

education

Teaching holography – Inspiring an interest in science

Pearl John

mail@pearljohn.co.uk



About the author

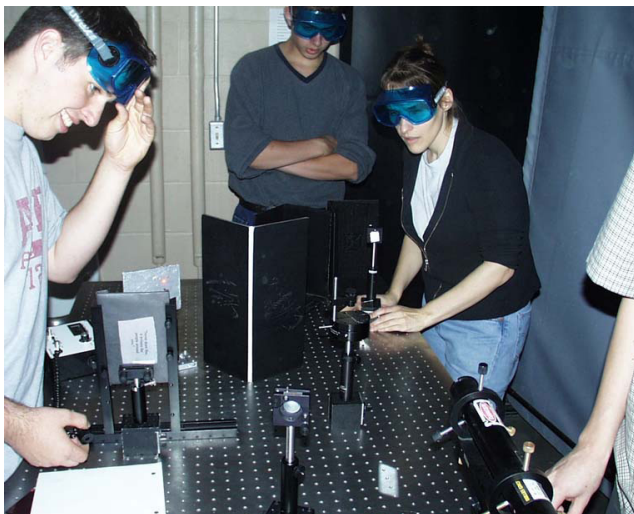
Pearl received an MA in Holography from the Royal College of Art in 1992. she presently works for the School of Physics and Astronomy at the University of Southampton, UK, and is involved in the education of schoolchildren in laser technology and its applications. She continues her holographic art in a studio at the University. Pearl is the recipient of this year's Shearwater Foundation's Art Holography award. Websites: www.pearljohn.co.uk, www.bowieart.com.

There is currently an international shortage in both skilled photonics workers and students taking science subjects. However, there are a number of initiatives aimed at addressing these shortages. The Columbia Career Center high school SPIE chapter in Missouri, USA, has recently created an educational CD-ROM to teach holography to students, to interest them in following career paths in optics and photonics.

The Columbia Career Center has a three-year Photonics program and is geared toward training 15–18 year old students to become Laser Electro-Optical Technicians (LEOTs). Holography has been used successfully in educational institutions as a motivational tool for students and a vehicle for the teaching of a wide variety of skills [1]. These include problem solving, teamwork, safety, communication, research, mathematics, analysis of data, documentation, equipment handling, and knowledge of light theory, which involves the principals of reflection, refraction, diffraction, interference and polarization. All of these skills are essential to the photonics industry and, as a result, holography is considered by the Center for Occupational Research and Development (CORD) [2] to be a national photonics skill standard for LEOTs.

Training in holography – using both simple and advanced techniques and equipment – prepares students for a variety of vocations involving laser technology. However, the teaching of holography can be beneficial at many different levels of education, including middle and high school students, college students and interested adults. In a testimonial to Shoebox Holography on the web site of Frank DeFreitas – <http://www.holoworld.com/holo/diode.html> – communications technology educator Bill Pugh notes that students benefit from learning holography in school because:

“The Science, Math, and Technology they learn from the process become meaningful to them. It has also been useful to build teamwork in the classroom. I have been teaching for 23 years and this is the best classroom tool I have seen in years.”



One of the most important aspects of learning holography and making a hologram is that it gives the student something to walk away with in hand, physical proof of their new-found skill and knowledge. Students can show their peers or parents their achievements, reinforcing their confidence in their accomplishment.



Holograms can now be produced successfully using laser pointers and this has revolutionized the teaching of holography in the classroom. Teachers are now able to afford pointers rather than the more expensive helium-neon lasers. Holograms can now be made inexpensively as a result not only of developments in laser technology, but also in holographic film technology and chemistry. While the above-mentioned CD-ROM was being developed, Professor Tung Jeong of Lake Forest, Chicago, published a new development/plate combination, which allowed for the production of many

more holograms, more cheaply and easily than ever before. This information is available on his website: http://www.holokits.com/a-teaching_holography.htm and is included in the “Making Holograms” CD-ROM.

There is now an opportunity to increase the number of people learning and teaching photonics/optics using holography. In the UK holography can be used as an activity to teach the physics behind light and optics while adhering to the National Curriculum for Physics and Applied Science at GCSE, AS and A' level.

During March 2003, the Columbia Career Center's fifteen or so SPIE high school chapter members, in conjunction with the University of Missouri, ran a Saturday science holography project. 43 holograms were made in two hours with approximately thirty 13 year-old students from local schools. Production of this quantity of holograms during an educational outreach activity would not have been possible without the chemical/plate combination recommended by Jeong [3].

Another, more far-reaching, project to inspire students' interest in science, specifically optics and photonics which Professor Jeong and I have been involved with is SPIE's and the Optical Society of America's (OSA's) Hands-On Optics (HOO) Project: Making an Impact with Light. We submitted a lesson plan to teach holography in informal education settings, to thousands of students across the States. A \$1.7 million grant was applied for and awarded by the National Science Foundation in the USA. The HOO program unites the SPIE and the OSA with key industry partners, Mathematics, Engineering, Science Achievement (MESA) and the National Optical Astronomy Observatory (NOAO).

HOO is a three-year informal science program designed to bring optics education to tens of thousands of under-represented students nationwide. The program will focus on connecting optics industry volunteers with teachers and individual students. The program will reach out to females and minority groups who are typically not adequately represented in the science and technology workforce. Sample activities include building a kaleidoscope, building a pinhole camera, and creating holograms. The HOO module will consist of optics-related programs that will take place after school, during weekend sessions, and at summer camps or family workshops.

Elizabeth Rogan, executive director of OSA said “Our goal with HOO is to enhance science education for these populations and to foster an interest in science, which may open doors to futures these students had never considered.”

Funds provided through the HOO grant will also make possible extensive training for teachers, parents and optics professionals, all of whom will play various leadership roles within the HOO activities. Development of the pilot program is scheduled to begin early this year. Expansion toward a national

program will take place in 2006. NOAO will play a key role in training teachers and volunteers, and in developing the optics kits.

The first meeting of the HOO National Advisory Board for Hands-On Optics is taking place in San Jose, CA on January 25 during **Photonics West**.

HOO needs help in order to make the program a success. Input regarding successful ideas, materials and kits to help the program are welcome and encouraged. Suggestions and input are especially welcome in the following areas: lasers, fiber optics, and optical communication, digital and pinhole cameras, holography, geometrical optics, optical illusions and vision, color, filters, interference, and polarization, light sources and optical materials.

The Hands-On Optics program will need volunteer optics experts in the classroom to help educators make the most of the optics education experience. The volunteers will assist educators with use of the optics kits and will add a real-world view of optics. Volunteers could also help by organizing shadowing days and tours of optics-related workplaces in the community. HOO is also looking for business support – sustainable program impact and expansion is dependant on industry support. Industry can partner with HOO programs and schools in a number of different ways including providing publicity, human resources, facility tours and workplace introductions, financial and material contributions, etc. Companies can become a HOO site – The HOO program includes all types of informal science education opportunities including those at science centers, museums, scouting events, club activities and other educationally enriching programs.

HOO is looking to partner with individuals and organizations that can contribute to the educational vision, and resources. People interested in broadening and deepening the educational impact on students through the sharing ideas or materials with the HOO program can contact Jason Briggs at the OSA (jbrigg@osa.org).

I hop that educational projects such as the “Making Holograms” CD-ROM and the HOO program will inspire students’ interest in the kind of work that we holographers do. I also hope that captivating students with holography will help address the falling numbers taking science subjects and therefore the shortage of skilled photonics workers.

References

- [1] P. John and E. Poché 2002 *Making Holograms in the Classroom: OE Reports* April <http://oemagazine.com/fromTheMagazine/apr02/edu.html>
- [2] CORD, *National Photonics Skills Standards, Photonics Spectra*, Pittsfield. Mass. 1995
- [3] T. H. Jeong, Riley Aumiller, Raymond Ro and Jeff Blythe *Teaching Holography in Classrooms Making Holograms with PFG-03 Plates with JD-4* http://www.holokits.com/a-teaching_holography.htm
- [4] SPIE/OSA HOO press release

Useful site

Professor Tung Jeong's Holokits website can be found at:
http://www.holokits.com/a-simple_holography.htm