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Fall 96

Curriculum **a**nd **F**aculty **D**evelopment Newsletter for Two-Year College Physics Teachers

Part of a workshop project

Supported by

National Science Foundation

Joliet Junior College (IL)

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First TYC Introductory Physics Conference Summary - June 1996

The First Two-Year College Introductory Physics Conference (TYC IPC I) was held in Joliet. It started at 3 pm on Tuesday on June 11, 1996, and ran until noon on Saturday (June 15) with sessions each evening. This workshop-style conference served as a follow-up and update to our earlier workshops on Microcomputer-Based Laboratories (MBL), Conceptual Exercises and Overview Case Studies (CE/OCS), and Physics Simulations (PS). This newsletter features details and excerpts of information that was shared at this conference.

Present at the First TYC IPC were many of our past workshop leaders plus some additional presenters from TYC's (list on p. 12). Many, if not most of these sessions were centered around an active-learning hands-on workshop format rather than lectures.

The general theme of the conference was heat and thermodynamics. We looked at what we should be teaching, determined some of the misconceptions in heat and thermodynamics and how we can make an overall assessment in this area. Some participants and leaders shared pre- and/or post testing results in the area of heat and thermodynamics. Small groups met during the conference and as a result, prepared reports on their discussions (see pages 4 & 5).

In addition to heat and thermodynamics, there were plenty of activities in a variety of areas. One such activity was the preliminary version of the Electricity and Magnetism Concept Inventories that were constructed in the summer of 1995 and tested at a few places in the 95-96 academic year. A newly revised version, based on this testing, was reviewed and discussed extensively.

Another interesting session was held on Technical Physics. Physics instructors from Henry Ford CC led a three hour hands-on workshop session on their NSF funded Advanced Technology Education Technical Physics project which features a case-study format using an automobile trunk lid or door. It is designed to use the PASCO 700 interface system and sensors either on a Mac or Windows platform. A round table discussion followed on the needs and role of technical physics in TYCs.

Priscilla Laws presented highlights of the three units in the Workshop Physics Activity Guide on heat and temperature. The participants used air for the MBL-experimental study of ideal gas law relationships. Performing a computer-enhanced guided derivation of kinetic theory relationships, they used fire syringes to create adiabatic compressions that caused paper to ignite. Laws also showed some QuickTime movie sequences from Interactive Physics simulating the compression of ideal gas molecules system. It is possible to analyze these sequences with VideoPoint to help students overcome misconceptions about ideal gas compression and expansion. Particularly the idea that temperature and heat energy are related to the inelastic collision of molecules. Participants also had an opportunity to work with a newly designed heat engine available from PASCO Scientific.

Presentations were made on Interactive Lecture Demonstrations on energy, simple harmonic motion, and heat and the new Visualizer software, which reconstructs a vector representation of position, velocity, and acceleration from MacMotion data.

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Introductory Physics Reform

T. O'Kuma
Lee College
Baytown, TX

During the first Introductory Physics Conference, I had the honor of giving a talk on some ideas concerning "introductory physics reform." As a fringe watcher and a bit player, I felt as if I could summarize some of the exciting events that have taken place over the last ten years that have influenced and shaped this effort.

I started by posing the question, "Why do introductory physics reform?" To justify such an endeavor, certain evidence indicates that there may be a strong need for a reform. In a recent issue of the Announcer[1], testimony to a National Science Foundation review panel presented by Robert Hilborn, current AAPT President, was printed. In this testimony, Hilborn made several statements that are applicable to the need for introductory reform, including:

> "We now have overwhelming evidence that the standard introductory physics course, dominated by lectures and cookbook-type laboratory exercises, succeed only with the highly motivated and best prepared student."

> "Our standard approach to teaching just seems to widen the gap between what we want to achieve and what the outcome actually is."

> "...introductory physics instructors suffer a kind of pedagogical schizophrenia: they want to provide students with a solid and broad grounding in fundamental principles and techniques, but they want also to let students know about contemporary issues and excitement of physics."

I also added the statement,

> "We would like students to understand some basic physics principles and how to apply these principles to everyday life and nature."

In addition to these quotes, there is growing evidence from physics education research (PER) endeavors that students are not learning basic conceptual information during the "standard lecture" approach. On concept tests,[2,3] students only improved 10% to 13% using traditional instructional approaches. After traditional instruction, students tended to score only 30% to 50% on a numerical problem solving test.[4] Additional evidence indicates that students do not substantially change their beliefs of basic concepts during the traditional course.

In an effort to improve these deplorable performances, several "reform" efforts have been made during the last 10 years. The best financed and most publicized effort was the Introductory University Physics Project (IUPP)[5] which began in 1987 by John Rigden (now at the American Institute of Physics), Don Holcomb (Cornell University), and others. Many other efforts have been made since then that include full curriculum efforts, partial curriculum efforts, and "bits and pieces". Some instructional models[6] based on the results of PER include:

i. Physics by Inquiry - Physics Education Group at University of Washington - Lillian McDermott
ii. Workshop Physics - Priscilla Laws at Dickinson College
iii. Overview Case Study - Alan Van Heuvelen at Ohio State University
iv. Spiral Physics - Paul D'Alessandris at Monroe Community College
v. Understanding Basic Mechanics - Frederick Reif at Carnegie Mellon University
vi. Electric & Magnetic Interactions - Ruth Chabay & Bruce Sherwood at Carnegie Mellon University
vii. Peer Instruction - Eric Mazur at Harvard University
viii. Tools for Scientific Thinking and RealTime Physics - Ron Thornton at Tufts University and David Sokoloff at University of Oregon
ix. CASTLE by Mel Steinberg at Smith College
x. Conceptual Exercises - David Maloney at Indiana-Purdue University at Fort Wayne
xi. Socratic Induced Dialogues - SDI - Richard Hake at Indiana University
xii. Anchoring and Bridging Analogies - John Clement at University of Massachusetts
xiii. Concept Based Problem Solving - Jose Mestre, W. Gerace at University of Massachusetts
xiv. Physics as Mathematical Modeling - David Hestenes at Arizona State University
xv. Radical Constructivist - Dewey Dystra at Boise State University
xvi. Interactive Lecture "Tools" - Bob Beichner at North Carolina State University
xvii. and others

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O'Kuma continued from page 2

All of these models have several important elements in common, which are:

i. Active Learning
ii. Strong emphasis on interaction with phenomena
iii. Clear and explicit linkage of representation to phenomena
iv. Elicit student conceptions
v. Have students evaluate alternative hypotheses
vi. Goals of tasks are conceptual and conceptual means are required to accomplish them.
vii. Tasks are reduced to a size that is more manageable for novice students to handle.
viii. LESS IS MORE

Additionally, there have been some two-year college reform efforts that have included the Physics Enhancement Programs for Two Year Colleges (PEPTYC), this Two Year College Physics Workshop Project, the North Carolina Alliance, and the Two Year College in the Twenty First Century Project (TYC21).

All of these models and programs are just to indicate that there is a tremendous amount of activity going into "introductory physics reform." Part of this reform is spurred on by the idea that there has to be some form of assessment to determine the success of the reform effort.

One indicator of success for an instructional model may be the use of concept tests, such as the Force Concept Inventory, and numerical problem solving tests, such as the Mechanics Baseline Test.

In a recent article on a survey of 6000 introductory physics students,[7] Richard Hake reported on the success of "interactive engagement curriculums" like the instructional models listed previously as compared to the traditional curriculum.

The following table is based on accumulated data[4,7] and uses Hake's "normalized gain" factor g, where

$$g = (\%\ \text{post test} - \%\ \text{pre test})\ /(100\% - \%\ \text{pre test}).$$

Force Concept Inventory Results - using "normalized gain"

a. *Traditional*	g
High School, N = 763	0.25 ± 0.04
Two - Year College, N = 73	0.18 ± 0.05
College & University, N = 1255	0.20 ± 0.07

b. *Interactive Engagement*	g
High School, N = 307	0.55 ± 0.14
Two - Year College, N = 411	0.53 ± 0.11
College & University, N = 2908	0.51 ± 0.14

c. *Partial Interactive Engagement*	g
College & University, N = 717	0.23 ± 0.03

Mechanics Baseline Test

a. *Traditional*	% Correct
High School, N = 645	33 ± 6
Two - Year College	none reported
College & University, N = 139	48 ± 7

b. *Interactive Engagement*	%Correct
High School, N = 93	55 ± 8
Two - Year College, N = 87	63 ± 7
College & University, N = 711	60 ± 16

Although the above evidence may not make a conclusive case for engaging in introductory physics reform or to use an interactive engagement curriculum, it does suggest or indicate that it may be worth an instructor's time and effort to engage in reform and to investigate more about these interactive engagement curricula.

I finished my talk with three concluding questions:

> "Should we teach introductory physics with a different approach than the 'traditional' approach?"
>
> "If so, what approach should we use?"
>
> "How do we 'measure' the effectiveness of this (or any) approach?"

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[1] R. Hilborn, "The NSF Review of Undergraduate Education in Science, Mathematics, Engineering, & Technology," Announcer, 26 (1), 3/96, pgs. 60-63.

[2] I. Halloun and D. Hestenes, "The initial knowledge state of college physics students," AJP 53 (11), 11/85, pgs. 1043-1055.

[3] D. Hestenes, M. Wells, & G. Swackhamer, "Force Concept Inventory," TPT, 30 (3), 3/92, pgs. 141-158.

[4] D. Hestenes and M. Wells, "A Mechanics Baseline Test," TPT, 30 (3), 3/92, pgs. 159-166.

[5] J. Rigden, D. Holcomb, & R. DiStefano, "The Introductory University Physics Project," Physics Today, 46 (4), 4/93, pgs. 32-37.

[6] Based on an initial list provided by David Maloney, 10/93.

[7] R. Hake, "Interactive-engagement vs traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses," submitted to AJP, 5/96.

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TYC IPC I Schedule

Joliet Junior College
June 11-15, 1996

Tuesday
3:00 Welcome and Introductions
3:15 Maybe Doing Introductory Physics Reform (T. O'Kuma)
4:00 Implementation of Physics Education Research (D. Maloney)
5:00 Heat & Energy Issues (A. Van Heuvelen)
7:30 Simulations and multi-media approaches (D. Winch)
8:30 Introduction to Group Projects

Wednesday
8:30 Henry Ford CC ATE Project (R. Eshelman)
11:30 The NSF ATE Program (M.Weeks)
12:00 Lunch and Round Table Discussion of Technical Physics
2:00 CD Physics (D. Winch)
3:15 Alan's Update (A. Van Heuvelen)
4:45 Netscape, Simulations, or group work (S. Olsen / D.Winch)
7:30 Electrical Concept Inventory (C. Hieggelke / D. Maloney / T. O'Kuma / A. Van Heuvelen)

Thursday
8:30 Workshop Physics Approach to Heat and Thermal (P. Laws)
1:00 NSF & Physics Education (J.D. Garcia)
1:30 HTML, Simulations, or group work (S. Olsen / D. Winch)
3:30 Physics using Modeling (G. Swackhamer)
7:30 Participant Sharing

Friday
8:30 Visualizer and the Vector Playground (R. Thornton)
10:30 Interactive Lecture Demonstrations I (D. Sokoloff / R. Thornton)
1:00 Interactive Lecture Demonstrations II (D. Sokoloff / R. Thornton)
2:00 Interactive Long Distance Learning (A. Wenger)
3:30 Argonne's Advanced Photon Source Field Trip
7:30 Participant Sharing

Saturday
8:30 Magnetism Concept Inventory (C. Hieggelke / D. Maloney / T. O'Kuma / A. Van Heuvelen)
9:00 Group Projects
9:45 Group Reports
11:00 Conference Summary and Evaluation
1:00 Optional Field trip to the Museum of Science & Industry, Chicago, IL

IPC I Group Projects

Group 1: Bill Hogan, Bruce Kaasa, Joe Krivicich, Myron Mann and Otmar Selgrad

Project: *What concepts do students really need in heat and temperature?*

- Kinetic Theory (Particle Model)
  - Gas Laws
  - Absolute Temperature
  - Extend it to solids and liquids
- First Law
  - Energy Transfer
  - Work
  - Internal Energy
  - Phase Changes
- Second Law
  - Entropy
  - Efficiency
  - Coefficients of Performance

Group 2: Tim Collins, David Mills, Nick Nicholson and Sherry Savrda

Project: *What concepts, principles and relations should be explored? What concepts do students really need in heat and thermodynamics?*

What is heat?
What is temperature?
What is the difference between heat and temperature?
What is meant by thermal equilibrium? (Zeroth Law)
Atomic model of matter
Use of P-V diagrams to represent thermodynamic processes.
Physics of phase changes (T-Q graphs)
Entropy-related concepts (2nd law)
Thermal properties of solids and liquids
Real life applications

What areas do students have difficulty with?
All of it!
The language...adiabatic, isothermal, isobaric, isovolumetic, entropy, enthalpy, etc.

What are effective activities?
Glass bead in mercury apparatus
Thought experiments such as a drop of coffee on hand vs entire cup (on hand-same temp)
Rub hands together
Drop brick on clay or stiff mashed potatoes with imbedded temperature probe.
Drop identical mass heated objects onto block of wax to show they sink to different depths.
Ranking tasks, ALPS stuff, interactive demos, MBL activities, etc...
Put same amount of energy into different liquids and monitor temp change.

continued on the next page

Group Reports continued from previous page

Group 3: Mark Bunge, Marilyn Neis, Bill-Gene Smith and Aaron Wenger

Project: *Thermal Shots*

- A. Kinetic interpretation of temperature
  - Mechanical equivalent of heat
  - Electrical equivalent of heat
- B. Factors related to thermal energy
  - Temperature difference
  - Structure (specific heat)
  - Phase
  - Mass
  - Work
- C. Methods of thermal energy transfer
  - Conduction
  - Convection
  - Radiation
- D. Thermal Expansion
  - Linear
  - Volume
- E. Thermodynamic “state”
  - First law (PV diagrams)
  - Second Law
    - Entropy and other thermodynamic variables
    - Vapor dome
    - Efficiency of engines and refrigerators

Group 4: Marie Plumb, Laurie Thomas, Myra West and John Splett

Project: *What concepts, principles and relations should be explored? What concepts do students really need in heat and thermodynamics?*
(for the algebra-based course)

- A. What topics should be “covered”:
  - Temperature
  - Colorimetry
  - Linear Expansion
  - Phase Transition
  - Kinetic Theory (Gas Laws)
  - Four Laws of Thermodynamics (Engines)
  - Heat Energy Transfer
- B. What the activities should be:
  - Zeroth Law and temperature
  - Colorimetry
  - Heat Energy Transfer - demos
  - Linear Expansion (no lab)
  - Phase Change (Fusion & Vaporization)

Group 5: Mickey Odom, Earl McMurry, Eldon Eckard and Butch Diesslin

Project: *What concepts are needed before teaching kinetic molecular theory?*

1. Atoms exist
2. Geometrical concepts - area, volume and length
3. Kinematics (Particle)
4. Dynamics - Newton’s Laws
5. Energy and Momentum - elastic collisions and translational, rotational and vibrational motion for applications
6. Ideal Gas Law - pressure, temperature, Avogadro’s number and mole concept

Group 6: Bob Donner, Bill Brantley, Bob Eshelman

Project: *Observations that are really HOT (lots of energy in a small space)*

1. The heat death of the universe is a “cool” subject
2. 1st law rewritten - “ya can’t get something for nothing”
3. 2nd law rewritten - “ya can’t break even”
4. 2nd law does not prohibit evolution towards complexity on a local scale
5. Inefficiency is not only an engineering mistake - NATURE makes us do it.

General Physics	*Engineering Physics*
Heat	
Thermal Energy	
Temperature Scales	
Expansion	+ Stress Gas laws
Specific heat	+ Cv and Cp
Phase changes	
1st Law	
2nd Law	
Heat Engines	

First IPC Summary continued from page 1

Other sessions included topics such as Interactive or Long Distance Learning in physics, HTML and the World Wide Web as well as a hands-on session on CDs and physics. Participants also had the opportunity to share what they had developed and were invited to submit items for publication (see list and various articles in this newsletter).

During the conference, the group traveled to nearby Argonne National Laboratories to visit the new Advanced Photon Source. After the conference on Saturday afternoon, a field trip was made into the city of Chicago to visit the Museum of Science and Industry.

Mealtimes provided the participants with an excellent opportunity for informal discussions with each other and the conference leaders. At the Friday evening supper each participant was invited to share information about their work at their home institution.

What makes this project worthwhile to us are comments by participants such as, “I always am refreshed by your workshop (conferences). Really like getting to work with motivated people.” This is what gives us the energy to keep this project operating. Thanks!

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A Simple Lenz's Law Apparatus

Robert Speers
Firelands College of Bowling Green State University
Huron, Ohio

From a classic physics viewpoint — forces between masses, forces between electric charges, and forces between permanent magnets act along imaginary lines that connect the objects. The gravitational force is always attractive. The electrostatic and static magnetic forces are either attractive or repulsive.

One of the absolutely greatest surprises of nature is that: whereas no force acts between a stationary electric charge and a stationary magnet, a force does act on an electric charge that is moving with respect to a magnet and the force is at right angles with an imaginary line between the electric charge and the magnet and at right angles with the direction of motion of the electric charge!

An attention getting demonstration of the properties of the electromagnetic force is the Lenz's Law apparatus, which is composed of a permanent magnet and an aluminum tube. It can be shown that no static force acts between the magnet and the tube. Yet, when the magnet is dropped down the tube it takes considerably longer to fall through the tube than when it is dropped outside the tube. A practical application, infrequently seen in our modern digitized laboratories, is the damping of the movement of mass scales.

The availability of high-strength inexpensive neodymium-iron-boron permanent magnets has produced many novel applications. Such a magnet has provided a solution to the excessive vibration of the simple mass-spring vertical accelerometer that is being used for Amusement Park Physics. The modification to the accelerometer is to glue a small button shaped neodymium-iron-boron magnet at the bottom of the mass and surround the accelerometer with sheet aluminum. Since the electromagnetic force is proportional to the relative speed of the magnet and the aluminum the mass-magnet acts in classic damped harmonic motion. The damping factor can be adjusted by changing the thickness of aluminum and the degree of wrap of the aluminum sheet around the accelerometer.

An excellent experiment about damped harmonic motion can be created with this apparatus, the sonic ranger, ULI, a computer, and MacMotion.

THE VISUALIZER'S VECTOR PLAYGROUND

Many students have difficulties understanding vectors and vector operations. Students particularly have difficulty in understanding that vectors are independent of a coordinate system.

The Vector Playground which is part of the Visualizer software is designed to introduce students to vectors and vector operations.

A vector can be created on the screen by dragging the mouse to create a vector of the desired size and orientation. Any vector can be moved around by clicking on the label and dragging it around. To change the magnitude or the orientation you click on the pointed end of the arrow, drag the mouse to the desired final position and release it. You also can rotate the vector continuously (about the z axis), cause a selected vector to continually increase or decrease in length, or see the Cartesian coordinates of a selected vector or the magnitude and angles of the selected vector relative to the three axes.

A new vector can be created that is the sum of the two selected vectors which will appear on the screen at a random position. You can only move this vector but not rotate it or change its length since its magnitude and orientation are determined by the constituent vectors. Rotating or changing the magnitude of either of the initial vectors causes the sum vector to change. Difference vectors as well as scalar and vector products can be created and manipulated. By using the arrows on the keyboard you can rotate your viewpoint and see the result from different perspectives.

The Visualizer can represent most data in vector form including real MBL MacMotion data. That is, it reconstructs and represents position, velocity, and acceleration data by vectors which are represented by directed line segments. This is a new type of software which has the goal of improving student understanding of the role and importance of vectors by transforming the experimental data from the graphical representation into the vector diagram representation.

At the IPC conference, participants had a chance to use a beta version of the Visualizer. Written in an open doc format, it will be even more powerful than the current version. They are also working on making the interface with the user much more intuitive.

Information presented at the TYC IPC I with these edited excerpts from a paper submitted for publication in the Proceedings of ICUPE (9/96)

Interactive Lecture Demonstrations

David R. Sokoloff
University of Oregon
Eugene, OR

Ronald K. Thornton
Tufts University
Medford, MA

Interactive Lecture Demonstrations (ILDs) represent a general strategy for making the learning environment in large (and small) lectures more effective by increasing student involvement. We have used and evaluated the effectiveness of Microcomputer-Based Interactive Lecture Demonstrations (ILDs) in introductory physics lectures since 1989 and have found them to be very successful for teaching physical concepts. The ILDs consist of a sequence of conceptually simple physical experiments using the Tools for Scientific Thinking microcomputer-based laboratory (MBL) tools. Students are actively engaged by the use of a learning cycle which includes a written prediction of the results of an actual physical experiment, small group discussion with their nearest neighbors, observation of the physical event in real time with the MBL tools, and comparison of observations with predictions. The development of this strategy has been based on the outcomes of physics education research and on our experiences with guided discovery laboratory curricula using MBL tools. There is strong evidence for significantly improved learning and retention of fundamental concepts by students who participate in ILDs as compared to those taught in traditional lectures.

The ILD Procedure

After several years of research, we formalized in 1991 a procedure for ILDs which engages students in the learning process and, therefore, converts the usually passive lecture environment to a more active one. The steps of the procedure are:

1. The instructor describes the demonstration and does it for the class without MBL measurements.
2. The students record their individual predictions on a Prediction Sheet, which will be collected, and which can be identified by each student's name written at the top. (The students are assured that these predictions will not be graded, although some course credit is usually awarded for attendance at these ILD sessions.)
3. The students engage in small group discussions with their one or two nearest neighbors.
4. The students record their final predictions on the Prediction Sheet.
5. The instructor carries out the demonstration with MBL measurements displayed on a suitable display (multiple monitors, LCD, or computer projector).
6. A few students describe the results and discuss them in the context of the demonstration. Students fill out a Results Sheet, identical to the Prediction Sheet, which they may take with them for further study.
7. The instructor discusses analogous physical situation(s) with different "surface" features. (That is, different physical situation(s) based on the same concept(s).)

These steps are performed for each of the simple demonstrations in the sequence making up an Interactive Lecture Demonstration.

Student involvement in understanding these simple conceptual demonstrations is obvious from observing students in the classroom. The instructor must use her/his judgment in controlling the amount of time devoted to steps 2 and 3. The small group discussions in a large lecture class are initially quite animated and "on task." In time, however, the discussions may begin to stray into extraneous matters, at which point it is time to move on to steps 4 and 5. The instructor must also have a definite "agenda" for steps 6 and 7, and must often use guidance to move the discussion towards the important points raised by the individual ILDs.

Our studies of student understanding using the research-based Force and Motion Conceptual Evaluation with large numbers of students show that introductory physics students do not commonly understand kinematics and dynamics concepts as a result of thorough traditional instruction. This research and that of others, along with the development of user friendly microcomputer-based laboratory tools and our experience with computer-supported active laboratory curricula have allowed us to develop a strategy for more active learning of these concepts in lectures using Microcomputer-based Interactive Lecture Demonstrations. Assessments using the Force and Motion Conceptual Evaluation indicate that student understanding of dynamics concepts is significantly improved when these ILDs are substituted for traditional lectures.

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Electrical Concept Inventory (ECI) and Magnetic Concept Inventory (MCI)

Curtis Hieggelke
Joliet Junior College
Joliet, IL

In the summer of 1995, a week-long CE/OCS Follow-Up Workshop was held at Lee College (Texas).

The major goal of this workshop was to develop a test or tests that could be used in pre/post test modes to measure the basic conceptual understanding of students in the areas of electric and magnetic interactions. The area of circuits was excluded since there are several such tests currently available.

Much of the work on these inventories was inspired and, in part, based on earlier work in these areas by Dave Maloney (Indiana-Purdue University at Fort Wayne) and Dennis Albers (Columbia College, Columbia, California).

Attending the workshop and participating in the development of these instruments including myself were

Mark Bunge (San Jose City College, San Jose, California),
Dwain Desbien (Highland Community College, Highland, Kansas),
David Maloney,
Marv Nelson (Green River Community College, Auburn, Washington),
Tom O'Kuma (Lee College, Baytown, TX),
Marie Plumb (Jamestown Community College, Jamestown, New York),
Alan Van Heuvelen (Ohio State University), and
Myra West (Kent State University - Stark Campus, Canton, Ohio).

At the workshop there were several physics education research background presentations and discussions on the issues concerning electricity and magnetism. Previous work by Maloney and Albers was reviewed and discussed including student data at several institutions.

The structure of the development of the inventories centered around two teams, one responsible for the electrical area and the other for magnetism. Several times during the week, a preliminary version of each inventory was presented to the whole group and aggressively critiqued. Finally at the end of the week, two inventories had been developed, one for electric concepts (37 questions) and another one for magnetic concepts (19 questions).

Preliminary testing was done with students in 1995-96 at four different institutions and with physics faculty members at five TYC physics workshops. This data (student and faculty) was reviewed and the inventories were modified in the late spring and early summer of 1996 by Dave Maloney, Tom O'Kuma, Alan Van Heuvelen and myself.

These revised inventories were then reviewed and discussed at the first Introductory Physics Conference for Two-Year Colleges held at Joliet Junior College in June 1996. The 1996 version of the Electrical Concept Inventory has 30 questions and Magnetic Concept Inventory has 19 questions. A protocol was established and, along with the revised inventories, sent to the IPC TYC participants for more testing and review. Some preliminary results were reported at the 1996 Summer AAPT meeting at the University of Maryland.

Due to the fact that the inventory is still very much in the development stage we are not yet releasing the materials to a wide audience. However, if you would like to see or use the inventory, we will send you a copy if you agree to

(1) not distribute the instrument, or any part of it, along to anyone else without explicit permission from us and
(2) share your data with us.

Specifically, we ask that if you actually administer the inventory that you follow the established protocol. Whether you administer the inventory or not, we ask that you give us written criticisms, comments, suggestions, etc., on the specific questions as well as the inventory as a whole. We are especially interested in any gaps or deficiencies you perceive in the inventory.

If you are interested, please send a written or email request to me at Joliet Junior College (curth@jjc.cc.il.us).

Ranking Tasks Book

We are interested in receiving any corrections or comments on the ranking tasks in the Selection of Physics Ranking Tasks book. Please send them as soon as possible so we can include them in the next printing and mailing. We are also working on an answer key so if you have one (or part of one), please send that also. Thanks.

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Physics, Engineering and Interactive Television

Aaron Wenger
Itasca Community College
Grand Rapids, MN

There are lots of reasons not to use interactive television (ITV) for science or engineering instruction:

“Talking heads, who wants that?”
“Gotta redo my whole set of lectures”
“I’m too nervous for TV”
“Too hard to get ready for, it’s gotta be perfect or people will see mistakes”
“Union issues”
“They’re just gonna use it to replace teachers”
“How will the students react, how will they get help, what about labs?”
and lots more.

Some years ago I became convinced of a few things that served to move me toward using (intelligently, I believe) ITV. These are:

1. There are approximately zero physics majors in two year colleges. In this I do not count education majors.
2. There are significant numbers of pre-professional students in two year colleges and, if attention is paid to defining the career, significant numbers of engineering students.

Given the above, several questions occurred to me:

1. Why not arrange instruction to best prepare pre-professional and engineering students, especially engineering students, as they need the largest number of physics or physics based courses?
2. How could a small two year college arrange to offer a complete two years of engineering when some of the courses will normally be small as engineering instructions starts to fragment already in the second year?
3. Would real advantages of instruction arise if two or more colleges collaborated in a engineering program, and what technology might facilitate such collaboration?

My answers were to seek a way of adding the following courses to the traditional set of math and physics taught at almost all two year colleges:

Statics - no formal lab but use made of simulation programs and a student designed statics trainer
Dynamics - no formal lab but simulation programs used.
Circuits - two quarters, analysis plus lab and simulation experience
Digital Logic - one quarter, analysis plus lab and simulation experience
Mechanics of Materials - one quarter, measurements lab included
Fluid Dynamics - one quarter, student designed fluid trainer used
Thermodynamics - one quarter, student designed trainer used for heat flow experiment.

Such a list of coursework clearly demanded that either new personnel be hired or that a way be found to identify and use existing instructors to share the load. We were perhaps lucky in that within the same community college system as my college there was a fairly new physics instructor whose graduate work was in mechanical engineering. He and I started discussions as to how an engineering collaboration could be started making use of both our backgrounds. Both of our colleges had been tied into an interactive television system years before that was usually only used to bring university graduate courses into the colleges. Few if any ITV courses were actually being taught by two-year college people.

Out of a summer’s worth of talking about this we emerged with a few firm ideas. These were:

1. ITV should not be used at the entrance of engineering instruction. We would not allow it to be used in calculus physics or the first year of math instruction. It is precisely at this point - physics and beginning calculus - that many engineering students experience the most difficulty. Often we find that if a student can be moved past the introductory shock of these two courses they wind up doing perfectly acceptable work in the succeeding engineering classes. Both of the colleges involved in our collaboration do “at home” introductory calculus physics classes although we do occasionally meet our two classes together via ITV to both acquaint them with the medium and to take advantage of particular teaching expertise in subject areas.

2. Our students need to see themselves as a single class. We make every effort to encourage collaboration between students across the sites. Recently via a NSF grant we have brought ITV into our labs so that students have routine access to the system to use in

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CaFD

Curriculum and Faculty Development Newsletter For Two-Year College Physics Educators

Fall 96

National Science Foundation

Joliet Junior College (IL)

Lee College (TX)

Wenger continued from previous page

problem sessions, homework and lab investigations. Our students take field trips together, party together, and raise money together. All of this is to teach teamwork and collaboration as well as make the medium of ITV feel very familiar to them.

3. ITV instruction must be supported. It is not a substitute for teaching nor will it reduce teacher load. This is important and it must be supported at both the sending and receiving end. We insisted that the receiving end school grant one credit of instruction to the receiving end instructor. We view this as the load necessary to foster mentoring and consulting of the students at the receiving end. We insisted upon faxes and copiers in our labs at both ends so that tests, quizzes, and homework could be easily and quickly exchanged. In the case of labs, we obtained duplicate equipment so that students could easily exchange ideas and results. Most of the equipment resources would not be available through existing budgets so we knew that would have to find grant money.

4. All instructors involved must see themselves as being contributors to the ITV collaboration not just on-lookers. As our collaboration has now grown to include two other schools, we continue to do it by consensus and continue to involve other instructors as active parts of the program either through teaching courses or through mentoring.

5. We would not see ourselves as entertainers. There is a natural fear of ITV teaching mostly coming from fear of the associated gadgetry or from the fear that “it’s gotta be perfect, someone might see me”. We routinely bring our classes in physics together and each of us acts as another student, free to ask questions and make comments. We both admit that we can make errors and use ITV to sharpen our class presentations. We both see the engineering program as “ours” and it is a true collaboration. A mistake on ITV is no worse than in a traditional lecture and perhaps has the advantage that it can be easily looked back at and cleaned up.

6. We would use the medium and not get used to it. For example, during the first year of our collaboration we both were asked by students if they could tape our lectures. We allowed that to occur and now we see students routinely using their tapes in group study and homework sessions. Taping allows them to pay more attention to the idea of a lecture and later use the tape for detailed note taking. Taping allows us to bring back part of a lecture if there is a general misunderstanding or if a quick reference is needed in a future subject. The tapes are done at student initiative and are not kept from class to class. We may or may not cover the same material or cover it in the same order from year to year. It is simply a tool available for the students. The colleges have no ownership of these tapes.

Our collaboration seems to have been successful. We graduated about forty students last year and for 1996-97 expect a freshman class of 50-60 students. That is not too bad for two schools with a joint enrollment of about 2,000. Most importantly, our students succeed when they transfer onto a university and engineering school. Our collaboration has generated enough interest among four year schools that beginning next year we will be offering the 3rd and perhaps 4th year’s of electrical engineering through ITV and a state university.

I believe that the most import aspect of our collaboration is that it was faculty invented. We designed a program to better serve the students and, that as a side benefit, has generated numbers for the administrators. We did not have the demand for numbers to dictate to us the limits of a program.

WP Excel 5 Tools Problem

Priscilla Laws
Dickinson College
Carlisle, PA

There is a problem with the version of the Macintosh WPTools for Excel 5 on the VideoPoint CD ROM. The problem is that if you try to install WPTools on an Excel 5 file that already has WPTools on it, you might get a message when using the new installation that says, “A Document with the name WPTools.xla is already open.” To fix this problem you must follow a procedure to delete both the WP Standard Toolbar and the WP Chart Toolbar. To do this you should:

1. Hold the Control Key and click on the WP Toolbar to get a pop-up menu.
2. Select the Toolbars item.
3. Delete the WP Standard Toolbar
4. Delete the WP Chart Toolbar
5. Quit Excel
6. Re-open Excel and follow the instructions to reinstall Excel.

Or, if you download the Excel Tools from our Web Site, you will get a newer version of WPTools that allows you to reinstall all of the tools without bothering with this process. The Workshop Physics Web site is located at http://physics.dickinson.edu

New BBS and Internet E-mail System

We have made some major changes in our electronic communications systems. For more information we have added a WWW site (http://ac4.jjc.cc.il.us/tyc/tyc.html) and are setting up FTP (file transfer) capablities.

For the first five years of this project we have offered workshop participants modem-based internet E-mail service using the American Institute of Physics' PINET system. In addition, we offered a modem-based bulletin board system (BBS) using a very simple and easy to use system called 1st BBS from 1st DESK Systems (800-522-2286). Both of these provided an 800# for easy access from anywhere in the country. Recently, PINET discontinued offering a modem-based internet E-mail service which has forced us to consider alternate means of providing such services.

The solution that is being implemented is a combined system which involves a BBS system that has an internet E-mail feature. This required us to change the BBS software to a much more powerful system called FirstClass® (FC) from SoftArc Inc. (905-415-7000). The TYC/FC BBS with an internet e-mail gateway is a full-featured commercial type of system with many similiarities to systems such as America Online.

The new TYC/FC BBS uses a graphical user interface to provide electronic messaging and conferencing for high-speed communication over a modem. It can be used for electronic mail, obtaining and sending files, group discussions, remote communications and information. It is easy to send and receive E-mail from other BBS users. Since the TYC/FC BBS system has an Internet E-mail gateway, users can mail and receive electronic mail from the Internet. We also now offer two separate phone lines, 24 hours a day: 800-728-1050 (toll free) and 815-741-0614 (toll charges).

To access the TYC/FC BBS you will need:

(1) either an Intel based computer system with Windows 3.11 or higher or a Macintosh with System 7.X or higher,

(2) a 2400 baud modem or higher (9600 prefered with up to 36.6K baud access currently available),

(3) First Class (FC) client BBS software 3.12, and

(4) the special TYC/FC settings file.

To obtain the First Class (FC) client BBS software 3.12, and the special TYC/FC settings files, send us your name and type of computer (or email tycphysics@tyc.jjc.cc.il.us). If you specify the type and speed of your modem, we will customize it even further. If you already have the First Class (FC) client BBS software 3.12 you just need to setup the settings file.

Full E-mail functions are built in to allow you to: read your E-mail, reply to or forward a message, create and send E-mail, retract a sent message, send and receive files, find out who has read the messages you have sent or received, organize your sent and received messages into folders, send and receive electronic forms, and search for messages by subject, content, sender, and recipient.

To send mail to an internet address is simple. Just type the Internet E-mail address folowed by a comma and the internet name. (for example- To: olsen@jjc.cc.il.us,Internet).

To receive internet mail simply give senders your TYC/FC name with the @tyc.jjc.cc.il.us address (for example John Doe's internet address would be John_Doe@tyc.jjc.cc.il.us)

Conferences are special interest areas containing messages you can browse and respond to. They're similar to mailboxes, but groups of people can access them. With conferences you can: browse messages on a given topic; transfer files to and from a conference; contribute items to a conference; display information about a conference; view the list of subscribers; and search for posted items by subject, content, sender, and recipient.

The TYC/FC offers several ways to share files with other users. You can: attach files to an E-mail message and send them to users or conferences; save files attached to private E-mail messages or conference items; upload and download files to the TYC/FC server. You can also transfer any type of file, including graphics, sound, and special application-dependent files and download files from the CD-ROM disks that are online.

In the near future, we will add the capability of participants connected to the internet to access the BBS files over the internet. However, we are awaiting the software to do this.

For technical help with the system contact Scott Olsen (olsen@jjc.cc.il.us or 815-773-6642) at Joliet Junior College.

First ('96) TYC IPC Participants

Bill Brantley	Pensacola Jr. College	Pensacola	FL
Stan Briggs	Henry Ford Community College	Dearborn	MI
Mark Bunge	San Jose City College	San Jose	CA
Tim Collins	Western Wisconsin Technical College	La Crosse	WI
Blaine Diesslin	Vermilion Community College	Ely	MN
Bob Donner	UWC-Baraboo/Sauk County	Baraboo	WI
Eldon Eckard	Bainbridge College	Bainbridge	GA
Tom Embry	Indian River Community College	Fort Pierce	FL
Bob Eshelman	Henry Ford Community College	Dearborn	MI
Bill Hogan	Joliet Junior College	Joliet	IL
Bruce Kaasa	Iowa Central Community College	Fort Dodge	IA
Joe Krivicich	Joliet Junior College	Joliet	IL
Myron Mann	Los Angeles Valley College	Van Nuys	CA
Earl McMurry	Indian Hills Community College	Centerville	IA
David Mills	College of the Redwoods	Eureka	CA
Marilyn Neis	Nicolet Area Technical College	Rhinelander	WI
Nick Nicholson	Central Alabama Community College	Alexander City	AL
Mickey Odom	Albuquerque Technical Vocational Institute	Albuquerque	NM
Marie Plumb	Jamestown Community College	Jamestown	NY
Sherry Savrda	Lake-Sumter Community College	Leesburg	FL
Otmar Selgrad	Moraine Park Technical College	Fond du Lac	WI
Bill-Gene Smith	South Florida Community College	Avon Park	FL
Bob Speers	Firelands College-Bowling Green State Univ.	Huron	OH
John Splett	Erie Community College	Buffalo	NY
Laurie Thomas	Don Bosco Technical Institute	Rosemead	CA
Aaron Wenger	Itasca Community College	Grand Rapids	MN
Myra West	Kent State University-Stark Campus	Canton	OH

First ('96) TYC IPC Invited Presenters

Rick Bailey	Henry Ford Community College	Dearborn	MI
Stan Briggs	Henry Ford Community College	Dearborn	MI
Bob Eshelman	Henry Ford Community College	Dearborn	MI
J.D. Garcia	National Science Foundation	Arlington	VA
Curtis Hieggelke	Joliet Junior College	Joliet	IL
Priscilla Laws	Dickinson College	Carlisle	PA
David Maloney	Indiana University	Fort Wayne	IN
Tom O'Kuma	Lee College	Baytown	TX
Scott Olsen	Joliet Junior College	Joliet	IL
David Sokoloff	University of Oregon	Eugene	OR
Gregg Swackhamer	Glenbrook North High School	Northbrook	IL
Ronald Thornton	Tufts University	Medford	MA
Alan Van Heuvelen	Ohio State University	Columbus	OH
Peggie Weeks	National Science Foundation	Arlington	VA
Aaron Wenger	Itasca Community College	Grand Rapids	MN
David Winch	Kalamazoo College	Kalamazoo	MI

First ('96) TYC IPC Contributed Presenters

Mark Bunge	San Jose City College	San Jose	CA
Blaine Diesslin	Vermilion Community College	Ely	MN
Tom Embry	Indian River Community College	Fort Pierce	FL
Bob Eshelman	Henry Ford Community College	Dearborn	MI
Nick Nicholson	Central Alabama Community College	Alexander City	AL
Marie Plumb	Jamestown Community College	Jamestown	NY
Bob Speers	Firelands College-Bowling Green State Univ.	Huron	OH
John Splett	Erie Community College	Buffalo	NY
Aaron Wenger	Itasca Community College	Grand Rapids	MN

A TIP OF THE HAT FOR TYC PHYSICS

John E. Enger
Northwest College
Powell, WY 82435

A new report that you will all want to read will soon be available from the National Science Foundation. It is entitled, "Shaping the Future: New Expectations for Undergraduate Science Education," and is often referred to as the "George Report" in honor of the chair of the NSF Subcommittee on the Review of Undergraduate Education in Science, Mathematics, Engineering, and Technology. The following commentary is based on a draft copy of the report and remarks offered by Dr. Melvin George at the First National Meeting of the TYC-21, on August 2, 1996.

The charge to the subcommittee was to consider the needs of all undergraduates attending all types of institutions in the areas of Science, Mathematics, Engineering, and Technology (SME&T), and to make recommendations based on their findings.

An observation reported by Dr. George indicated that too often higher education students today are "finding very large introductory classes using ineffective lecture styles for ‘covering the material,’ poor access to faculty, a low frequency of laboratories, ‘cookbook’ type lectures, and too infrequent discussion of the implications of the ideas being considered." That sentence actually makes me feel pretty great, for in my classes and many of you who teach physics in the TYCs, a major effort goes into providing the opposite environment to that found in the statement above. The report goes on to urge an America in which: "All students have access to supportive, excellent undergraduate education in science, mathematics, engineering and technology, and all students learn these subjects by direct experience with the methods and process of inquiry." In spite of the reality of barriers to improvement noted in the report such as: poor student preparation by many in SME&T studies, lack of resources and organizational rigidity, coupled with a faculty reward system that too often does not emphasize quality teaching; many of your classes are lively centers of learning based on microcomputer-based laboratories and other student centered techniques based on physics educational research.

I read the report as an affirmation of your efforts and applaud those of you who have made the effort to change the paradigm.

The report also makes a series of recommendations for change to accomplish the goal stated above. Of greatest interest to you might be:

a) For SME&T faculty: "Believe and affirm that every student can learn, and model good practices that increase learning; start with the students experience, but have high expectations within a supportive climate; and build inquiry and an excitement of discovery, plus communication and teamwork, critical thinking, and life long learning skills into learning experiences."

b) For SME&T departments: "Set departmental goals and accept responsibility for undergraduate learning with measurable expectations for all students; offer a curriculum engaging the broadest spectrum of students; use technology to enhance learning; work collaboratively to improve teacher preparation with education departments, the K-12 sector, and the business community; and provide for graduate students intending to become faculty members, opportunities for developing pedagogical skills."

Other recommendations are found in the report for state governments and higher education boards, accrediting agencies, business, industry, the professional community, the national administration and legislature, and the National Science Foundation. At minimum you will want to read the recomendations for Governing boards and administrators.

The report should be required reading for those of you needing to find support for your efforts in improving introductory physics at all levels. It will soon be available from the National Science Foundation. To order *Shaping the Future: New Expectations for Undergraduate Education in Science, Mathematics, Engineering, and Technology* (NSF 96-139) call 703-306-1666 or send an e-mail to undergrad@nsf.gov and ask to be put on the mailing list for the document when it is printed (est. late fall, 1996).

The executive summary can be found at
HTTP://www.ehr.nsf.gov/EHR/DUE/documents/review/96139/summary.html.

CaFD

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Educators*

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Foundation*

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Junior
College (IL)*

*Lee
College (TX)*

‘97 TYC Physics Workshops/Conference Schedule

Constructing & Implementing Meaningful Microcomputer Simulations in Introductory Physics ***(PS)***
March 6-8 Bainbridge College, Bainbridge, GA (near Tallahassee, FL)

Building a Better Understanding of Physics & Developing Effective Problem Solving Skills in Introductory Physics using Conceptual Exercises and Overview Case-Studies ***(CE/OCS)***
April 3-5 Monroe Community College, Rochester, NY

*TYC Introductory Physics Conference II (**TYC IPC II**)*
June 17-21 Lee College, Baytown, TX (near Houston)

Implementing Modeling, Digital Video Analysis, & Microcomputer-Based Laboratories in Electricity, Magnetism, and Optics in Introductory Physics ***(MBL II)***
September 18-20 Green River Community College, Auburn, WA (near Seattle)

Implementing Workshop Physics and Effective Microcomputer-Based Laboratories in Mechanics, Sound, and Heat in Introductory Physics ***(MBL I)***
October 9-11 Joliet Junior College, Joliet, IL (near Chicago)

Apply early! For applications contact:
TYC '97 Physics Workshops at Joliet Junior College
1215 Houbolt Road, Joliet, IL 60431-8938
or call (815) 729-9020 Ext. 2603
e-mail: tycphysics@tyc.jjc.cc.il.us
http://ac4.jjc.cc.il.us/tyc/tyc.html

In the next Issue of CaFD

Curricula in Transition at the College of the Redwoods (Eureka, CA) and
A Modeling-Centered/Active Learning Curriculum: Part 2 at Columbia College (Columbia, CA)

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Curtis Hieggelke
Natural Science/PE Dept.
Joliet Junior College
1215 Houbolt Road
Joliet, Illinois 60431-8938