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University, Schools, Teachers: Cooperative Relationships

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Introduction

The Physics Education Research Community (PER) has made unusual strides in studying the learning and teaching of physics. Its studies encompass the full range of levels of physics learning, but the focus of this paper will be on college level students. There is a strong interest in the US in improving the science understanding of all students, and a growing recognition that progress in this area depends on physics departments as well as schools of education and many other factors. From the US National Science Education Standards comes the phrase "what students need to know, understand, and be able do"[1] and a commitment to science for "All" students. Both require major changes in the preparation of teachers, and in the professional understandings and skills of those proffering the teacher preparation programs.

Student Understanding

There is growing improvement in our understanding of enhancing student understanding of physics and physical science. The shift is away from statements such as "how to teach student teachers to teach physics in schools" to "modeling learning and teaching strategies which enable students to understand physics in such a way that should they choose to become teachers, they become enablers of others learning physics in the same manner." The student's initial college learning experience will occur in introductory physics courses taught by persons who may not recognize the crucial role they are playing when a few of the students in their introductory course choose to become teachers. In the US, the solutions to improving teacher preparation are couched in terms of improving undergraduate education for all students, based on knowledge provided by those who study learners and the learning community.

The most recent National Research Council (NRC) report *Improving Undergraduate Instruction*[2] included the following statements. "What students learn and how they are taught in college science, technology, engineering, and mathematics (STEM) courses are issues that have occupied educators for many years and have been the focus of previous NRC studies. These studies point to the growing body of empirical research showing that learning can be enhanced when college instructors incorporate teaching strategies that are student-centered, interactive, and structured around clearly stated measurable learning outcomes. A crucial question, then, is why introductory science courses in many colleges and universities still rely primarily on lectures and recipe-based laboratory sessions where students memorize facts and concepts, but have little opportunity for reflection, discussion, or testing of ideas?"[3] The GIREP International Seminar on Teacher Education will undoubtedly include sessions that will address this issue.

Collaboration Across Departments and Institutions

Students preparing to teach will have courses in physics departments, in schools of education, and in local schools where they will have their first opportunity to practice their profession. Students should encounter common expectations in each of these venues informed by our modern knowledge of

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[1] NRC (1996a). *National Science Education Standards.* Washington, D.C., National Academy Press. (pp, 2).
<http://books.nap.edu/catalog/4962.html>

[2] NRC (2003). *ImprovingUndergraduate Instruction in Science, Technology, Engineering, and Mathematics.* Washington, D.C., National Academy Press.
<http://books.nap.edu/html/improving _undergraduate instruction/>

[3] Ibid., p. 1.

learning, the learner, and the craft of teaching. To achieve this there must be active communication and planning across all three venues.

Professional Society Statement

A major step in encouraging cooperation between schools and universities occurred in the US in 1999, when seven member societies within the American Institute of Physics (AIP) supported the following Statement on the Education of Future Teachers[4].

Statement on the Education of Future Teachers (Dec. 1999)

> The scientific societies listed below urge the physics community, specifically physical science and engineering departments and their faculty members, to take an active role in improving the pre-service training of K-12 physics/science teachers. Improving teacher training involves building cooperative working relationships between physicists in universities and colleges and the individuals and groups involved in teaching physics to K-12 students. Strengthening the science education of future teachers addresses the pressing national need for improving K-12 physics education and recognizes that these teachers play a critical education role as the first and often-time last physics teacher for most students.
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> While this responsibility can be manifested in many ways, research indicates that effective pre-service education involves hands-on, laboratory-based learning. Good science and mathematics education will help create a scientifically literate public, capable of making informed decisions on public policy involving scientific matters. A strong K-12 physics education is also the first step in producing the next generation of researchers, innovators, and technical workers.
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> Signators: American Institute of Physics, American Physical Society, American Association of Physics Teachers, American Astronomical Society, Acoustical Society of America, American Association of Physicists in Medicine, and the American Vacuum Society

This statement while directed to faculty members of physical science and engineering departments, must ultimately result in physics faculty collaborating with faculty colleagues in education and in the K-12 schools where the earliest physics teaching occurs. An example of a major program launched to answer this call is the joint project of the APS, the AIP, and the AAPT called PhysTEC.

A Collaborative Response

The Physics Teacher Education Coalition (PhysTEC)[5], a joint venture of the American Physical Society (APS), the AAPT, and the AIP, is a collaborative three-society answer to the entreaties in the Future Teachers Statement: "for departments and their faculty to take an active role in improving the preservice training of K–12 physics/science teachers." This project, supported with funding from the National Science Foundation (NSF), the Fund for the Improvement of Postsecondary Education (FIPSE), and the APS, provides a formal mechanism for our professional societies to launch a national effort to improve physics/physical science teaching in the United States by forming a national coalition of physics departments.

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[4] Professional Society Statement on the Education of Future Teachers, http://www.aip.org/education/futeach.htm

[5] See http://www.phystec.org.

The first stage involved selecting six Primary Program Institutions (PPIs) as the first members of the Coalition (Ball State University, Western Michigan University, Oregon State University, Xavier University, University of Arkansas, University of Arizona). These were universities whose physics departments in collaboration with their colleagues in education and the local schools agreed to create model programs for improving the science preparation of future K–12 teachers. These programs begin at the preservice level and extend into an induction and mentoring phase in the first few years of the new teachers' careers. The ultimate goal is to have at least 17 model programs, some supported by private and corporate funds raised by the APS.

Program Components associated with Primary Program Institutions are:

(1) A long-term, active collaboration among the physics department, the department of education, and the local school community;
(2) A Teacher-in-Residence (TIR) program that provides for a local K–12 master teacher to become a full-time participant in assisting university faculty in course revisions and team-teaching, and to act as a "reality check" for both preservice teachers and university faculty;
(3) The redesign of content and pedagogy for targeted physics courses based on results from physics education research and utilizing appropriate interactive technologies;
(4) The redesign of content and pedagogy for elementary and secondary science methods courses with an emphasis on inquiry-based, hands-on approaches to teaching and learning;
(5) The participation of physics faculty in the improvement and expansion of school experiences for their students; and
(6) The establishment of a mentoring program conducted by TIRs and other master teachers to provide a valuable induction experience for novice science teachers.

PhysTEC is unique because, as the lead society within the project, it builds on the APS reputation as the primary professional society serving the broadest group of physicists in education and industry. The other two collaborators are the AAPT which serves the K-12 teaching community, two-year college community, as well as colleges and universities, and the AIP which is the umbrella organization for nine member societies, including the APS and the AAPT.

PhysTEC will also be described by Ingrid Novodvorsky and in her GT2 on Thursday morning in Round Table 1.

Two Worlds or Three?

In the Seminar Workshop theme, *Contribution of research into teacher training*, there is a statement calling for "the co-operation of two worlds." I do not wish to pursue the research theme, but rather the identity of the "worlds" that should be cooperating in improving teacher preparation.

In the US there has been a chasm between faculty in the physics departments and their colleagues in education. Physics faculty members have often expressed pride in their not recommending school teaching to their students and distrust if not distain for programs in education. A number of the national reports addressing undergraduate education and educating teachers have been rather explicit in addressing the shortcomings of postsecondary education (both physics and education faculty) in preparing teachers. In the NRC (2001) report *Educating Teachers of Science and Mathematics and Technology*[6], the following statements are made: "Most instructors of these new teachers—including postsecondary faculty in science, mathematics, engineering, technology, and education—have not been

[6] NRC (2000). *Educating Teachers of Science, Mathematics, and Technology: New Practices for the Millennium.* Washington, DC: National Academy Press. <http://books.nap.edu/html/educating_teachers/ >

able to provide the type of education that K-12 teachers need to succeed in their own classrooms. Many faculty in science, mathematics, engineering, and technology (SME&T) at the nation's colleges and universities may not be sufficiently aware of these changing expectations to provide the appropriate type and level of instruction needed by students who would be teachers. Nor do most of these faculty have the kinds of professional development experiences in teaching that would enable them to model effectively the kinds of pedagogy that are needed for success in grade K-12 classrooms."[7] It is important during this seminar to determine if the conditions described in this paper exist only in the US or if they occur in the countries represented here.

Roles for Professional Societies

Many of the US national reports formally describe a role for professional societies in the teacher reform efforts. One example is presented below. *Educating Teachers of Science, Mathematics, and Technology*[6], a report from the National Research Council of the National Academy of Sciences, offers a series of recommendations for professional and disciplinary organizations based on extensive evidence from research that shows how various stakeholders might contribute individually and collectively — even systemically — to the improvement of teaching in these subject areas.

The NRC/NAS recommendations for professional and disciplinary organizations include the following:

(1) Organizations that represent institutions of higher education should assist their members in establishing programs to help new teachers;
(2) Professional disciplinary societies in science, mathematics, and engineering, higher education organizations, government at all levels, and business and industry should become more engaged as partners (as opposed to advisors or overseers) in efforts to improve teacher education; and
(3) Professional disciplinary societies in science, mathematics, and engineering, and higher education organizations also should work together to align their policies and recommendations for improving teacher education in science, mathematics, and technology.

Summary

The three professional societies that teamed up to carry out the PhysTEC project have become engaged as partners with six Primary Program Institutions (PPI) (and ultimately with 17) who are producing models for improving the preparation of K-12 teachers. They are also forming a broader coalition of physics departments who are acting to improve the preparation of teachers, but not at an advanced level of the six PPIs. We hope to provide evidence that professional societies can indeed provide leadership not simply recommendations that others do the task.

References

The references provided with this report all include web-addresses, which allow persons to review the documents, and in many cases download them for professional use. If this proves valuable to participants at the conference, John Layman (JL15@umial.umd.edu) would appreciate hearing from you.

[7] Ibid., p. 2.