

## Comments on education in optics in different countries

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As I listened to the excellent talks in this conference, especially in the session on "Education in Optics in Different Countries," and learned about the educational systems in the USSR, the United States, Japan, China, and other countries, I began to muse on the more general question: What are some of the more general characteristics of an educational system (indeed, of any system) that are important for the health and the development of that system, independent of its formal organizational structure? From these musings I would like to offer a few very general and impromptu thoughts in answer to that question.

One basic characteristic, already mentioned by other participants, is surely an **insistence on quality** and on the **maintenance of high standards**—quality in the selection of faculty and in the selection of students, high standards in the evaluation of students and in measuring and evaluating the results and accomplishments of the system.

Another important fundamental characteristic, also mentioned previously by other speakers but worth repeating, is a **focus on fundamentals and on the long term**. Educational institutions should, for example, communicate with and understand the immediate needs of industry, but they must take and defend a longer view also. It is very difficult for anyone to accurately predict longer term manpower needs, or foresee future technical developments that may greatly change students' career paths. It is important therefore to focus on fundamentals (and also on preparation for continuing education), so as to prepare students for future changes, and not to train for obsolescence or even joblessness 20 years down the line.

A third set of desirable characteristics might be summarized as **flexibility, experimentation, openness, and honesty**. Be flexible and willing to try new things; and where new ideas and approaches are concerned be willing to make an occasional speculative investment, to experiment with new ideas, and try out new concepts to see how they work. Eliminate artificial barriers—for example, between departments and schools. Communicate extensively with others, and be very honest with yourself about what you are doing and how well you are doing it.

A fourth general principle might be a focus on **local control**—for example, local control of curricula or of academic planning, at the working level rather than in some centralized ministry. But at the same time as one fosters local control and initiative and experimentation, one needs to have some broader or more centralized quality measures and standards of evaluation also. In the United States, for example, there is a very high degree of local control over curricula and local control of degree-granting authority in schools, colleges, and universities. But at the same time we also have unified nation-wide measurement tools such as the Scholastic Aptitude Tests and Graduate Record Exams (SATs and GREs) which provide widely-published statistical results, so that local institutions, including both their administrations and their students, can see how well they are doing on a nation-wide comparative basis. We also have for example accreditation agencies to give some guidance and constraint to local educational curriculum setting.

Finally I think one must have a perpetual concern for **rewarding entrepreneurship and creativity and talent**, and for **the development of people** at all levels. Entrepreneurship can mean at one level young PhD graduates starting new companies, and a social and economic system that fosters and rewards this. At another level it can mean the academic entrepreneur who initiates a needed new academic program. One must of course always have a certain conservatism, especially in the academic arena where it may not be so easy to measure the success, or the “profit earned,” by a new venture. One must be wary of the kind of “operator” (to use an American slang term) who is always starting new ventures and promising great accomplishments, but then seldom delivers real measurable results.

Still, it is the initiative and the ability and the energy of its people, faculty, staff and students, that is always the most fundamental and valuable resource of an educational institution; and these people must have necessary support, encouragement, and continuing opportunities for development. New faculty members, particularly in a research institution, need adequate start-up support to permit them to become productive from the start. Personnel at all levels need adequate support both to do their work well, including the opportunity to influence how they perform their regular tasks, and to control some of the organization’s resources. They also greatly need to continue their own personal development on a career-long basis.

Particularly important, it seems to me, are opportunities for the kind of international and world-wide contacts afforded by attendance at professional meetings such as this one, and by periodic opportunities for travel and for sabbaticals or refresher courses or overseas study periods or fellowships. People in less developed or more isolated institutions must have the stimulation and renewal and updating afforded by periodically repeated study or fellowship opportunities in the wider world; and people from even the more advanced and developed parts of the world need to learn occasionally that people in other countries may have not just problems and difficulties but also ideas and accomplishments from which the developed world can learn.

I believe this St. Petersburg meeting has been a very great success both toward bringing out some of the general principles I have mentioned above, and toward providing the kind of international two-way exchange of ideas and stimulation I have mentioned in the last paragraph. It has been a most stimulating experience to take part in it.