The 3D Classroom

An eBook from
Sensavis Education

# The Future of 3D Education

## What every educator should know about using 3D in the Classroom



SENSAVIS
Revolutionizing Education

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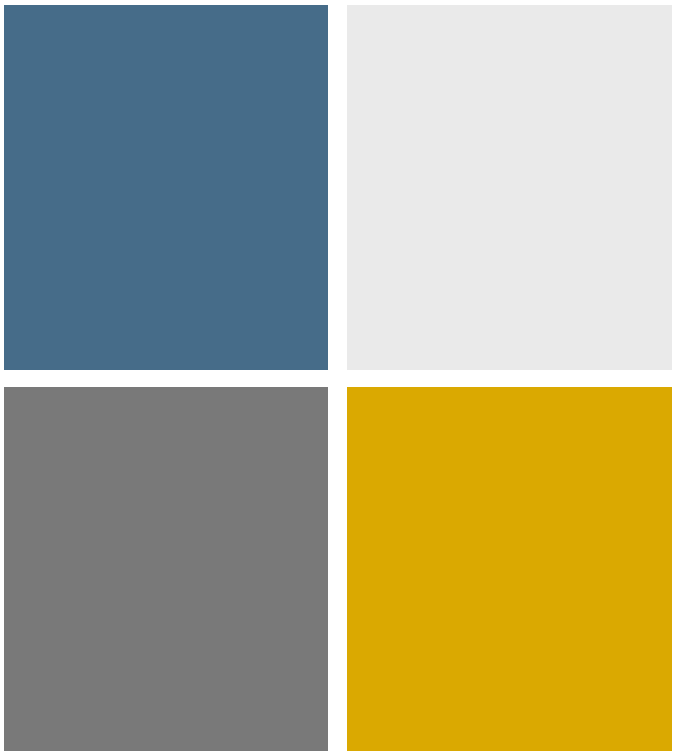
*"Over the last several years, the use of educational 3D has gone from being seen as a 'fad' to becoming a powerful and proven instructional technology."*

**-** Nancye Blair Black, educator and author: InDepthEducation.com



# INTRODUCTION

## Why 3D is the Future of Education

INTRODUCTION

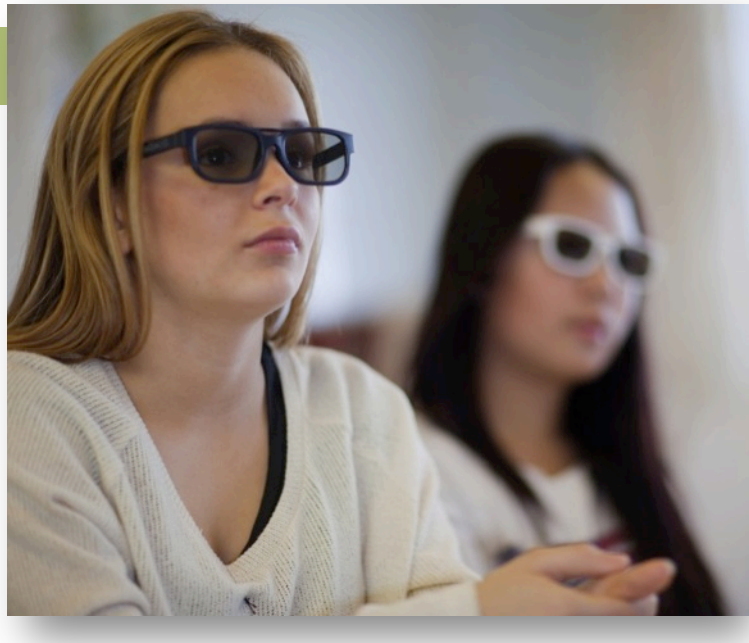
## Why 3D is the future of education

It's well known among educators that complex and abstract topics can be understood more easily (especially by younger students) when concepts are introduced visually. Visuals not only improve a student's ability to understand how something works, but also help with retention. Furthermore, by seeing the "whole" of something, children are better able to understand the parts.

Even more importantly, research shows that 3D-animated models are able to represent information in the most efficient manner to speed learning and comprehension.

## Advances make 3D affordable

Recent advances in 3D animation technology and viewing equipment have made it possible to bring high-quality 3D learning solutions into the K-12 classroom more affordably.



Seeing in 3D is the closest thing to actually being there.

**Research findings:**

- The majority of children are visual or tactile learners, whereas the majority of instruction is auditory.
- Students learn more by seeing and experiencing than by listening.
- Students said they learn better when they can see a 3D image.

## INTRODUCTION

### This is not your childhood 3D.

Today's technology can even provide an interactive 3D (depth perspective) experience that is nearly like looking at a live object, while allowing students to control … or even create … the visuals interactively.

Yet, the adoption of 3D technology as an effective, affordable and even essential component of education in the 21st century classroom is only just starting.

### Content availability increasing

3D content focused on science, mathematics, history and more is readily available today and more is continually being developed. With 3D elements added to lessons, teachers can engage students at a whole new level and capture the interest of even the most reluctant students.

This **ebook** takes a look at the current research, findings and examples of successful implementation of 3D technology in the classroom

**Read on to learn more.**

**Is 3D something that could work in your school? Let us know what you think.**

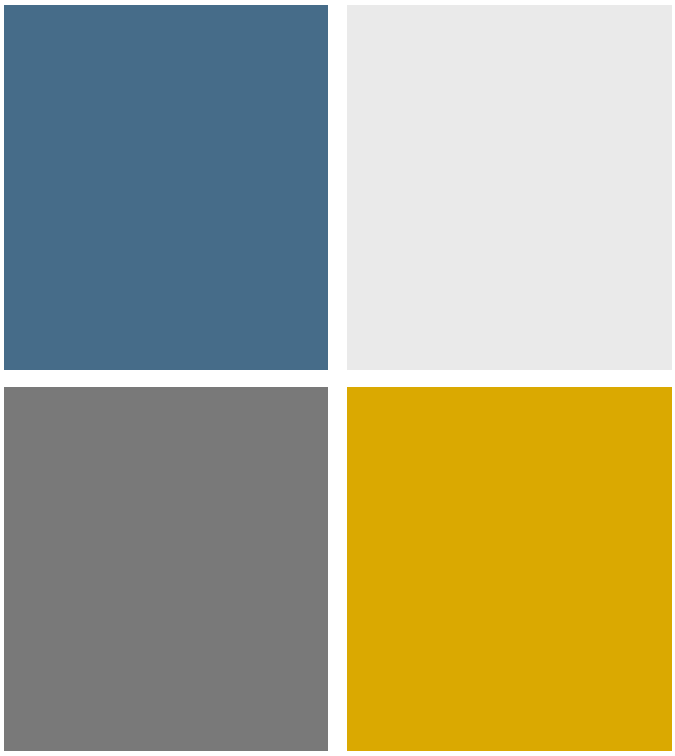
**Join our Discussion** >

Linked In Group:

The 3D Classroom

**Take our Survey** >

the3dclassroom.com/survey



# CHAPTER 1

## How does 3D improve learning?

CHAPTER 1

## How does 3D technology improve learning?

3D animations make it possible for students to move rapidly from viewing a whole structure to various parts of the structure, even zooming in to microscopic and cellular levels. This process of amplification and simplification can be an especially effective aide to understanding.

"With 3D visuals, educators are able to simplify complex, abstract and even impossibly large amounts of information into a coherent form," said Professor Anne Bamford, director of the International Research Agency, who led The "Learning in Future Education" or "LiFE" project.

*"By rendering the world visually, 3D helps children understand greater levels of complexity, and animations allow students to see structures and how things work in a real-life way."*

Teaching methods that work more closely with how the human brain is designed to work are the most effective. Research shows that:

- 85% of school-aged children are visual and kinesthetic learners and
- only 15% are auditory learners.

Experts say that most school-age children learn best through kinesthetic means: touching, feeling, and experiencing the material first-hand.

According to Stafford and Dunn in *Teaching Secondary Students Through Their Individual Learning Styles* (1993):

*"Children enter kindergarten as kinesthetic and tactual learners, moving and touching everything as they learn. By second or third grade, some students have become visual learners."*

## CHAPTER 1

*"During the late elementary years some students, primarily females, become auditory learners. Yet, many adults, especially males, maintain kinesthetic and tactual strengths throughout their lives."*

The human brain is designed to learn through experience. 3D is how we experience the world around us.

"The closer we can get to a life-like experience of a message, the closer we get to an understanding of that message (and in shorter time)," said **Magnus Arfors**, Founder/CEO of Sensavis Education.

### The impact of 3D on academic results

Research shows that 3D animations have a significant positive effect on learning, recall and test performance.

In a seven-country European LiFE study, researchers found that 3D improved understanding and retention.

*85% of students prefer visual and kinesthetic learning while only 15% prefer hearing about a topic as a way to learn about it.*

The study report concluded that 3D animations supported learning and allowed more material to be covered in less time. The 3D images promoted greater pupil engagement and communication.

**A study of the impact of 3D in the classroom has found that it improves test results by an average of 17%.**

CHAPTER 1

# About the LiFE study of 3D in education

The "**Learning in Future Education**" (or **LiFE**) project by Professor Anne Bamford was the first international study of 3D use in education, and showed very positive results.

In fact, Bamford said she was surprised by the results and didn't expect to see such dramatic increases in student learning and positive responses from all the schools.

The study included 15 schools in seven European countries: England, Sweden, Italy, France, Germany, The Netherlands and Turkey. The schools represented a broad spectrum of types of schools including public and private, wealthy and less affluent. The focus was on pupils between 10-13 years old.

## Results

The results of the study showed consistent improvement in test scores.

Anne Bamford, Educator/ Researcher

- 86 percent of pupils improved from the pre-test to the post-test in the 3D classes, compared to only 52 percent in the 2D classes.
- Within the group that improved, the rate of improvement was also much greater in the classes with 3D.
- Test scores improved an average of 17 percent in the 3D classes, compared to only an 8 percent improvement in the 2D classes between pre-test and post-test.

The effects of the 3D learning were so strong and impressive that students in the non-3D groups in LiFE study trials who heard what their peers were learning demanded the same access to the technology.

CHAPTER 1

## Qualitative Data

In addition to test score improvement, qualitative data showed that 100% of teachers *agreed* or *strongly agreed* that 3D animations in the classroom helped students **understand things better**.

The teachers commented that the pupils in the 3D groups had deeper understanding, increased attention span, more motivation and higher level of engagement. The 3D group also showed behavioral and communication changes and improved classroom interaction.

For example **92% of pupils on average were attentive during the 3D part of the lesson** while only 46% were actively paying attention during the non-3D part of the lessons.

**Lesson speeds** also can be impacted positively with 3D content. For example, a lesson that normally required two to three class periods to complete was taught in just one class period.

### Other case studies

School districts in Colorado and North Carolina in the U.S.A. have also reported outstanding results from trials of 3D education programs.

In one of the first significant studies of the effects of three-dimensional content on K-12 instruction in the U.S.A., Colorado's Boulder Valley School District (BVSD) found that the use of 3D content helped increase student engagement and improve achievement—with the lowest-performing students seeing the greatest benefits.

Through a **pilot project called "BVS3D,"** Boulder Valley teachers used stereoscopic 3D content in eight classrooms within four schools during the 2010-11 school year.

CHAPTER 1

# The BVS3D Study

According to digital learning architect **Len Scrogan**, past director of Instructional Technology for the Boulder Valley School District and current professor at the University of Colorado-Denver, key findings from the study included:

**Better student engagement**.
This was evidenced in three significant ways: Increased attention (focus), longer focus (attention span), and fewer disruptions (better classroom behavior).

**Positive feedback from students**.
In a survey of high school students involved in the pilot, 76 percent said they preferred learning in 3D over traditional methods. Elementary, middle school and special education feedback was similarly positive, Scrogan noted.

**Increased understanding of abstract concepts**. Students said 3D provided better visualization than textbooks and helped them understand complicated ideas and structures better.

Len Scrogan, Future-Talk 3D

Kristin Donley, BVSD Teacher

## Improved Test Scores

Test results were also positive: The control group (2D) test scores increased 9.7 percent, whereas the 3D group scores increased 35 percent.

"Besides helping students better understand abstract concepts, 3D has engaged our students and the use of it has encouraged them to pursue projects in making 3D animations themselves," **said Kristin Donley**, science and STEM instructor at Monarch High School in the BVSD.

"My involvement in the 3D pilot these past years has also made me think about learning in a whole new way. I am creating better assessments that utilize filming and manipulatives to assess whether students understand abstract concepts rather than using standardized tests."

CHAPTER 1

## Results in North Carolina

At Dixon High School in Holly Ridge, N.C., biology teacher Jason Chambers has been utilizing 3D content in his classroom with amazing results. “In General Biology alone there has been a more than 50 percent improvement in test scores. Our principal is ecstatic,” Chambers said (as reported in the Future-Talk 3D blog by Len Scrogan).

Mr. Chambers reported that all of his classes (including those with special needs students) achieved a remarkable 100% proficiency using the 3D material. He reports that in his honors classes, more than half the students (12 total) achieved a 4, the highest possible score on state standardized tests, where typically only 4-5 students would earn that score.

**Test scores improved 50% in a North Carolina school using 3D in biology.**

## Impact on student behavior

In addition to the improved test scores and better learning, teachers noticed that students’ increased levels of interest and engagement in the content led to better overall classroom behavior.

At a special education school in Colorado, teachers found that each time 3D education was used, it gave teachers in this challenging educational environment 40 minutes of uninterrupted quality science instruction.

“Total focus. No behavioral incidents. That's significant,” said Scrogan about the report.

CHAPTER 1

## Teacher comments on behavior

*"3D kept kids on the edge of their seats."*

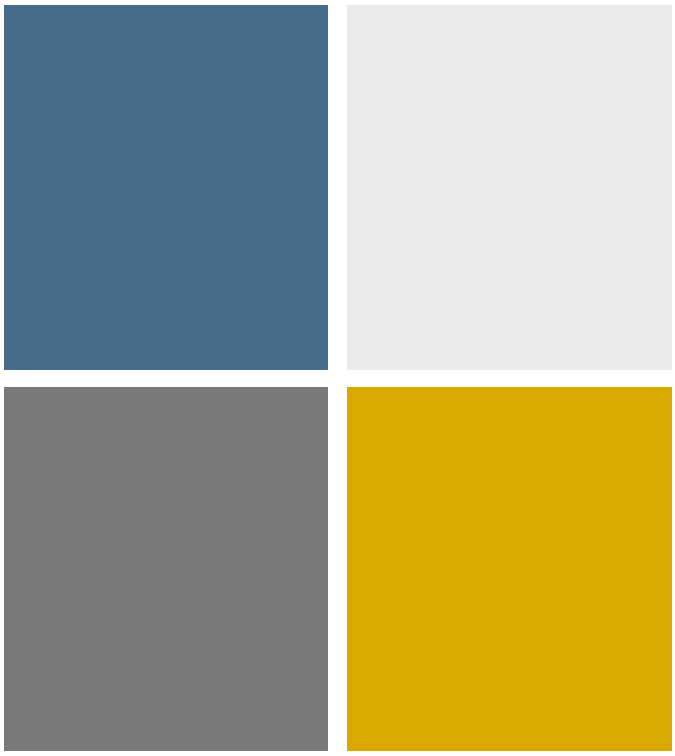
*"There is no way anything else works like this for behavior—enabling these students to learn for an entire 40 minute class without any behavior call outs."*

**Research shows 3D learning produces:**

- Faster absorption of material
- Deeper understanding of subjects
- Increased attention span
- Better retention of material
- Greater motivation to learn
- More engagement with content
- Higher test scores

***"Since we started working with interactive 3D visualization in our teaching, it is impossible to go back. We saw that more students increased their knowledge and learning—and many of these students were our low or medium achievers before using the 3D classroom."***

*– Mattias Boström, former school principal*
*Högalidsskolan, Sweden*



# CHAPTER 2

## How does 3D work?

CHAPTER 2

# How does 3D visualization work?

### What is 3D and what isn't?

3D (Three-Dimensional) imaging has been around for a long time, almost since the beginning of photography. However, new techniques and advances in technology have made it possible to have high-quality virtual 3D images that look real.

Understanding what exactly 3D is can be confusing because the term 3D is commonly used to describe renderings that are merely 3D illusions, using a single image (with shading, perspective and shadowing) but not truly possessing depth. These techniques are commonly used in online gaming and CAD drawings, for example.

Another type of 3D uses **anamorphic** pictures, which are two-dimensional pictures that, when viewed from a certain angle, appear to be three-dimensional. You may have seen examples of these in sidewalk and street art.

*(Photo courtesy of Edgar Mueller, www.metanamorph.com)*

*An anamorphic street painting by Edgar Müller of Germany appears to be three-dimensional, but is, in fact, a 2D representation that uses expert shading and perspective to achieve a 3D effect.*

Other types of 3D technology include:

- **stereoscopic** (two images viewed at the same time) and
- **anaglyph** (contrasting colored images, typically red/cyan), both of which require a special type of glasses for viewing images.

**"Real 3D doesn't exist until we have something called 'z' depth, where objects seem to evidence depth—fading into the distance, or jutting right into the classroom," said Scrogan.**

CHAPTER 2

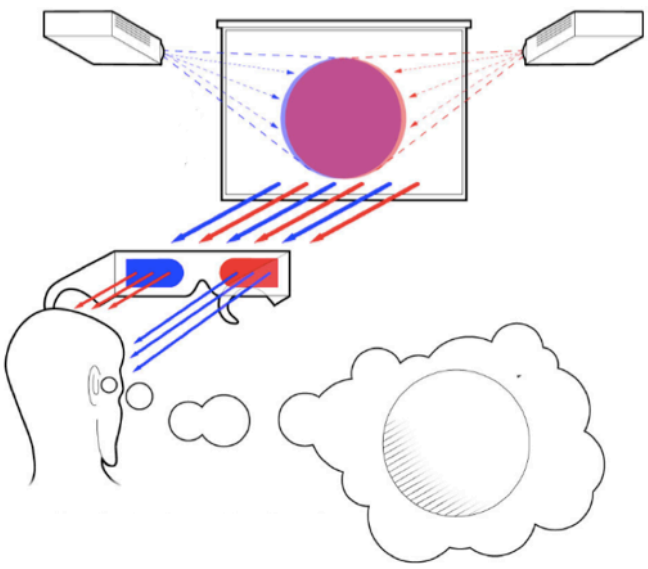
## How stereoscopic 3D works

Stereoscopic viewing works by presenting two different images to the left and right eye, simulating what our eyes see in real life. The brain combines the two images to create the perception of 3D depth.

**Active 3D systems** work by alternately displaying the images for the left and right eye in rapid succession – too quickly to see the images separately. To separate the images, active shutter glasses are worn, which block the right eye at the moment the left image is shown and vice versa. The glasses are synchronized with the projector or TV screen that sends signals to the glasses controlling when each lens opens and closes.

**Passive 3D systems** rely on a monitor (or TV screen) with a high refresh rate to display alternate full-screen images for the left and right eye. These are then synchronized to the passive 3D glasses to appear as a 3D image. This type of equipment used to be expensive, but the prices are coming down rapidly.

## Four types of stereoscopic 3D and how they work

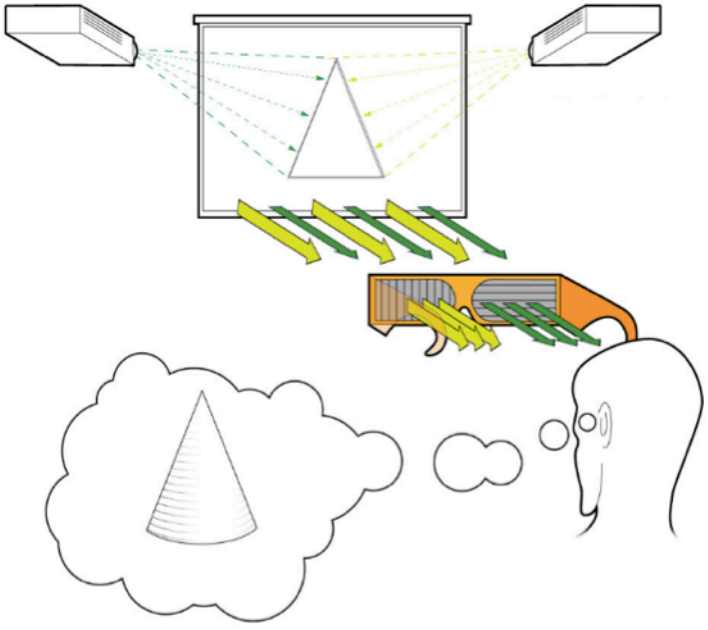


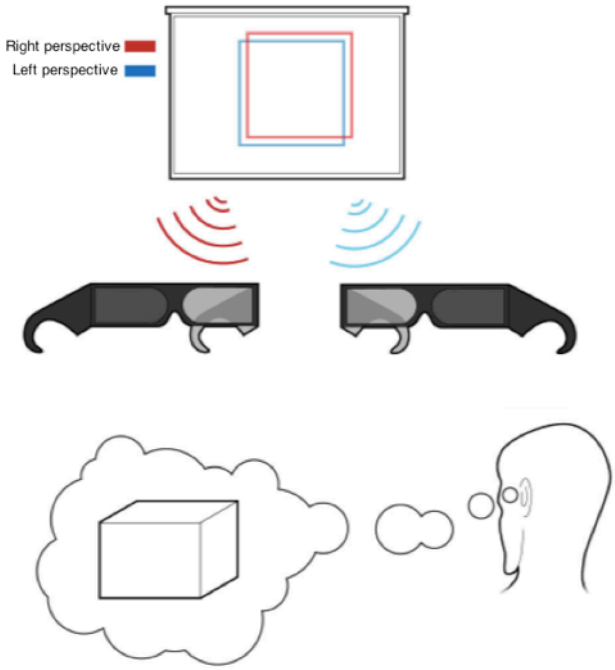
### Anaglyph 3D (red/blue glasses)

Two images are displayed onto a screen, one for each eye. The two images have slightly different perspectives. Each lens blocks a different layer in the eye it is covering, so each eye sees a different image. Your visual cortex combines these views and your brain perceives a 3D image.

CHAPTER 2

# Four types of stereoscopic 3D and how they work






**Polarized 3D Glasses**

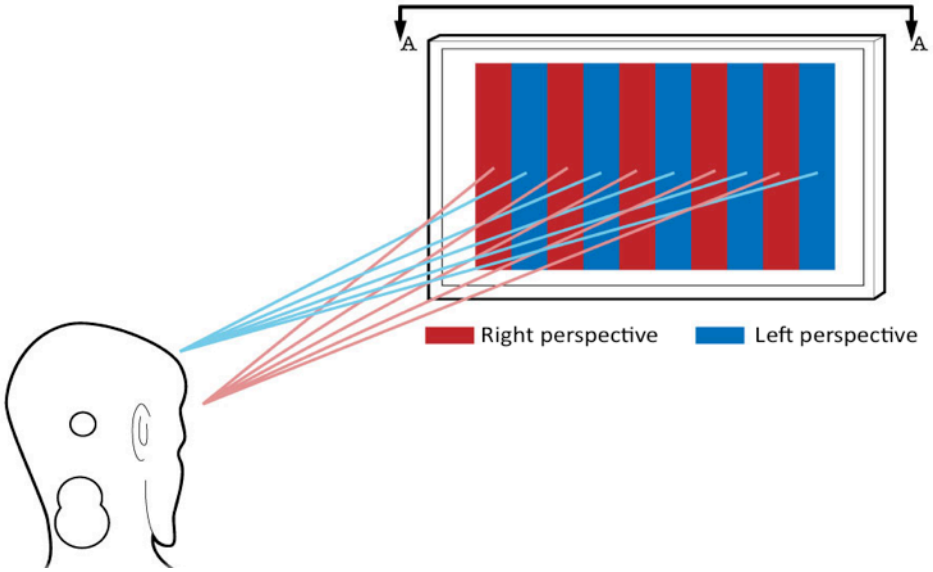
Similar to anaglyph images, two images are synced onto one screen. The two images have different perspectives and different polarizations. Each lens of the polarized 3D glasses allows only one of the polarized images into the eye, filtering out the other. Again, your brain combines these two separate images into one 3D image.

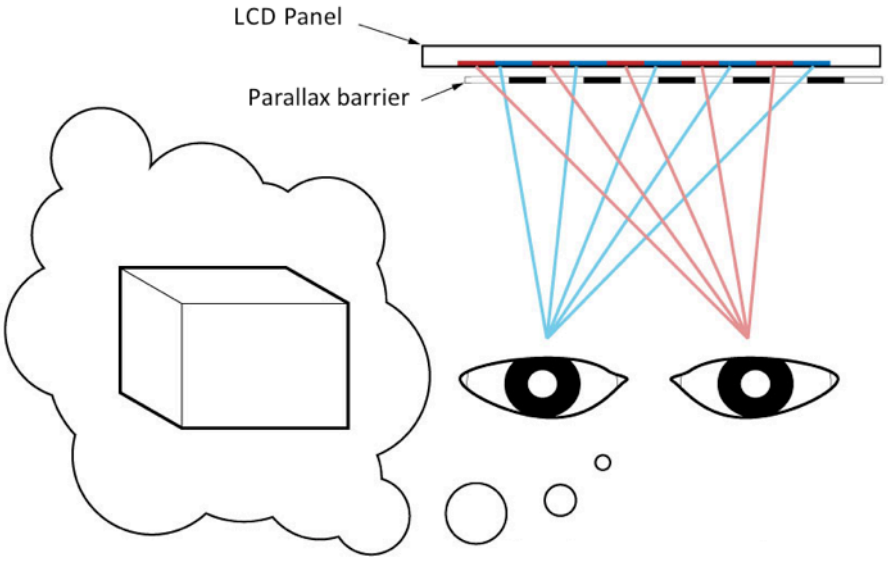
**Active Shutter Glasses**

Two different perspectives are alternately displayed on a screen. An emitter sends out a signal to the glasses causing first the right then the left lens to darken. The two perspectives alternate and refresh many times per second and the brain combines them into one 3D image.

CHAPTER 2

# Four types of stereoscopic 3D and how they work




**Parallax Barrier (no glasses)**

Two images with different perspectives are interlaced onto a screen simultaneously. A filter, known as a parallax barrier, has a series of precision slits that allow each eye to see a different set of pixels for each perspective.

CHAPTER 2

# Equipment needed

Generally, the technology needed for a 3D learning program in schools is easily adapted into the classroom, and teachers find effective ways to incorporate 3D into their lessons.

For example, in the LiFE, BVSD and Swedish classroom studies, the package of technology provided to the pilot schools was easy for the teachers to set up and use.

The equipment needed includes:

## 1. A 3D-enabled projector (or monitor)

For stereoscopic 3D teaching, a 3D projector or 3D display monitor (TV screen) is needed.

A 3D-ready projector typically costs no more than a standard 2D projector used in classrooms today and, unlike older 3D technologies, only one projector is needed to create vivid 3D imagery. 3D-ready projectors – available from a wide variety of manufacturers – function normally as regular 2D projectors as well.

## What's needed for stereoscopic 3D

3D-enabled projector
Active glasses
Laptop with graphics card
3D software

OR

3D monitor
Passive glasses
Laptop with graphics card
3D software

CHAPTER 2

*"Today, nearly all projectors are stereo 3D-capable and generally no more expensive than those that are not 3D-capable," said Bamford.*

An alternative to projectors are 3D monitors (TV screens). These are affordable with prices similar to HD TVs readily available on the market today. The typical size used in classrooms is 55 inches, but 70-inch monitors also are used. It also is possible to set up a series of monitors (such as four 55-inch monitors) to function together as one wall-sized screen.

"Many schools are surprised to find out they already own the equipment needed to start implementing 3D," added Scrogan.

## 2. A PC or laptop with a graphics card

Most standard PCs and laptops can be fitted with the necessary upgraded graphics card for a small cost. More recent laptops tend to have adequate graphics cards built-in.

"It makes sense to have a dedicated laptop specifically for 3D use so that it is always ready when needed and has enough memory available to function well," said Fredrik Boström, a former principal at a Swedish 3D pilot school.

CHAPTER 2

## 3. 3D glasses (active or passive)

Active glasses are generally heavier and about 10 times more expensive than their "non active" counterparts, and they need to be charged (or run on batteries). Generally, today's 3D projectors require the use of active glasses, but 3D monitors (TVs) may use passive glasses. (However, some monitors require active glasses, and certain projectors use passive glasses when shown on a special silver screen).

"Passive glasses typically sell for less than $2 and are easy to replace if lost or broken," said Mattias Boström. "They also are designed to fit children's smaller faces, and being lighter, may be more comfortable for children to wear."

## 4. 3D software content

More and more content suitable to the classroom is being developed by a number of 3D software manufacturers, some of which is developed specifically for grade-level curriculums. **Sensavis** is one publisher and among the first to offer interactive content for K-12 classrooms.

"The main strengths of The 3D Classroom lie in our software and our content," said Arfors.

*Passive glasses such as polarized 3D glasses from LG are less expensive than active glasses but higher quality than the old style anaglyph (red/blue) glasses many people remember from the early days of 3D cinema.*

The software allows a user to steer and zoom seamlessly, to change parameters and to experience simulations in real time for a variety of subjects ranging from human physiology and Newton's laws of motion to the landscape of mathematics. "In addition, The 3D Classroom content can also be viewed in the highest quality of stereoscopic 3D, as well as in 2D," added Arfors.

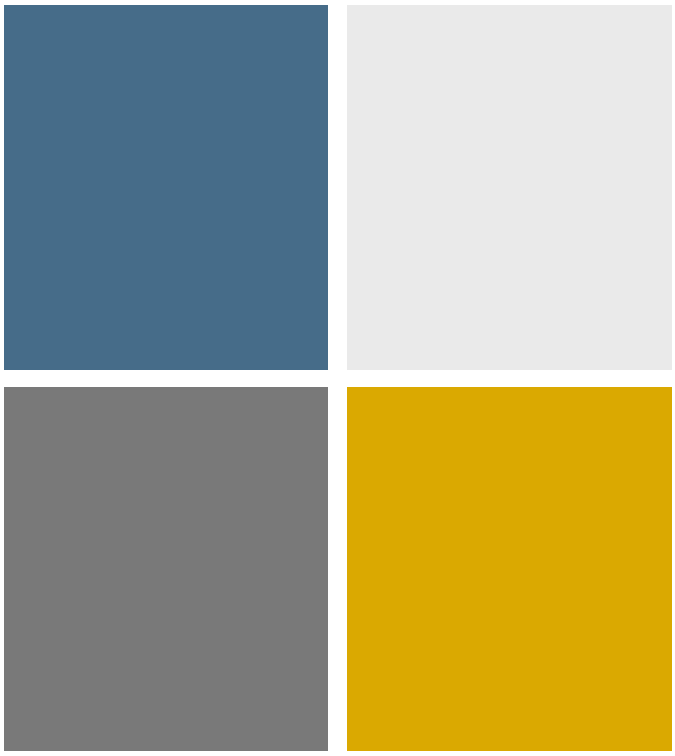
CHAPTER 2

## Other types of 3D offerings

In addition to prepared curriculum content for 3D teaching, other types of supplementary tools are available today that allow teachers (and students) to integrate 3D visuals into lesson plans. Some of these include:

- **Presente3D:** Presente 3D is an add-on to Microsoft PowerPoint that allows teachers and students to turn their presentations into anaglyph or stereoscopic 3D.
- **3D Books:** Books with anaglyph images are becoming more and more common in a variety of subjects from space to dinosaurs.
- **Hasbro My3D:** With this viewer, downloadable 3D apps, and an iPod Touch or iPhone, students can have the sensation of immersive experiences like traveling through the Solar System or swimming with sharks.
- **3D Ladibug Document Camera:** This camera can show objects and manipulatives in anaglyph or stereoscopic 3D (passive or active) by using the 3D software.
- **Kid Pix 3D:** Kid Pix allows students to create images and videos in anaglyph 3D, and even put their own faces inside digital costumes.

Even items like 3D chalk, paint and crayons (which require 3D glasses for viewing) are readily available today.



# CHAPTER 3

## What is needed to make 3D in education successful?

CHAPTER 3

## What is needed to make 3D successful?

Around the world, a number of schools have already begun adopting 3D methods and modalities into their classroom teaching across all grade levels.

From occasional use of 3D visuals to full-blown educational programs that integrate 3D into the curriculum, teachers such as those who participated in the BVSD 3D pilot program and international LiFE pilot study, are finding that integrating 3D technologies in their classrooms has profound effects on student comprehension and retention, especially with abstract concepts.

*"Over the last several years, the use of educational 3D has gone from being seen as a 'fad' to becoming a powerful and proven instructional technology."*

- Nancye Blair Black, author of the InDepthEducation.com blog, and award-winning educator.

In addition to increasing student engagement and comprehension, using 3D in the classroom leads to improvement in classroom behavior, attention spans and motivation.

Even more impressive, the use of these cutting-edge technologies has proven to be particularly effective with previously low-performing students and those with attention-deficit disorders.

"Successful integration of 3D videos, simulations and interactives has transformed science and mathematics classrooms," says Black on her blog.

By integrating 3D into classroom teaching, teachers gain a tool that helps more students understand content faster.

CHAPTER 3

# Five potential roadblocks to 3D implementation

## 1. Cost and budgets

Certainly budget is one of the top considerations in many schools, but with a focus on **STEM** (Science, Technology, Engineering and Mathematics) in the U.S.A. and elsewhere, many schools are placing greater emphasis (and funding) on programs that support these key areas of future learning.

For instance, in the U.S.A., more than $260 million USD from both public and private sources was allocated as part of the U.S. "Educate to Innovate" program in 2009 and STEM grants.

In addition, the costs associated with implementing 3D technology in the classroom have come down considerably in the last few years. Science and mathematics are especially well suited to 3D content development.

"3D technology is six times cheaper today than when I first saw it at a technology fair in London four years ago," said Fredrik Boström, who is now employed by Sensavis.

*An increased focus on science and mathematics has many schools searching for new teaching tools in these areas.*

## 2. Availability of 3D teaching content

Another concern for some schools may be about how useful the technology will be once purchased – and how often it will be used. Until very recently, according to some teachers, there was a lack of quality grade-school-focused educational content available.

CHAPTER 3

"Two years ago, our school was using STEM grant funds to look into purchasing a 3D teaching program for our science curriculum," said elementary school science curriculum teacher Shannon Johnson, of Jacksonville Country Day School in Florida.

"At that time, there really wasn't a lot of good teaching material available aimed at lower elementary school students. It's exciting to know that is changing."

Today several vendors offer interactive or 3D projection content with varying degrees of quality, topics and price points. Certainly the choices and number of content titles will continue to grow.

Sensavis, for example, has a roadmap of content planned for the coming year with a focus on biology, mathematics, geography, mechanics, chemistry and physics — subjects which especially benefit from 3D visual content.

Science and math subjects such as biology, anatomy and physics lend themselves well to 3D content.

## 3. Non-native language

The limited availability of content in languages other than English might be a concern in some parts of the world. However, in the LiFE study Bamford found that the use of the 3D materials in English in countries where it wasn't the native language wasn't really a problem.

As they integrated 3D into the classroom, many teachers would turn down the volume and speak over the audio to customize the lesson more completely. In some cases, science teachers worked with English teachers to create cross-curricula teaching, so the students learned English vocabulary before watching the content of the 3D videos.

CHAPTER 3

Said a Turkish student in the LiFE study:

*"In some ways I think it is better that he speaks English [voice on the software] as we learn new words in English and now know quite hard words. Most games we play on the computer are in English so it is fine really. I want to get this content into my home, so I can use it whenever I want and be able to do (review)."*

## 4. Incorporating new content into lessons

Teachers find they can easily incorporate 3D into their lesson plans.

From the various studies and pilots of 3D programs, it is clear that teachers are able to implement 3D content into their lesson plans quickly and easily without changing their overall teaching methods.

Bamford stated that for most of the schools in the LiFE study, the implementation of the 3D was quite straight-forward and could be easily introduced with existing projectors, smart boards and general classroom arrangements.

Typically, 3D becomes an added approach rather than changing existing teaching methods.

"In other words, teachers add the 3D into their usual way of working rather than changing their way of working around the introduction of the technology," said Bamford.

As teachers become more accustomed to working with 3D as one of the many teaching tools they use to help students learn, they find new and better ways to incorporate it into their lesson plans.

CHAPTER 3

## 5. Teachers' acceptance of new technology

Certainly in some cases teachers have concerns about how easy it will be to implement new technology in the classroom. Yet, in spite of concerns about the learning curve for new technology, teachers in European and American pilot schools found it easy to integrate 3D content into their teaching methods. Furthermore, the learning curve proved to be minimal -- garnering enthusiastic use of the technology.

One teacher in the LiFE study said:

*"When computers first came in, they were exclusive and then all children were excited and the same thing happened with the smart board. Now these things are just part of learning. 3D is useful for learning so in no time it will become embedded and we won't know how we taught before 3D!"*

In addition, a 2013 Pew Research Center's "Internet & American Life Project" study of teachers and technology (U.S.A.) showed that, in general, teachers are quite technology and internet savvy.

Asked how confident they are in their ability to learn to use new digital tools and technologies, more than half of Advanced Placement (AP) and National Writing Project's Summer Institute (NWP) teachers (56%) say they are "very confident."

*Teachers have a higher degree of comfort with digital technology than the average adult does.*

CHAPTER 3

The PEW study also showed that science teachers have the highest rate of remixing material they find online and creating their own webpages, while English teachers are the most likely to have their own blogs.

Perhaps not surprisingly, age may affect how teachers perceive the introduction of new technology. According to the PEW study, teachers under age 35 are more likely than teachers age 55 and older to describe themselves as "very confident" when it comes to using new digital technologies (64% vs. 44%).

## Teachers and technology

The LiFe study concluded that 3D technology is not difficult for teachers to implement. Many teachers are excited by the prospect of new technology, and continuous learning, but even teachers who are not confident at the outset manage to master the technology quickly. Teachers reported:

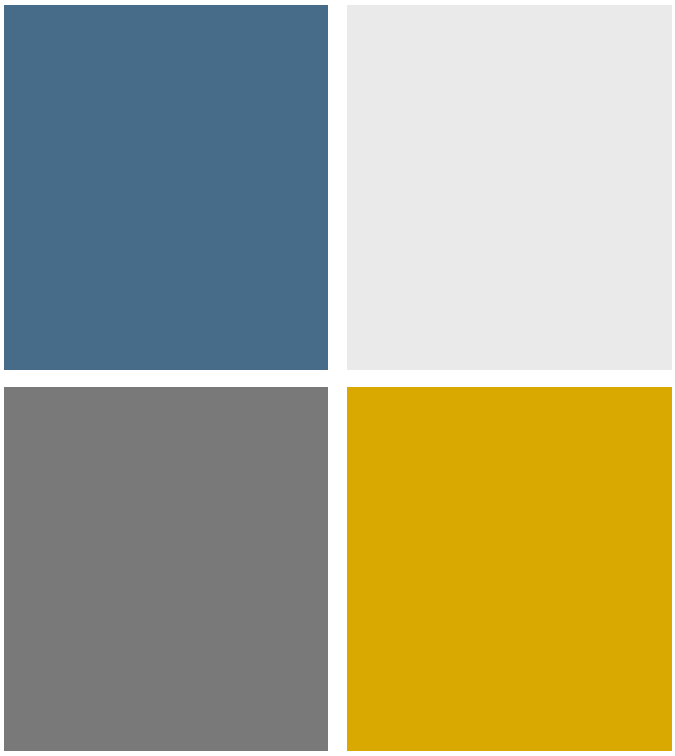
*"I am not good with technology but this has been easy to use."*

*"In our school there is a big variety in terms of how comfortable teachers feel with technology but with 3D they have all found it very easy."*

## PEW Study of Teachers and Technology Use

Some findings from the study included:

- 84% of teachers report using the internet at least weekly to find content that will engage students
- 68% of teachers say their school gives them formal training to bring digital tools into the classroom
- 85% of teachers seek out their own opportunities to learn more about effectively incorporating digital tools into their teaching
- 93% of teachers own a laptop computer (compared to 61% of all adults who own one)
- 47% own an e-book reader (compared to 19% of all adults)
- 78% use social networking sites compared with 59% of all adults



# CHAPTER 4

## Dispelling common myths about 3D in education

CHAPTER 4

# Dispelling common myths about 3D education

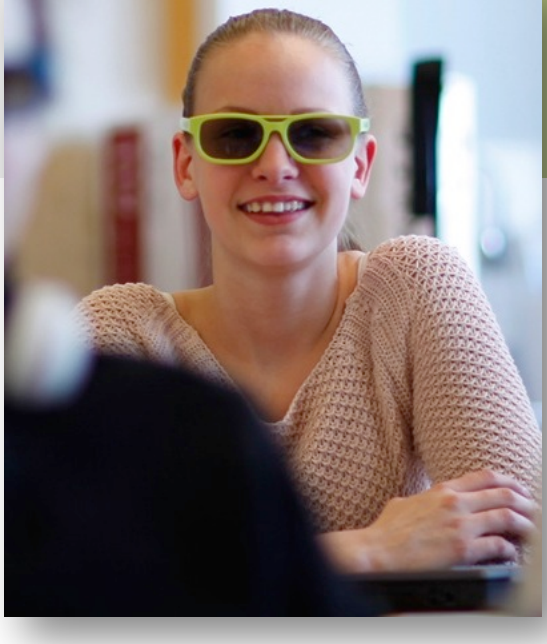
From the early days there have been "myths" that persist about the potentially negative effects of 3D, in particular on the eyes. Studies and recent research have proven these to be unfounded. Some common myths about 3D education include:

## Myth: 3D is "bad" for children

Stereoscopic 3D doesn't harm children or make them sick. On the contrary, 3D in education has been proven to help children with attention deficits focus, and has been shown to stimulate learning and memory in children in a way that two-dimensional flat images cannot.

Some people have complained they get headaches or dizziness from viewing 3D content. However, research shows that such symptoms are actually an indicator of an underlying vision problem.

"By making people aware of the underlying vision issues, which can often be successfully addressed by an optometrist or vision therapist, stereoscopic 3D can serve as a type of screening or warning about vision impairments," said Scrogan.



*Today's 3D glasses are more comfortable than older versions.*

In addition, the newer styles of 3D glasses are more comfortable and better made, and less likely to cause headaches than older styles.

Poorly made 3D products can cause fatigue and eye strain. Varying brightness and contrast levels, excessive and rapid use of the "3D effect," and insufficient control of objects appearing at the edge of the screen can all be tiring and produce discomfort. Using quality, professionally produced materials can reduce these negative effects, according to the American Optometric Association.

CHAPTER 4

## Myth: Stereoscopic 3D is harmful to the eyes

During the early days of 3D, the media was filled with notions on how 3D would affect the eyes, and some speculated that it would damage the eyesight or would make people sick. In a report published in 2011 called "3D in the Classroom," the American Optometric Association dispelled these notions:

"The American Optometric Association, along with other vision health professionals, has stated publicly – and frequently – that there is no evidence that viewing or attempting to view 3D images will harm a child's eyes."

*"Teachers, educational leaders and purse-string holders must be convinced first hand that 3D is much more than gimmicky 'edutainment'."*

- Len Scrogan, Digital Learning Architect, Professor, Boulder, Colo.

*Viewing high-quality 3D is not harmful to children's eyes.*

Children who have impaired vision may not always realize it, and so problems seeing stereoscopic 3D may indicate underlying vision problems. "In nearly all cases, after a comprehensive eye examination and appropriate treatment, normal levels of 'stereopsis' (the ability to see in 3D) can be achieved." (AOA report)

So in reality, not only is stereoscopic 3D viewing safe, but it can actually help uncover treatable vision problems.

CHAPTER 4

## Myth: People are born seeing 3D

Babies are not born with the ability to perform stereopsis (to see in 3D). Most start to have the beginnings of depth perception at about 6 months old. By the time they are 2 years old, most children can see in depth. It's not until the age of 5 or 6 that children's depth perception (and ability to see in 3D) is fully matured.

However, if vision problems exist or emerge during this period, then stereopsis may not fully develop. If children over the age of 7 are unable to see 3D or perceive depth, a vision evaluation by a specialist may be needed.

Children who have underlying vision problems that affect their ability to perceive stereoscopic 3D may have reactions such as: making negative comments (unable to perceive the 3D effect at all), rubbing their eyes, blurred or double vision, or, in rare cases, dizziness or feelings of nausea.

If any of these symptoms occur, experts recommend having an eye evaluation by a professional to uncover potential underlying problems.

You can find out more at http://www.3deyehealth.org/

*Children are not born seeing in 3D, but most have developed depth perception by the age of 6.*

CHAPTER 4

## Myth: Too much "screen time" is harmful to children

As children and people in general spend more time in front of screens, concerns over how much "screen time" is too much have arisen.

"Sitting in front of the TV or a computer screen for four hours may hinder your child's intellectual development but it will not damage his or her eyes," notes Dr. Mark Borchert, division head of The Vision Center at Children's Hospital Los Angeles.

While children can develop blurred vision, headaches and other problems when focusing too long on one object, such as a computer screen, it will not permanently damage their eyes.

Furthermore, the use of stereoscopic 3D for teaching is done in a very specific and limited way for only minutes at a time. Children are not passively watching entertainment or engaging in games for hours without looking away or taking a break.

The AOA and other optometric experts have stated that watching 3D video is not harmful, and that high quality, professionally made stereoscopic 3D products will not cause eye fatigue and eye strain which can occur with more poorly made products.

*Optometric experts have stated that watching stereoscopic 3D is not harmful and that high quality products will not cause eye fatigue.*

CHAPTER 4

## Myth: 3D has a "halo effect" that will wear off eventually

The teachers in some of the studies on 3D had concerns that there might be an artificial excitement about using 3D in the beginning that would quickly wear off so any positive effects wouldn't remain over the long term. That has been proven to be untrue. **The attention spans of children remained even after the 3D content was turned off,** because the children had become interested in and excited about the material they saw, and wanted to continue to discuss and understand it.

"In our study, we found that children who viewed objects in 3D were able to grasp that these things have depth, and that cells are spherical and have insides and outsides. Students who viewed the content only in 2D with a flat drawing, couldn't comprehend cells in this way. And in fact, they saw the cell walls as a line that one could 'jump' over not as a solid encasement around the entire sphere," said Bamford.

*3D captures children's attention and awakens interest that lasts even after the 3D is turned off.*

"When children were asked to draw models, the 2D children made 2D illustrations, while the 3D group made 3D models."

While of course children are often excited about new technology and teaching tools, the benefits of 3D visualization goes beyond simply being novel and "exciting." **Like illustrations in a book or using a computer to find information, the value that 3D brings to depth perception doesn't disappear over time**. In fact, it continues to help students comprehend ideas they couldn't "see" before.

# CHAPTER 5

## Implementing 3D successfully in schools

CHAPTER 5

# Implementing 3D in schools successfully

With the results of 3D in pilot programs and studies, it's easy to see that 3D has beneficial effects for students in the classroom. But there also are a number of reasons that support why 3D programs are beneficial for schools as well. Some reasons to implement 3D are:

## ✓ 3D engages "digital native" learners

Students today are very technology immersed and (as a result) are more engaged when content is presented in the way that feels most natural to them. The teachers interviewed in the LiFE study acknowledged the importance of good quality technology for today's students as they are "digital native" learners. Said one principal in the study:

*"The children know and like technology. We would usually use a plastic model. But it is small and hard to see. For children technology is the usual thing."*

*Today's children are "digital native" learners, having used technology their whole lives.*

## ✓ 3D helps "future proof" education

Schools that prepare students for the technology-driven reality are helping them become more ready for the future, and programs that use this technology are equipped to keep up with future changes in education.

## CHAPTER 5

Students today are very knowledgeable about general innovations in 3D and quite informed about the 3D products available. Many have 3D TVs, games or computers at home. For them, the use of 3D in the classroom is a natural extension of the world in which they live and will be a part of in the future.

One principal said: *"As I see it, the 3D increases visual retention and thus boosts learning. Schools have to keep pace with where the pupils are … many of these pupils have 3D at home and they have certainly seen 3D in the cinema. We need to ensure that school learning is just as rich. "*

### ✓ 3D is better for visual learners

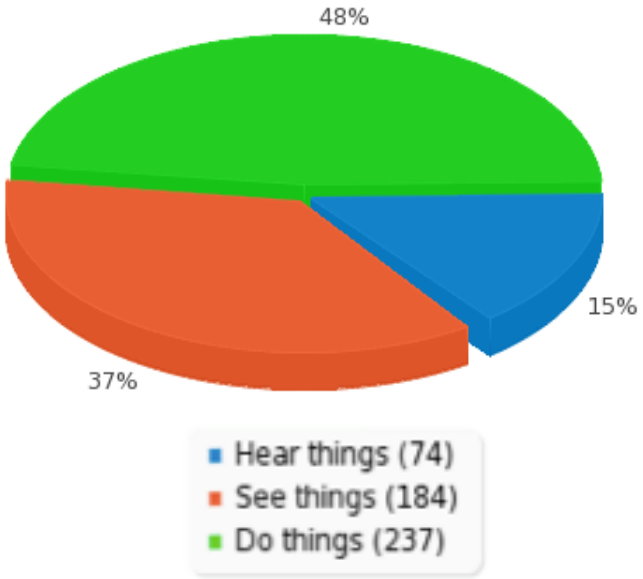
Complex concepts become more easily digested when reduced to imagery. 3D models are able to represent information in the most economical manner to facilitate learning and comprehension, thus simplifying complex, abstract and impossibly large amounts of information into a coherent form.

In addition, research has shown that 3D is especially good for visual learners, which make up a large percentage (65% by some estimations) of students.

- **FACT: The brain processes visual information 60,000 times faster than text. -** 3M Corporation, 2001
- **FACT: Visual aids in the classroom improve learning by up to 400 percent.** - 3M Corporation, 2001
- **FACT: 90 percent of information that comes to the brain is visual.** – Hyerle, 2000

CHAPTER 5

**Students' learning preferences (LiFE study survey)**




From the LiFE study, Bamford concluded:

- The majority of children in a class are visual or tactile learners, whereas the majority of instruction is auditory
- The pupils said they learned better when they could see the 3D images and see the functions of the body parts through animation
- 3D tended to encourage visual and kinesthetic learning

*3D images help children understand better than 2D textbook images can.*

## ✓ 3D helps special needs/learning challenged students

In both the BVS3D (Colorado) and European LiFE studies, researchers found that 3D tools were especially helpful for learning-challenged students. The test scores and comprehension levels both of students with attention and behavioral issues were markedly improved in classes where 3D was used.

One principal in the LiFE study said:

*"In this school we are very committed to ICT integration. The classes were very keen to try ... [we chose] a class with a lot of problems [pupils with special learning needs] and the 3D has really worked for them."*

CHAPTER 5

## ✓ 3D increases teacher interaction with students

The use of 3D in the classroom also can positively change the teacher-student dynamic, because the teacher, by necessity, moves to the back or middle of the classroom and interacts with the students while the 3D is being viewed. This can create a more collaborative atmosphere in the classroom and encourage the students to ask questions and have discussions more openly, discovered Bamford.

In parallel, students recognized that the teacher is the essential element and mediator in the learning process.

*"I don't think that 3D will ever replace the teacher. The teacher knows the subject and adds detail. The teacher knows how to go at the right pace, but at the same time, teachers need to change to the innovations."*

## ✓ 3D offers benefits in learning efficiency

One interesting finding in the pilot studies for 3D in the classroom is around learning efficiency. Teachers report that in some classes 3D helps students learn information faster, which can free up more time in the curriculum to do other things, or to go deeper than the teacher was able to before. Learning efficiency also can mean that students can get more information in a shorter amount of time.

"This is really interesting," said Scrogan. "It's the first clue we've ever had in 3D research about learning efficiency. It's a pointer. To me it's a pointer that further research needs to be done."

CHAPTER 5

# The "fun" factor

Don't discount the "fun" factor that 3D technology may bring to the classroom. According to brain-based learning expert Eric Jensen, fun is an important element, along with emotion, in helping students learn and remember.

"Fun is the major puzzle piece in brain-based learning that links the other concepts together. Fun can give motivation and ownership to a student's learning. It makes for smiles and laughter, which lower stress levels."

"Engaging students in activities that are creative and fun provides a positive learning experience," Jensen says in the "ABC's of Brain-Based Learning" (2000).

## Integrating 3D into the classroom

Generally, integrating 3D content into lessons is seamless, and teachers are able to turn the 3D on and off easily and refer to it as the lesson dictates.

*Students learn more when they are engaged and interested.*

Teachers typically use it between 8-15 minutes at a time in the middle of a lesson in combination with other teaching methods.

Here is an example of how a teacher might integrate 3D seamlessly into a lesson.

- The lesson starts with oral revision, followed by explanation and a 3D (physical) model.
- During the lesson, 3D projections are used several times for a total of 13-15 minutes (within a 60-80 minute teaching sequence).
- The teacher also may use experiments, group discussion and worksheets in the lesson.

CHAPTER 5

## Getting the technology in your school

For many schools, a driving factor in choosing to bring 3D into the classroom is to stay current in offering the latest technology to attract students to the school. 3D is a teaching technology that has proven benefits in helping students learn more, and faster.

For other schools, the improvements in student performance will be a key motivation. 3D education has proven benefits in both student retention and test scores.

And in some places, the ability to equalize learning for all students (including those with special needs) will be the main driver for getting 3D in the classroom.

But whatever the motivation, schools can be sure that 3D education is here to stay and is bound to be one of the go-to teaching methods of the future the way overhead projectors were in the past.

### A few tips for using 3D in the classroom

*(from the American Optometric Association)*

- Always preview the 3D materials and plan the lesson in advance.
- Keep the transitions within and between the 3D images slow and smooth. (Rapid movements in 3D space can be discomforting.)
- Have students who experience discomfort move further from the screen or display.
- Fade to black or a neutral screen during breaks or lengthy discussions.
- Use 3D in shorter segments, rather than for an entire class period.
- Ensure that students remove glasses before standing up or moving around the room.

***"We think in 10 years everyone will have 3D. There will be no schools in the world without it."***

- Matthias Boström, a former school principal now employed by Sensavis.

CHAPTER 5

## Getting started

3D technology is readily available from a variety of hardware and software providers today. 3D software content provider **Sensavis**, for example, has partnered with hardware providers LG and HP to provide a quick-start plug-and-play classroom kit that comes ready with the necessary graphics cards and software pre-loaded.

**The 3D Classroom** kit includes a 55-inch LG Monitor, HP laptop with upgraded graphics card, 35 pairs of passive 3D glasses, and software content. Teachers just turn it on and go.

Other providers offer 3D projectors and graphics cards that work with subscription-based or downloadable 3D content. Consult your local resellers for information about what is available in your area.

## How 3D improves education

- Sustains attention span longer
- Helps special needs children learn faster
- Provides a deeper understanding of complex issues
- Improves comprehension (proven by an overall 11 percent increase in essay scores)
- Improves test scores (unit test scores higher by 10-17%)
- Offers greater learning efficiency

**A study of the impact of 3D in the classroom has found that it improves test results by an average of 17%.**

## About the Author

This ebook was prepared by freelance writer Shari Monnes based on interviews with 3D experts and educators, including Len Scrogan, Anne Bamford, Mattias Boström, Fredrik Boström and others.

Monnes is based in Boston, Mass., U.S.A., and writes about digital technology.

# Supporting Research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“Our key point of difference is that the material is fully interactive,“ says Sensavis Education CEO Magnus Arfors.

“This means that the teacher can determine the ‘journey’ by steering with his or her fingertips.

The same material can be used from elementary school right up to the university level as the teacher, or the user, can select to view the subject from micro to macro detail.”

## About Sensavis

Sensavis is revolutionizing education through 3D learning with **The 3D Classroom**. Founded in 2009 in Sweden, Sensavis brings real-time interactivity and a realistic virtual learning environment to life with proprietary software that is like nothing else on the market.

Fully **interactive** and able to provide life-like zoom, movement and perspective, the line of educational titles offered through **The 3D Classroom** is continually growing.

The 3D Classroom offers 3D content for Anatomy, Biology, Geometry, Geography, Chemistry, Physics, Physiology, Mathematics and more. Find out more about **The 3D Classroom** at www.the3dclassroom.com.

**The 3D Classroom** plug and play kit comes with an LG monitor (screen), HP laptop and 35 sets of LG Cinema 3D glasses. Visit our website for more information: www.the3dclassroom.com/ebook-specialoffer.

**LG Monitors & 3D glasses**

LG Cinema 3D TV: Model LM610c, 55F (Resolution 1920 x 1080) FHD

**HP workstations (laptops)**

HP Elitebook Workstation 8770W


>> Find out more

**Watch the Demo Video online >>**


# To learn more, visit The 3D Classroom online:

www.the3dclassroom.com