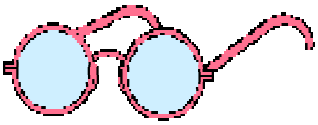
FORUM on EDUCATION
of the American Physical Society
Fall 2002

Looking Back

Thomas D. Rossing

As we advance in years, most of us spend more time thinking about the past and less time thinking about the future. That even happens to physicists. Although the future of physics has never presented a greater spectrum of interesting challenge, the writing of mature age practitioners of the art tend to reflect on the "golden age" of physics past. Our papers in journals are heavily loaded with references to past work by our colleagues, perhaps a commendable feature.



With that brief apology, I look back at the ten-year history of the APS Forum on Education, which was founded 10 years ago. Drasko Jovanovic, Fermi National Accelerator Laboratory, was elected the first chair, and the Executive Committee of the Forum on Education held its first meeting on October 25, 1992. The goals of FEd were given as:

- Improving channels for all interested physicists, including those not directly involved in teaching, such as those working in industrial and government labs, to become involved with physics education
- Focusing attention on the importance of good and universally available education to the health of the physics research enterprise and the quality and quantity of future researchers
- Promoting two-way communication between the physics research community and the physics education community
- Working cooperatively with other organizations for a sustained national effort in science education.

These goals have not changed appreciably over the past ten years.

The first FEd newsletter, prepared by Ken Lyons and dated February 1993, advertised for an editor. The second issue in October 1993, edited by Gerry Wheeler, noted that 15 applicants had answered the ad. The Forum decided on a troika composed of Stan Jones, Diandra Leslie-Pelecky, and Thomas Rossing, each editor to take the lead on one of the three issues of the year. In 1997, Sam Bowen succeeded Diandra as editor, and in 2000 Ernest Malamud took over Sam's position. Stan and Tom continue their editorial duties. Webmaster Ken Lyon began putting the Newsletter online, beginning with the Spring 1994 issue Since Spring 2001, the newsletter have been placed online only, thus saving printing and mailing costs. Jim Wynne, website administrator, now posts the newsletter both in html and PDF formats.

The editors often ask the questions: Are most of our members reading the Newsletter? Do they like what they read? Could it be improved? We don't get much feedback, but the lack of complaints

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probably means that it is satisfactory to most readers. One important function of the FEd is to arrange sessions on physics education at APS meetings. However, a relatively small fraction of our membership get to attend these sessions, and so the Newsletter is the main source of information about physics education and the APS role in improving education. We maintain close ties to the APS Committee on Education and to the American Association of Physics Teachers (AAPT). (For example, the authors in this issue include the President, the Vice-president, and a former president of AAPT, all of them active in ASA as well).

Some issues of the Newsletter have focussed on a particular theme, for example Outreach and Informal Education (Fall 1996), ABET (Summer 1998), Reform in Physics Education (Spring 1998), and Teaching on the Web (Fall, 2001). The articles and letters have treated a wide range of topics of interest to teachers and others interested in physics education. We welcome ideas for themes, and we would also welcome an offer to guest edit a special issue on a theme.

The Fall 1996 issue carried an index of authors for the years 1993-96. In researching this article, however, I discovered that no index had been prepared since that time. In keeping with the anniversary theme, I have prepared an index for all 10 years of the Newsletter. The list of authors reads almost like a Who's Who of physics education. One of our authors, a former chair of FEd (Rush Holt), is now in the Congress. I suppose there are neat ways to do indexes with a computer, but I'm not too familiar with them, so I have done it by hand. That probably means that I have missed an author or two and misspelled others, and for that I apologize.

Message from the Chair

Ken Krane

I would like to take this opportunity to use the Chair's column to bring Forum on Education members up to date on three issues that are under discussion by the Forum Executive Committee and to encourage comments by members on these issues.

1. APS Award in Physics Education

Of the thirty-some awards and prizes presented by the APS, none is specifically made to recognize accomplishments in physics education. To many individuals it is contradictory for the APS to promote programs in physics education and to encourage its members to participate in such programs but not to reward such efforts with an annual award prize that is on a par with those made for accomplishments in research. On the other hand, it seems difficult to craft an award that is differentiated from similar awards that are made by the AAPT. Both the Forum on Education and the Committee on Education have discussed this issue for the past two years with no agreement on award guidelines that would be unique to APS nor on how to fund such an award.

Recently an alternative suggestion was proposed - to make an annual APS award for accomplishments in physics education by a physics department, rather than by an individual. This proposal is certainly unique to APS, but it offers a new set of problems, especially that of making an appropriate template for judging departmental programs that can provide a fair and equitable competition among departments despite their size or level of funding. Moreover, as the experiences of the National Task Force on Undergraduate Physics have demonstrated, evaluation of a department's undergraduate programs requires a site visit and on-site discussions with faculty, staff, and students.

This topic continues to be under discussion by FEd and COE. The COE has appointed a committee to prepare a draft of an award document for the April 2003 COE meeting. FEd Chair-elect Wolfgang Christian is serving on this committee. If you have comments on this subject, please send them to Wolfgang (wochristian@davidson.edu).

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2. Joint APS/AAPT Sessions at Meetings

Given that one of the missions of the Forum is to bridge the gap between APS and AAPT, we have been discussing actions that the Forum can take to promote interactions between the two societies. One means would be to encourage joint sponsorship of programs at meetings - APS sessions at AAPT meetings and AAPT sessions at APS meetings. This seems especially appropriate given the demise of the joint annual meetings of APS and AAPT. Implementing this suggestion would require volunteers to help organize these programs. Ideas for sessions appropriate to the various meetings would also be welcomed. Please respond to me (kranek@physics.orst.edu) If you would be willing to volunteer or if you have a suggestion for a session topic.

Along these same lines, we want to encourage attendance by members of each society at the other's meetings. To that end, APS has approved a plan for the coming April meeting that will permit AAPT members (who are not members of APS) to receive a special badge at the meeting that will allow them to attend the four FEd-sponsored education sessions at the April meeting. A corresponding policy to allow APS members to attend sessions at the January AAPT meeting (Austin, TX) is under consideration by the AAPT Executive Board.

3. Teacher certification

From time to time, we become aware of attempts to weaken state requirements for the certification of K-12 teachers, especially regarding science and math qualifications. Often this knowledge is forwarded to the APS Education Office too late in the process for us to have any significant influence. We would like to establish a national "early warning network" to provide a timely advance notice of impending state reviews of teacher certification standards. The plan would be to invite a few key leaders in these states to a workshop on how to mobilize state support for strengthening the standards for science teaching. The FEd database can be used to identify individuals in each state who have an interest in K-12 education and thus who might be counted on to become involved in this effort.

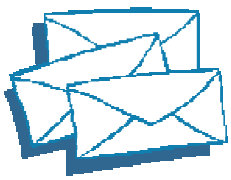
This topic will be on the table for discussion at the next meeting of the Executive Committee. If you have suggestions for implementing this program, please forward them to Karen Cummings (cummingsk2@southernct.edu) or Rick Robinett (rick@phys.psu.edu).

Ken Krane, Professor of Physics at Oregon State University, is Chair of the Forum on Education. He has previously held a number of positions in both APS and AAPT.

Letter to the Editor

Why the textbook *Physics: Principles and Problems* by Zitzewitz et al, has become the most widely used high school physics text

In a recent communication with the AIP Statistical Research Center Mark McFarling stated that the most commonly used high school physics textbook is *Physics: Principles and Problems* by Zitzewitz et al. Although the preliminary analysis is not complete, the text is used in about one-half of the regular introductory algebra-trigonometry physics course. This course is by far the most common course offered in high school physics. Current dominance of the high school market by the Zitzewitz et al text at is about the same as it was in 1997 and some years before. *Conceptual Physics* by Hewett dominates physics for non-science students, a lesser used high school course (1).



Modern Physics, the most widely used text for many years, had various authors but has now gone out of print. Over the last twenty years *Physics Principles and Problems* (originally by Murphy and Smoot) had steadily gained acceptance by the high school physics teaching community and had in 1987 a 33 percent share of the market to a present 50% share, while *Modern Physics* declined from

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almost universal acceptance by high school physics teachers to an at present 20% share of the market . Both texts were rated high quality by physics teachers (2).

The reason that most teachers shifted from the old standby *Modern Physics* to the Murphy and Smoot (now authored by Zitzewitz et al) was that the former text did not properly address the main problem that young students in high school have with their physics course--problem solving.. Earlier editions of *Modern Physics* had some direct relevant examples of how to solve the problems at the end of each section (3), but the newer editions, especially starting in the cold war era, erroneously relied upon so called "thinking" through the problems in the text by the student and solving them using pure thought and relevant cues in the text (4). This is what made physics "hard." The hard part of physics is in the problem solving for most students.

The Zitzewitz format has made it so that high school physics is finally "user friendly." Prior to its introduction the physics teacher had to make up six to eight problems based on the same concept such as I = V/R solving for I, R and V so that learning would take place. This has made the standard mathematical high school course not only "student friendly," but also teacher friendly (5). I have also found that many inner city students, who often were sold out by giving them the qualitative course such as "Conceptual Physics," were certainly capable of using Zitzewitz and doing the mathematical course with calculators(6).

Certainly, the publishers of the Zitzewitz *Physics: Principles and Problems* has provided the high school physics teachers with a student and teacher friendly high school physics text which is of good quality. It will enable all students to successfully traverse mathematical physics and should be held as a model for the publishers of even college texts. Physics teachers of
all types, high school, undergraduate and graduate, need this type of text with plenty of examples on how to do the physics problems at the end of the chapter. The format for all physics course texts should be modeled on the Zitzewitz format of single concept, examples, and drills and practices for reinforcement of each concept. That is why this text has become the most widely used high school physics text--because it is user friendly.

References:

1.Michael Neuschatz and Mark McFarling, "Maintaining Momentum: High School Physics for a New Millennium," AIP report number R-427 (1999) p 4-5.
2. Ibid.
3.H.Clark Metcalfe et al, *Modern Physics*, Holt, Rhinehart, and Winston (1960).
4. John E Williams etal, *Modern Physics*, Holt, Rhinehart, and Winston (1976).
5. Stewart E Brekke, "Mathematical Physics For All, First or Last, is Realistic," APS Forum on Education Newsletter, Spring 2002.

Stewart E. Brekke, Bensenville, IL, sbrekk@cs.com

Stopping the Revolving Door

Christopher Chiaverina

Last semester I had the pleasure of working with a truly gifted pre-service teacher. She knows her subject (physics) inside and out, spent untold hours preparing for her classes, and, in the words of my department chairman, is "a natural born teacher." A visitor to her classroom could immediately sense her love of physics and the joy she derives from sharing her knowledge with others. Equally apparent were her students' involvement in and enjoyment of the learning process. Therefore I didn't find it surprising when she received offers from some of the Chicago area's top school districts. Needless to say, I am very happy for her and the students she will teach. However, I do have one concern: will she remain in the classroom?

According to the National Center for Education Statistics' Schools and Staffing Survey, there is roughly a one in three chance that a beginning K-12 teacher will leave the profession within three

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years; 39% leave teaching after five years. And of course, some new teachers barely make it through the first semester.

This was the fate of Joseph Reynolds, an attorney who decided to leave law for teaching. According to an op-ed piece he prepared for the March 27 issue of *USA Today*, Reynolds, like many of us, was attracted to teaching by fond memories of teachers who had a profound and lasting influence on him. So after 25 years as a successful lawyer, he chucked it all to become a high school teacher. However, at the end of the first semester he decided to return to his law
practice.

Although low pay is often cited as a factor in a new teacher's decision to leave the profession, it isn't the only reason for teacher turnover. Money certainly didn't play a role in Reynolds's early departure. So why did he leave the classroom?

In a recent report by Susan Moore Johnson, et al. in the Harvard Education Letter- Research Online, the lack of support by colleagues and administration is one of the principal reasons for early exodus. Frequently given the most challenging assignments with very little assistance, beginning teachers feel overwhelmed and adrift. More often than not, these neophytes find that there is no where to turn for either succor or solace. With the rewards for their efforts being frustration and a sense of failure, it's no wonder that these recent inductees head for greener pastures.

Based on Reynolds's anecdotal evidence and the findings of Johnson and other educational researchers, it seems clear that if our schools are to keep good teachers they must find ways to address their needs. One solution: our schools and professional education organizations could get serious about implementing and supporting mentoring programs through which the experience and wisdom of seasoned professionals can be passed on to the next generation of teachers. A survey of the literature addressing teacher retention reveals support for this point of view. Perhaps the strongest statement I've encountered comes from the Southern Regional Education Board. In their *Reduce Your Losses: Help New Teachers Become Veteran Teachers*, they conclude: "Quality mentoring and induction programs are the greatest tools that states can give new teachers."

At first blush, it would seem that the new teacher is the only beneficiary of the mentoring. However, according to Johnson, "both novices and veterans benefit from frequent and meaningful interactions with colleagues. Therefore, the benefits of these school-based efforts are not limited to novice teacher induction, for they provide renewal for experienced teachers and the foundation for school-wide improvement."

The support of mentoring programs for both new teachers and individuals teaching outside their area of expertise must be a priority of stakeholders in education at every level. We must become as concerned about retaining teachers as we are about recruiting them. Then, and only then, will we put a lock on what University of Pennsylvania's Richard Ingersoll refers to as the "revolving door of teacher turnover."

Christopher Chiaverina, who has been a high school physics teacher for 34 years, is currently serving as President of AAPT. This editorial, which appeared as the President's Report in the Summer 2002 issue of the AAPT Announcer, *is reprinted by permission.*

Building Bridges within the Forum

Charles H. Holbrow

What can the Forum on Education and the AAPT do for each other? I was a member of the APS Committee on Education as we worked in 1990-91 to found the FEd, and I remember our aspiration was to involve research and industrial physicists in the rising efforts of their local communities to improve science education in general and physics education in particular.

> The objective of the Forum shall be the advancement and diffusion of knowledge regarding the inter-relation of physics, physicists and education. The Forum shall provide for all members of the Society an opportunity for discussion of and involvement with matters of physics education.

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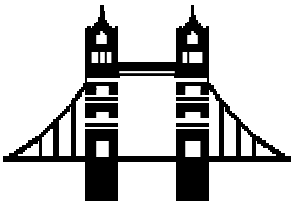
The mission of the AAPT,

> The objectives of this Association shall be the advancement of the teaching of physics and the furtherance of an *appreciation* for the role of physics in our culture

certainly supports a similar goal for its members.

The perspectives of FEd and AAPT members can be rather different, however. About 3000 members of AAPT teach high-school physics, and they are on the front-lines of state and local efforts to reshape science education. Few of the approximately 4000 members of the FEd teach below the college level, and an appreciable fraction of them do not teach at all. At the local level their concerns are likely to be to see that their children are well educated. Many also wish to help enrich local school programs by bringing their own expertise into the school or by providing access to the facilities of industrial, university, or laboratory research organizations.



AAPT and APS staffs already co-operate in several important projects. For example: APS (Fred Stein), with significant contributions from AAPT and AIP, is leading the PhysTEC program to build links between physics departments and schools of education in order to improve the science preparation of K-8 teachers; AAPT (Bruce Mason), with significant help from APS, AAS and AIP, is developing for the National Science Digital Library (NSDL) a physics component that will provide physics teachers with curricula resources keyed to the age and preparation of their students.

But FEd and AAPT can benefit from direct cooperation. Let me mention just two of many possibilities. First, anyone reading the FEd Newsletter has to be struck by the thoughtfulness and the imagination of many of its articles. The FEd thus acts as a think-tank for physics education, a rich source of interesting ideas. AAPT publications -- *The Physics Teacher,* the *American Journal of Physics* and the *AAPT Announcer* -- are also sources of commentary about physics education. I believe that more exchange of articles, more cross publication would benefit members of both organizations.

Second, although AAPT and FEd share members of four-year colleges and universities in common, we also connect to different parts of the physics community. Where the FEd enlists the industrial, university and research laboratory physicists that do not generally join AAPT, an important portion of AAPT membership are energetic and imaginative physics teachers from secondary schools and two-year colleges. These non-overlapping constituencies of the FEd and the AAPT can benefit from communication with each other. AAPT national meetings provide a unique opportunity for people from the physics research community to meet and talk with a wide variety of physics teachers. Recently, at the behest of the FEd, the APS has arranged for AAPT members to attend for free the FEd-sponsored sessions at the APS March 2003 meeting. AAPT is planning to respond with a similar gesture. By this kind of cooperation the FEd and the AAPT can foster better communication between various parts of the physics community, and everyone – especially physics students – will benefit.

If you have ideas for other ways AAPT and FEd might cooperate, I would be very pleased to receive them.

Charles Holbrow, the Charles A. Dana Professor of Physics in the Department of Physics and Astronomy at Colgate University, is President-elect of AAPT. He is an APS Fellow and a member of the Executive Committee of the Forum on Education. cholbrow@colgate.edu.

Don't Lecture Me on Lectures!

Kelly R. Roos

A combination of the title of the upcoming Illinois Section of the AAPT Fall Meeting, Teaching Better Physics Better, and the location of the meeting has stirred me to revisit a delightful article I read several years ago by David Griffiths, the recipient of the 1997 Robert A. Millikan Medal (the location for our Fall meeting is Millik*in* University, hmmmm). The article was actually a transcription of his acceptance speech at the national AAPT meeting, and was

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published in the American Journal of Physics (Am. J. Phys. **65** (12), December 1997).

We are somewhere in the neighborhood of the tenth anniversary of a reform movement to revitalize physics education. Those of you readers who are more "in the know" about the exact dates of the pioneering efforts of the reform movement may take me to task about the exact number of years since it all started, but at least I think I remember that it was around ten years ago that "physics education research" started to become a familiar term. One goal that seems to me to have permeated the movement over these last ten years is the debunking of the traditional lecture as a sound mode of physics instruction. And not just debunking, but there seems to be within the movement the attitude that our traditional teaching modes are hopelessly flawed and that not even a good lecturer can effectively lecture, regardless of any evidence or argument to the contrary. Griffiths does not buy into this. As you read through Griffiths' article, it becomes immediately apparent that he is not an advocate of the need to reform physics teaching, and indeed still rather likes the traditional lecture. He makes a very convincing, and intellectually sound case for the traditional methods.

My first direct experience with true debunkers occurred while attending the "Building Undergraduate Physics Programs for the 21st Century Conference" in 1998 in Washington, D.C., a meeting jointly sponsored by the APS and the AAPT. We had just gathered into our breakout groups to discuss the role of reforming teaching methods in revitalizing undergraduate physics programs. With a majority of debunkers present in my particular group, the overwhelming sentiment was toward a definite need to stop lecturing, and the few of us in the minority lecture party were continually "lectured" about the futility of the lecture. Upon suggesting that perhaps the effectiveness of any method of teaching strongly depends on the passionate dedication of the teacher we were informed that such an assertion was "demonstrably wrong!"

Whether the debunkers are right or wrong concerning lecturing, one thing is certain as we gaze across the physics teaching landscape today: the debunking hasn't worked, at least in the sense that the larger physics community has not adopted the anti-lecture stance. There is still an overwhelmingly large stronghold of traditionalists who cling to the lecture, despite a great effort by the reformers to "prove" to us lecturers that lectures are not effective.

So my debunker friends' rather curt statements regarding the "proven" inferiority of lecturing suggests to me that we who have not adopted "demonstrably" superior modes of teaching are either ignorant or stubborn. Now, I'm not sure about my degree of stubbornness (although I'm certain that there are those who would gladly comment on it), but I am not ignorant. I am open to new ways of instruction (as we all should be), and indeed, I have over the last ten years stayed abreast of and experimented with many of the novel modes of instruction which have come forth as a result of the reformers. But, I always seem to end up convinced that the new mode I had been trying was not really better than the traditional methods, and not worth the extra time and effort I usually expended in implementing the new fangled ideas. This, of course, is my own opinionated conclusion based on my own personal physics education experiments. For me the most important thing to bring to a classroom (perhaps along WITH several demos and the Force Concepts inventory?!)) is my passion for the subject matter born out of being deeply involved in scientific pursuits, and my dedication to the learners. I really do believe that such a combination CAN be demonstrably effective for teaching physics. Regarding my stubbornness--I refuse to consider it!

Well, if I have stirred you up by all this, and provoked you all a bit, then my mission in writing this short column has been accomplished. I believe these are things which must be continually discussed, and we should never believe that we and/or our chosen methods of physics instruction have "arrived" at such a state that we are beyond critical self examination towards improvement. I invite your comments, and would love to discuss further these issues with any of you who are interested. In the mean time, independent of your "mode," keep up the good teaching!

Kelly Roos, a professor in the Department of Physics at Bradley University, is serving as President of the Illinois Section of AAPT. A slightly shorter version of his editorial appeared in the Fall issue of the Illinois Physics Teacher.

APS Education and Outreach Programs

Fred Stein

Overview

The APS Director of Education and Outreach works with all units through four APS standing committees: the Committee on Education, the Committee on Careers and Professional Development, the Committee on Minorities, and the Committee on the Status of Women in Physics. The APS/Education web site contains descriptions of programs, committees and links to current innovations in undergraduate education. http://www.aps.org/educ/.

Committees

- **The Committee on the Status of Women in Physics (CSWP)** continues an active site visit program (originally started with NSF funding) to universities and, more recently, national labs. Members from corporate partners raised funds to create a new brochure *Physics in Your Future* to encourage middle school girls to consider physics as a career. COE also coordinates the APS/IBM research Internships and has launch the listserve *Friends of CWSP*.
- **The Committee on Minorities (COM)** continues its program to award 20-30 two-year university scholarships each year to minority students majoring in physics. An email Mentor program was initiated. An evaluation of this program is on-going. COM has also launched a survey to determine the number of minority Ph.D. physicists employed at the DOE national labs. COM has also produced a new poster.
- **The Committee on Education (COE)** has endorsed the statement on the web, *Why Study Physics*. It has also approved submitting the statement *Physics for Everyone* to POPA and the APS Council. COE has discussed the APS role in promoting digital libraries for science education.
- **The Committee on Careers & Professional Development (CCPD)** has created the Web Site Bulletin Board to post announcements and inquiries about jobs and professional development activities for faculty and their students.

Programs

- Teachers' Day at the APS March and April meetings brings 50-100 high school teachers from the local area in contact with conference scientists for a day of hands-on workshops and cutting-edge talks and discussions.
- APS is helping to organize a conference in Colorado in February 2003, to promote Mobile Physics Outreach.
- APS is helping to plan the VII Interamerican Conference on Physics Education to be held in Cuba July 4-7, 2003.
- APS is a partner in the National Task Force on Undergraduate Physics and their current project of college and university site visits.
- APS is a partner in the annual New Faculty Workshops and in the Conferences for Physics Department Heads and Chairs held annually at ACP.
- APS is an active, registered lobbyist informing and assisting the U.S. Congress to consider policies that will ensure a high level of resources for science research and science education at all levels.

Physics Teacher Education Coalition: A Grant Supported Program

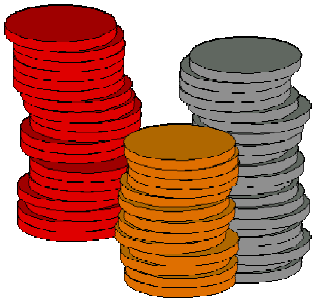
- PhysTEC is a program to improve the science preparation of future K-12 teachers. It aims to help physics and education faculty work together to provide an education for future teachers that emphasizes a student-centered, hands-on approach to Learning science. APS, in partnership with AIP and AAPT recently hired a full-time PhysTEC Coordinator, Kevin Aylesworth to manage the project. http://www.phystec.org

For additional information, contact:
Dr. Fredrick M. Stein, Director of Education and Outreach, American Physical Society (301) 209-3263 stein@aps.org

Is it Just Change, or is it Improvement?

Karen Cummings

I have come to the conclusion that most human beings (myself included) just do not like change. I think this generally present aversion is rooted in the fact that we usually have our professional and personal lives running fairly smoothly and efficiently. Change means that time and effort must be spent in adjusting to whatever is new. At least that is why I get mad every time Microsoft brings out a new version of Word, Excel, PowerPoint or Windows. I already know how to use the old versions very efficiently. And, they do everything that I need them to do. Why should I take all the time and energy required to become comfortable using a new version of Word?



I think another example of the general, and well founded, human aversion to change is many educator's response to computer based systems for homework assignment, grading and recording of grades. There are several systems already in wide spread use. Larry Martin, through North Carolina State University, developed WebAssign. CAPA (Computer Assisted Personalize Assignment) is a Michigan State University project. The Homework System by C. Fred Moore is centered at the University of Texas at Austin and John Wiley and Sons Publishing is bringing out a program called E-Grade.

All of these systems are basically computer software packages that focus on homework and exam processing. All of these systems allow the assignment and submission of a wide range of types of problems including essays and numerical problems. None of them can automatically grade an essay. None of them is very good at assessing the method or process by which students arrive at a right or wrong answer to a numerical problem. They do not give partial credit. However, they all allow for numerical problems with randomly assigned values for the variables so that students can be assigned the same problem, but a random number generator ensures that they get different numerical solutions.

Although I have already admitted to you that I do not like change, I must say that I started using such systems years ago. I did so not because I am a lazy educator, or even because I am infatuated with technology (although I think that I may be). Rather, I started using these systems because I was unsatisfied with the process by which homework is typically completed and graded in introductory science courses.

Perhaps the most common approach to homework in an introductory course is to assign the entire class several problems from the textbook. The students then write out solutions to the problems and graduate student teaching assistants or faculty members grade the written responses. Many of us know this approach well. It is the one we use and/or the one that was used with us. At some institutions, homework in introductory courses is assigned but not graded at all.

I believe that are significant problems with all of these approaches to assigning and grading homework. For example, students can submit work which is entirely someone else's. It is also very hard for instructors to customize problems to take into account the level of their student's preparation or write new problems for their class. Perhaps most significantly though, students do not get enough meaningful and timely feedback on their work. Graduate students and faculty members are busy people. So, despite our best intentions, homework is often not graded very promptly and/or with little more than a cursory check for completeness and correct answers. Largely because I believe that immediate feedback is critically important to the learning process, I decided to try using the computer based homework systems discussed above.

My first experience with computer based homework systems was as an instructor in the large introductory physics courses at Rensselaer Polytechnic Institute. Within days of starting to use the new system, there were outcries from students. Some called me too lazy to grade. Others said that I was a technology zealot. Both of these groups of students said that they *hated* doing homework on the computer. But, despite the complaints, I persevered. At the end of the term, I tried to more accurately assess the extent of unhappiness. I remember how I braced myself as I processed responses to an end of the se-

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mester survey but in the end was mildly shocked by the outcome. Seventy percent of the students either strongly agreed or agreed with a statement indicating that they *liked* doing homework on the computer. Another ten percent of the students were neutral. Only twenty percent of the class did not like using the system, and more than half of those students were fairly mild in their reluctance.

This fall, I started my first tenure-track appointment as an Associate Professor of Physics at Southern Connecticut State University in New Haven, Connecticut. In terms of their level of preparation and their comfort with technology, the students at Southern Connecticut are very different from the students at Rensselaer. Upon my arrival at this very different institution, I decided to again try using a computer based homework system in my introductory classes. I was again somewhat surprised to find that the vast majority of the students really like using the system. My students at both institutions indicated that they like knowing when their answer is wrong while they still have a chance to fix it and that this feedback often motivates them to continue to work on a problem until they get it right.

However, I do not assign homework for the students' enjoyment. I assign homework in the hope that students will learn physics as a result of doing it. Do students learn more doing homework this way? I can't say for sure. What I do know is that on end of the semester surveys the majority of students in my classes report that they *feel* that they learned more doing homework on the computer than they would have using the standard process of homework submission and grading. I also know that careful studies by the developers of the systems at North Carolina State and Michigan indicate that levels of learning with computer based homework are equivalent or higher to those in classes where the homework was done on paper.

There are differences between the ways in which I used a computer based homework system with the several hundred students in Rensselaer's introductory physics courses and the way I use it with my 50 or so students at Southern Connecticut. The smaller number of students in my class at Southern Connecticut means that I can require that students keep a "homework notebook" in which they record their work, in addition to submitting answers on the computer. These notebooks are periodically reviewed. This approach provides an attractive combination of immediate feedback on correctness via the computer, and partial credit and process review through the instructor. Another added benefit of the computer based homework system to the Southern Connecticut students is that the ease with which the instructor can write and assign problems that are not in the textbook means that the system can be used to refresh the student's mathematical skills without using class time. I have written several series of progressively more difficult questions which guide students through a self-review of the mathematics required in the course. This seems to be a big help to many of my current students.

Computer based homework systems facilitate the distribution of personalized homework problems, provide the immediate feedback to students that is so important for motivation and learning and provide real time (or "just in time") data to instructors on the status of individuals and the class which allows dynamic, student-centered approaches to learning. For these reasons, I have stopped asking myself *if* I should use a computer based homework system and started thinking about *how* I best use the system to improve student learning and maximize student comfort with technology. Sometimes change really is worth the effort because it isn't just change, it is improvement.

So why should I take all the time and energy required to become comfortable using the new version of Microsoft Word?

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Executive Committee Virtual Meeting

Executive Committee Virtual Meeting

To save travel expense, the FEd Executive Committee held a "virtual meeting" in the form of a teleconference on October 19. Following is a summary of some of the items of interest to FEd members.

- Fred Stein reported that a new brochure from the Committee on the Satus of Women in Physics is ready for distribution. Teacher days are planned for both the March and April APS meetings and all are invited to participate. A conference called "Physics on the Road," February 22-23, 2003 will bring together those who take experiments and exhibits out to schools (physics vans) aimed at grades 4-7.
- The VIII InterAmerican Conference on Physics Education will be held in Havana, July 7-11. Information is available at <www.physics.ohio-state.edu/~aubrecht/VIIIIACPE(E).html>
- The nominating committee has received a lot of nominations but few from industry or the National labs. The deadline for nominations is 14 weeks before the April meeting.
- In order to facilitate the building of bridges between AAPT and APS, AAPT members will be allowed free admission to all four APS FEd sessions at the APS meeting and will be issued a special badge only for the FE d sessions.
- FEd members should become more involved in teacher licensing issues in their states. Working with the APS Education Office, we could alert members in each state to get involved in discussions early enough to influence decisions.
- The FEd Executive Committee plans another virtual meeting early in January and then to meet during the April APS meeting in Philadelphia. Forum members are invited to suggest agenda items.

Browsing Through the Journals

Thomas Rossing

- The number of students taking A-level (advanced level secondary school) physics exams in England, Wales and Northern Ireland this summer rose by 2.7% to over 31,500, according to an article in the September issue of *Physics World*. Total A-level entries in all subjects, in contrast fell by 6%. The numbers taking AS-level physics, a physics exam taken at the end of the sixth form, increased by 17.3% to almost 39,000. Fears that students would try the new AS-level physics and then abandon the subject were unfounded, it appeared, as a high percentage of those who took AS-level physics in 2001 went on to do a full A-level in 2002. The overall pass rate for physics was 92% at A-level and 85% at AS-level. Meanwhile the number of students in Scotland taking Higher physics fell by 4.4%.
- The Bakken Museum, which includes about 2000 scientific and medical instruments is one of three Minneapolis science museums described in an article in the May issue of *Physics in Perspective*. Founded by Earl Bakken, the inventor of the first wearable transistorized cardiac pacemaker and founder of Medtronics, the collection focuses on "electricity in life," specifically the historical role of electricity and magnetism in the life sciences and medicine.
- A special feature on "Uncertainty, Risk and Disaster" in the September issue of *Physics Education* includes articles on "Teaching accuracy and reliability for student projects," "A practical guide to open-ended course work investigations," " Extreme value theory," "Challenger," and "Fire resistance of framed buildings."
- Women from 41 nations are assembling the first international organization to promote the recruitment, retention and networking of female engineers and scientists, according to a story in October issue of *The Institute*, a publication of IEEE. A landmark vote creating the International Network of Women Engineers and Scientists (INWES) was cast during the 12th International Conference of Women Engineers and Scientists

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July 27-31 in Ottawa, Canada. INWES is expected to become operational next year.

- Although American universities are producing new scientists and engineers at an unprecedented rate of well over half a million a year, the supply of doctorates in science and engineering may not be enough to meet recruitment needs over the coming decade, according to an article in the July issue of *Scientific American.* Since 1996 the number of science doctorates has decreased, primarily because of the decline in degrees earned by noncitizens who have been drawn to universities in China, South Korea and Taiwan. The number of doctoral degrees granted to U.S. citizens has apparently stopped growing and shows signs of leveling off at about 16,000 to 17,000 annually, probably not enough to meet our needs. Underlying the plateau is the failure in recent decades of white American males to enter science and engineering doctoral programs.
- The main scientific advisory panel to the White House has joined the call for more research funding for the physical sciences, according to a story in the 5 September issue of *Nature.* A letter from the President's Council of Advisors on Science and Technology (PCAST) calls for a funding increase in fields such as physics and engineering to match the five-year doubling of biomedical research at the National Institutes of Health, which will be completed next year. Because Bush appointed PCAST only last year, and it comprises scientists and engineers friendly to the administration, lobbyists are optimistic that Bush will heed its advice. Michael Lubell, APS director of public affairs, calls the letter "a breath of fresh air." A similar story appears in the 6 September issue of *Science*.
- More than 76% of physics lessons for 11-14 year olds in the UK are taught by teachers without a physics degree and more than one-third are taught by teachers without a physics A-level, according to an article in the September issue of *Physics World.* In order to support these teachers, the Institute of Physics has embarked on a Supporting Physics Teaching project, designed to develop the competence and confidence of non-specialists teaching physics to 11-14 year olds. The project aims to produce a set of 6 CD-ROMs covering the physics components of the science syllabuses across Great Britain and Ireland. Each episode will consist of three elements: the physics, the associated learning challenges, and successful teaching approaches.
- If the process by which individuals enter and progress through programs in mathematics, science, technology, and engineering (MSTE) can be likened to a pipeline, the pipeline is very leaky during the college years, according to an article in the October issue of the *Journal of College Science Teaching*. More than 40 percent of all students who enter college with an interest in mathematics, science, and engineering majors leave these majors between their first and second years. The pipeline is even leakier for women, and the leaky pipeline continues into the workplace. At least one university has instituted a one-credit course that supports female students in their aspirations toward MSTE majors and careers.
- "The Internet's Impact on Teacher Practice and Classroom Culture" is the subject of an article in the June issue of the *T.H.E. Journal.* One of the positive results discussed is that students spend more time teaching each other and even teaching the teachers. Given the massive amount of information available on the Internet, any student is now able to find information not formerly known by the teacher. Girls seem to be as comfortable as boys in searching for information on the Internet, in contrast to studies that show boys are more generally more comfortable using computers than girls. The Internet changes the face of the computer world from one centered on programming and adventure games to one that includes a significant communications focus.

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