INAVATE

N° and issue date : 111201 - 01/12/2011
Circulation : 11500
Frequency : Monthly
InAVate_111201_44_304.pdf
Web Site: http://www.inavateonthenet.net/

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Page : 44
Size : 80 %
1614 cm2

This September Texas Instruments revealed the results of a five month study into the impact of 3D as a teaching tool in the classroom. Anna Mitchell explores the lasting impact of the project and what the results mean for implementation of 3D in the classroom.

Adding a dimension

There was nothing outstanding about the science classroom I walked into in Reading, UK early in 2011. Parallel rows of pupils faced a whiteboard at the front of the room, workbenches were fixed to each wall surrounding the space and there was a projector mounted on the ceiling.

This scene could have been one from my days at school until the teacher, Ros Johnson, head of science at The Abbey School, turned on the projector. The pupils donned glasses and suddenly we were looking at a beating 3D heart that was, from my point of view, projected somewhere above the pupils heads in the middle of the room.

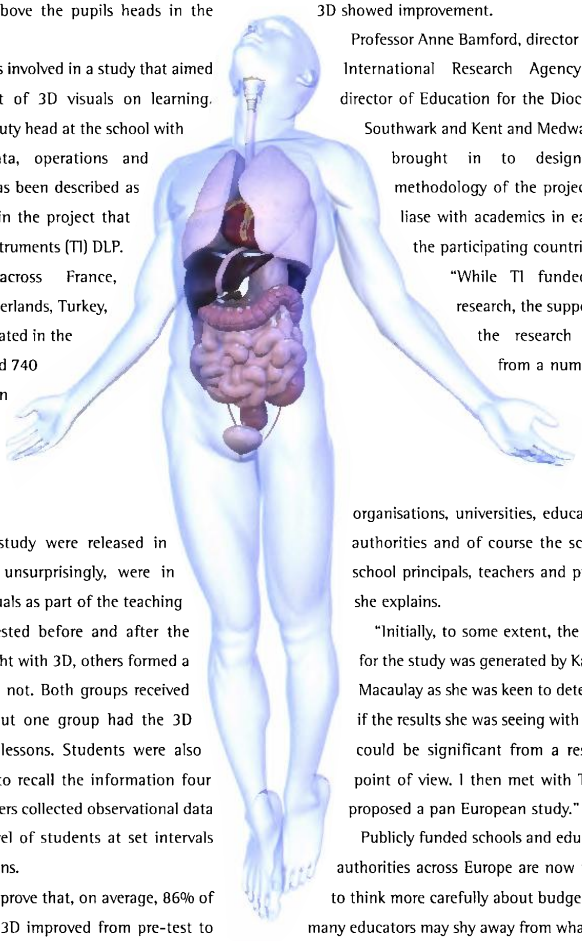
> *"The 2D learners were not so good [as the 3D learners] at explaining, for example, the functions of the human heart. There was definitely a big difference between the groups."*
> - Madeleine Liwell Jeppsson, Gärsnäs school

The Abbey School was involved in a study that aimed to research the impact of 3D visuals on learning. Kathryn Macaulay is deputy head at the school with responsibilities for data, operations and communications. She has been described as one of the key drivers in the project that was funded by Texas Instruments (TI) DLP.

Fifteen schools across France, Germany, Italy, the Netherlands, Turkey, UK and Sweden participated in the project that encompassed 740 students, aged between 10 and 13, and 47 teachers. It ran from December 2010 to May 2011.

The results of the study were released in September 2011 and, unsurprisingly, were in support of using 3D visuals as part of the teaching process. Pupils were tested before and after the project. Some were taught with 3D, others formed a control group and were not. Both groups received the same instruction but one group had the 3D content added to the lessons. Students were also tested on their ability to recall the information four weeks later and researchers collected observational data on the engagement level of students at set intervals during each of the lessons.

The study claimed to prove that, on average, 86% of the pupils taught with 3D improved from pre-test to post-test. Meanwhile 52% of the pupils taught without 3D showed improvement.



Biology lends itself well to teaching in 3D

Professor Anne Bamford, director of the International Research Agency and director of Education for the Diocese of Southwark and Kent and Medway was brought in to design the methodology of the project and liase with academics in each of the participating countries.

"While TI funded the research, the support for the research came from a number of organisations, universities, educational authorities and of course the schools, school principals, teachers and pupils," she explains.

"Initially, to some extent, the desire for the study was generated by Kathryn Macaulay as she was keen to determine if the results she was seeing with pupils could be significant from a research point of view. I then met with TI and proposed a pan European study."

Publicly funded schools and education authorities across Europe are now forced to think more carefully about budgets and many educators may shy away from what they consider as a costly investment. But Professor Bamford argues that 3D is actually a comparatively cheap technology to implement.

"Most schools already have a computer and a DLP ready projector. The main expenditure will be the 3D active glasses, and these are now comparatively cheap, in fact much cheaper than the average text book," she says. "The amount of freely available or low cost 3D content continues to expand and, while more content is still needed, this should happen quickly as more schools demand 3D. So it is really a very small investment. It [has the potential] to save investment in more expensive infrastructure and resources as the 3D [technology] can bring the world and endless possible resources into the classroom."

Currently, the technology is outpacing content development but as Bamford notes that's changing. "Unfortunately there is no Dutch content yet," comments Deborah van der Kuil a teacher at the Laurentius Foundation in the Netherlands and a participant in the research. "But for the time being it is nice to use the 3D technology [for] biology projects."

The Luarentis Foundation is a group of 24 primary schools and kindergartens in the Netherlands and van der Kuil handles ICT for the organisation. Despite the limited content she is convinced that 3D visuals can improve learning. "Children can remember the curriculum better and afterwards they can tell you more about the subject they have just been taught than children who are taught in 2D.

"We also saw that children who have concentration difficulties were able to concentrate for longer during the 3D lessons. The pupils made more noise and talked

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[L-R] Children at the Abbey School in the UK; There is some content for 3D teaching but its lack remains a barrier for wide-spread implementation

more during the 3D lessons but teachers thought this was positive because the children were responding more to the lesson."

Van der Kuil's observations are supported by data from the report that claims, on average, 92% of students were attentive during 3D lessons, while only 46% were actively paying attention during non-3D lessons. Test scores improved by 17% in the 3D classes, compared to an 8% improvement in the 2D classes between pre-test and post-test.

"Teaching in 3D is a remarkable educational tool that enables students to enhance their learning capabilities by truly engaging and interacting with the subject criteria in a highly effective way," adds Macaulay. "This research clearly demonstrates the 'real' results that high quality teaching in 3D generates and further reinforces the need for wider appreciation of how 3D technology can be adopted in the classroom to allow the students of today and tomorrow to fulfil their potential."

The Gärsnäs school in Sweden was also involved in the project and tested 3D projection in biology and maths lessons for children aged 12 to 13. "The kids pay more attention and get a more in-depth understanding of the topics," says Madeleine Liwell Jeppsson, a teacher at the school. "The 2D learners were not so good at explaining, for example, the functions of the human heart. There was definitely a big difference between the groups."

Again language was a challenge for Swedish educators but Liwell Jeppsson says that the use of technology should expand as more language content becomes available in the coming months. And there's a great deal of momentum behind the technology in the country. Bo Erixon, manager of ICT strategy for the Executive office at Simrishamn municipality in Sweden says: "We want the schools in Simrishamn to be in the forefront of ICT. The public schools must be dynamic and keep up with the technology and development of society."

At the moment the technology development seems to be outpacing content providers. Ulf Greiner is product line manager for business projectors at NEC Display Solutions Europe, a company that supported the project by acting as a technology partner for schools in Sweden, Germany and the Netherlands. He says: "Ultimately, the content will be the deciding factor in how fast this technology spreads. Many 3D providers in various sectors are in the process of adding educational content to broaden their portfolios. Producers of more traditional teaching materials are in demand here on account of their pedagogic experience."

> *"We saw that children who have concentration difficulties were able to concentrate for longer during the 3D lessons."*
> *- Deborah van der Kuil, Laurentius Foundation*

Nieve Cavanagh, senior product manager at Casio – a manufacturer of 3D projectors, adds: "Most schools don't have the required content available to hold lessons in 3D, whether it's interactive text books or other visual teaching aids. Most teachers simply don't have the time to change their lesson plan at the drop of a hat."

The project also highlighted how well versed students were with 3D content, demonstrating that most had seen 3D films in cinemas and some had 3D televisions at home. "Schools need to take account of the children's surroundings and incorporate that into their teaching concept," explains Dr. Michael Kirch, research associate in the Primary School Education department at the LMU and a researcher on the project.

Greiner added: "Today's children are immersed in the internet, tablet devices, laptops and smartphones and this interactive and digital experience needs to be incorporated into the classroom if it is to engage children effectively."

Amidst the high praise from educators and researchers were notes of caution. Dr Kirch described the results as "overwhelmingly positive" but said the technology was not a panacea for education. "It's time to leave the 'teacher up front' approach behind," he says. "Let's get our children learning together in groups and motivate them to start teaching each other. For this to work the children need to have their own interactive experiences."

There's still a great deal of work to be done to convince teachers that 3D can be a beneficial technology. Projects like this one will help get the message across and many manufacturers are quite active in involving and learning from teachers to provide useful solutions. It is important now that technology consultants and integrators that serve and want to work within schools arm themselves with knowledge to convey real benefits and not just push technology into schools for short-term profit.

Cavanagh warns against schools spending money for technology's sake and says classrooms are already inundated with technology that isn't being used to its full potential. "With school budgets already stretched there needs to be a compelling case backed up with hard evidence to show that 3D >

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< helps teachers to increase student engagement. At the moment we simply don't know how much it does, and measuring something so qualitative is hard.

"There hasn't been the rush [of uptake of 3D technologies in schools] that some manufacturers have been expecting. In about three to four years, people's perceptions will gradually start changing as clearer benefits of 3D are seen. However, until then, schools will have to look closely at what benefits they will get out of 3D and weigh up decisions on a case by case basis."

Professor Bamford believes whilst some teachers are very well informed there is, in general, a lack of awareness surrounding the technologies that can be drawn on in education. "There is a lack of emphasis in teacher education on how technology can enhance learning. As a general picture, the pupils involved in the study were far more informed about technology than their teachers [were]."

It's rather unsurprising that a study into the benefits of a projection technology, funded by TI, brought back positive results. Critics could argue the methodology would have been designed to show the technology in a positive light. There is no doubt that these considerations should be taken into account but it doesn't mean the results should be ignored. What the project shows is that pupils enjoy, engage with and learn from 3D visuals as part of a wider teaching programme.

> *"The main expenditure will be the 3D active glasses and these are now much cheaper than the average text book."*
> *- Professor Anne Bamford, International Research Agency*

Two 3D ready projectors: NEC U Series ultra-short throw projector [top] and Casio Signature projector [below]

The researchers and teachers involved in the project all seem very realistic that 3D technology isn't a magic tool that will immediately transform how pupils learn and retain information. They're also very cautious and add that it shouldn't be used all the time or be relied to engage a class when the teacher cannot. But they value it as another dimension to add to their resources.

As austerity measures are implemented by stretched governments across Europe education boards will have to think carefully about spending on technology. But they can't loose sight of the fact that to engage pupils they need to embrace the technologies students use and understand out of school. 3D projection can support that goal. ∞