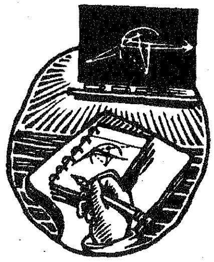


Electro-Optics Games

BY ROBERT ZAFRAN

Students love games! So why not use them to teach electro-optics technology principles? In Electro-Optics Games, two to five member student teams learn about laser applications, fiber optic principles, basic optics principles, interference filters, and other electro-optics phenomena while racing against the clock and other teams.

The LASE (Laser Applications in Science Education) Project,[1] was created in 1988 by Gareth Williams (San Jose State University) and Malcom Cornwall (Brighton Polytechnic University) for high school physics classes. A series of LASE "stations" stress qualitative exploration and analysis through hands-on activities, although quantitative analysis is an integral part of several of the stations. Students investigate electro-optical phenomena using photosensitive devices, oscilloscopes, signal generators, and associated optics equipment.

LASE activities promote student analysis of the processes, mechanisms, and outcomes of both teacher and self-directed investigations. Students don't just "do" experiments to obtain data that confirms already established concepts and principles. They are challenged to explore, modify, and extend the activities and then present their "findings" in both oral and written form via student and teacher seminars and LASE Log, a print publication.

Through this open-ended, ownership-oriented teaching methodology, students better understand and retain the fundamentals as well as advanced concepts associated with modern electro-optical technology.

High school and middle school students involved in the LASE Project encounter a multi-disciplinary (science, mathematics, computers, electronics technology) approach to their education. The industry-oriented, project-based method of task accomplishment is a mainstay philosophy of LASE. Both teacher and student participants positively benefit from the "what-if?" investigative aspect created by this research-oriented methodology. Using these student centered activities, the LASE Project has proven itself as an effective vehicle to teach students optically associated phenomena and simultaneously help them learn that teamwork is an essential ingredient in the completion of almost any multi-faceted task.

In late 1990, I was awarded an OSA Educator's Grant[2] to extend the LASE project to the middle school (grades six to eight) arena. Union Middle School in San Jose, California, was chosen as a LASE project development site because of its proximity to my school site and for its self-contained Special Education program. I had been advising my son's Special Education teacher in her enhancement of physical science activities offered to her students. My son's class of 16 learning-disadvantaged children was selected for a specially tailored version of the LASE Project enhanced with supplemental explorations in basic optics principles using OSA's unique Optics Discovery Kit.[3] Along with a small number of my high school physical science students, I made weekly visits to Union Middle School during the Spring of 1991.

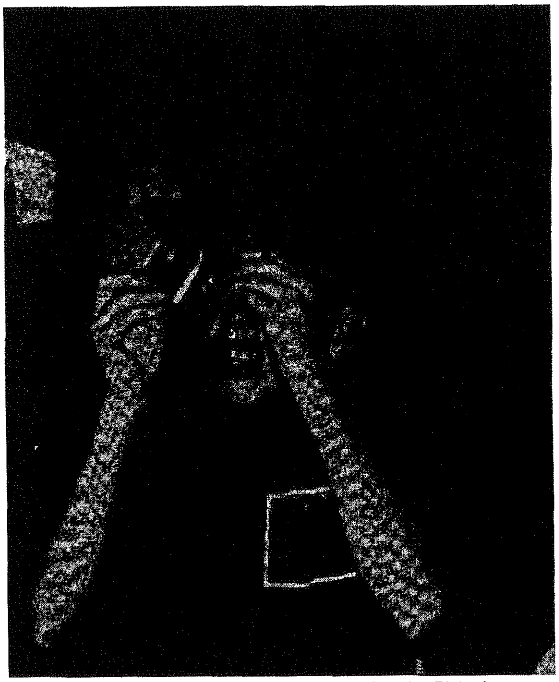
Because of the unique nature of presenting technical material to learning-disadvantaged students, each session was concluded with some sort of "optics challenge" to the students. At first, these challenges were simply used to end the lesson on a positive note keeping within the philosophy of the application oriented objectives of the LASE activities and the optics principles lessons. It became quite obvious that all of the students really enjoyed the "optics challenges" and they began asking for them at the start of each session. I realized that if more of the methodology of each session was based on this "challenge" principle, the students would be more attentive and, at the same time, more receptive of the formal material being presented. Also, a "lessons learned" period at the start of each session revealed that the students were learning and retaining a large portion of the optics principles embedded in the "challenges." What had started out as a gimmick to close a session became the mainstay of the presentation methodology! As much as possible, LASE stations and usage of the Optics Discovery Kit materials were restructured in a "games" format patterned after the ending session challenges. Hence, the birth of the Electro-Optics Games scenarios.

The games

To date, three Electro-Optics Games have been formally developed: Mirrors, The Right Image, and Light Links.

Mirrors

In the Mirrors game, teams of four students are challenged to intercept a low power (less than 0.5 mW) HeNe or solid-state laser beam and direct it to a 10-cm circular target some 5 m from their table site. Each team member uses a 2.5-cm circular dichroic filter that acts as a mirror to the red colored laser beam. The arrangement and location of the hand-held filters is selected by the team so as to optimize the deflection and direction the beam. Student teams race each other to see who can maintain their beam "on target" for three seconds. Variations of this game involve different numbers of students, each holding one or two filters, and different sized filters or mirrors.



OSA's Optics Discovery Kit helps students find the Right Image.

Light Links

In Light Links, teams of four students are challenged to form a "continuous" light path made by linking 30-cm strands of fiber optic bundles, each team member holding one bundle. The winners are the first team that successfully link their bundle so that the low power laser light directed at the starting end of the fiber optic path exits from the end of the last fiber optic bundle. More challenge is added when the teams are tasked to lengthen the light path to more than four fiber optic bundle strands by joining with members from other teams.

Right Image

The Right Image uses the OSA's Optics Discovery Kit plastic lens set consisting of two different focal length double concave lenses and one double convex lens. Two student teams are challenged to produce the "right" (inverted, reversed, enlarged, etc.) image of a particular object, usually the classroom clock, by using a unique combination of one, two, or all three lenses. Either a predetermined or open-ended time period is selected depending on the "degree" of challenge desired and the skill level of the students. The Right Image can be used to acquaint students with the Optics Discovery Kit or used as a summary and/or assessment activity after conducting the optics investigations suggested in the Teacher's Guide. The lens set as well as other materials from the kit are also used to investigate laser light phenomena.

Electro-Optics Games has proven to be an educationally sound methodology to introduce almost any student to the arena of optics associated technology. Through competition, student teams are challenged to investigate, create, and refine methods and mechanisms to quickly and efficiently accomplish one or more electro-optics associated tasks. Students who have manifested a "disinterest" in science have been observed to join in the "spirit"of the games, thus becoming active players in their education. The LASE Games seem to develop a sense of ownership promoting the interest of students who have then often focused and participated in follow-on science activities! Often, classroom activities consist entirely of optics games followed by discussion of the optics principles involved and possible extensions of the game to encompass other optical phenomena.

Electro-Optics Games can be used in conjunction with the LASE Project investigations and classroom usage of OSA's Optics Discovery Kit, and can also function as an independent curriculum unit or as a supplement to an existing unit on optics phenomena. Electro-Optics Games is a particularly useful instruction for the learning-disadvantaged and/or "At Risk" students who have short attention spans or reading difficulties.

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References

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