, and sanitation for an entire class. It lists for $7,895.

SAFARI Montage has partnered with AVRover and BenQ to provide 3-D content to educators who decide to purchase the system. While most of the SAFARI 3-D content is not yet available, Beekman says it will be soon.

According to AVRover and BenQ, 3-D classroom components must meet very strict standards in order to be sustainable. For example, eyewear must be robust, easy to operate, sanitized after use, have a continuous-use battery life of six hours or more, and fit the faces of students ages four through 18. And everything must be easy to use.

"Educators have a lot to think about when considering how to implement 3-D," said Bob Wudeck, business development manager for TI's pro AV group, "including the brand of projectors, the content you want to use, research on 3-D and the technology, how best to invest, what type of glasses to use, and how you're going to clean those glasses."

Wudeck noted that AVRover's eyewear-cleaning box is a convenient solution, and he said "little things like this" can really help a district when switching to 3-D.

He added, "There really isn't a significant capital investment up front. The only thing you'd really have to buy is the glasses."

"After displaying a working 3-D system at Infocomm and [the National Educational Computing Conference] this past June, I have been overwhelmed with interest from all segments of the 3-D industry," said Mike Rodems, founder of Sound Video Systems, maker of the AVRover.

"I have met with people from the manufacturing segment: glasses, video cards, projectors, and computers. I met people who produced 3-D systems that utilized other technologies. I met 3-D video and object content producers. I met distributors of 2-D content that want to include 3-D content in their offerings. I met dealers who want to offer 3-D systems and 3-D content to their customers. I also met educators who want to know what is available and how to integrate it into their curriculum."

He continued: "Based on the incredible interest I have seen in 3-D, I believe the availability of more affordable technology will encourage content producers to develop more and more educational content that will enhance the learning experience in certain classes, primarily math and science. [3-D video] also will enhance the design and engineering process in higher-ed and the business world, by allowing designers and engineers to better communicate their concepts and designs with decision makers and customers."

Having content readily available might encourage more educators to make the switch to 3-D-compatible projectors, although Wudeck said educators already are lining up to future-proof their classrooms with or without content.

"Because of the affordability, ease of use, and quality of 3-D, educators will start implementing pilot programs around the country in about 90 to 120 days," predicted Wudeck. "Just since NECC, TI has had an incredible [number] of requests for demos. And when more content comes in, I'd say, five to six months, then you're really going to see a huge boom."

"Once the pilot programs get running, we'll start to get data about how kids remember ... and understand content better when they see information in 3-D," said Dave Duncan, worldwide education business development manager for TI. Like Wudeck, Duncan believes that white papers and case studies from 3-D pilot programs will be available during next year's major tradeshows.

"We're still in the early phase of the adoption curve," said Wudeck, "but it's moving fast. Expect to see some big rollouts in 3-D next year." eSN

LINKS:

TI DLP
http://www.dlp.com

AVRover
http://www.avrover.com

BenQ
http://www.benq.us

SAFARI Montage
http://www.safarimontage.com

USC's Entertainment Technology Center
http://www.etcenter.org

New York Institute of Technology
http://www.nyit.edu

Iowa State's VRAC
http://www.vrac.iastate.edu/c6.php

Plano Independent School District
http://www.pisd.edu

Boulder Valley School District
http://www.bvsd.org

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