ATE Program for Physics Faculty

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Interim Evaluation Report
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SECTION I

Introduction to the Evaluation for the ATE Program for Physics Faculty

The ATE Program for Physics Faculty, directed by Thomas O'Kuma and Dwain Desbien, engaged Momentum Group, Fort Worth, TX to conduct an external evaluation of the ATE Program for Physics Faculty (ATE/PPF). The purpose of this report is to summarize evaluation activities and findings of the ATE/PPF project during the second year of the project, June 1, 2007 through May 31, 2008. In this interim evaluation, recommendations regarding future project activities are offered as suggestions for improving the project and are presented in Summary Comments and Recommendations (page 61) in this report.

In Year Two of the ATE/PPF project, five workshops were conducted at various sites. These workshops were: Data Visualization Techniques and Strategies (DVTS), Mt. San Antonio College, CA (June 28-30, 2007); Data Visualization Techniques and Strategies-MBL (DVTS-MBL), Howard Community College, MD (October 25-27, 2007); Instructional Strategies in Introductory Physics (ISIP-LC), Lee College, TX (November 8-10, 2007)[1]; New Faculty Training Conference (NFTC), Delta College, MI (March 6-8, 2008); and Tools for Introductory Physics (TIP), Estrella Mountain Community College (April 17-19, 2008). In addition to the participant feedback from attendees at these five workshops, feedback from participants attending the Adaptable Curriculum for Introductory Physics (ACIP) conducted in April 2007 is included in this report

The primary external evaluation activities conducted by Momentum Group in Year Two included the following:

- Consulted with the PIs on several occasions (telephone/face-to-face).
- Revised Post-workshop Questionnaire used with ATE/PPF workshop participants.
- Administered the Plans for Implementation Questionnaire to participants in the DVTS, DVTS-MBL, ISIP-LC, NFTC and TIP workshops. Conducted follow-up.
- Observed the New Faculty Training Conference at Delta College (MI).
- Administered the Post- Implementation Questionnaire to participants in the ACIP, DVTS, DVTS-MBL, and ISIP-LC. Conducted follow-up.
- Reviewed the on-line communications prior to the NFTC.
- Reviewed and analyzed project materials including the Final Day Workshop Evaluation.
- Prepared an interim evaluation report for Year Two of the project.

[1] The ISIP-LC workshop was an additional workshop (i.e. one not originally planned in the workshop schedule) offered by the project to meet the high demand for the ISIP workshop that was conducted at Estrella Mountain Community College in March 2007.

The ATE/PPF project evaluation, both internal and external components, is intended to provide information to the project staff and other stakeholders on the extent to which the project activities are addressing the goals of the NSF ATE program, the specific goals and underlying objectives of the ATE/PPF project, and the needs and expectations of the physics faculty who participate in the workshops with the intent of improving instruction for their students. To this end the evaluation is guided by several questions that focus on project implementation, classroom implementation, and impact of instructional changes. In addition, the potential for sustainable changes in physics classroom instruction is also a focal point of evaluation and will be examined when participants' have completed their initial plans for implementing changes they learned in the ATE/PPF workshops.

Methodology and Data Sources

The PIs conducted internal evaluative activities as a part of their protocol for continuously improving the workshops. The Final Day Workshop Evaluation Form served as the primary post-workshop evaluation[2] to provide the PIs with information about the workshop content as well as information about the arrangements/logistics for the workshop. Follow-up electronic communications with the participants served as another formal means for securing internal evaluative information. The results of the internal post-workshop evaluation were made available to the evaluator, and the participant responses and commentary are used in this report. The PIs were thoughtful and diligent about forwarding unsolicited comments they received from the workshop participants to the external evaluator. These unsolicited comments, coupled with those received independently by the evaluator and solicited on the Post-Implementation Questionnaire, are included in this report.

In addition to the internal evaluation instrument, the Post-Workshop Questionnaire, the Implementation Plans Questionnaire, and the Post-Implementation Questionnaire[3] were developed and used by the external evaluator to provide feedback on the value of the workshop to the participants and the extent to which the workshop influenced the participants' interest in and intent to implement changes in their own classrooms. Since the plans for implementing changes in the classroom varied for each participant, i.e. some participants intended to implement changes immediately while others deferred implementation until the 2008-2009 academic year, the data about implementation remains incomplete at the time this report was prepared.

The PIs provided information about each workshop to the evaluator, and in the case of the New Faculty Training Conference, which was attended in its entirety by the external evaluator, a full complement of materials was given to the evaluator during the workshop. The PIs offered a full complement of workshop materials from the other

[2]An additional questionnaire (Post-Workshop Questionnaire) was developed by the external evaluator and administered by the project staff at the conclusion of each workshop.
[3]The Post-Workshop Questionnaire was administered on paper and the Implementation Plans Questionnaire and Post-Implementation Questionnaire were delivered electronically.

workshops to the external evaluator, but these extensive sets of materials were not needed or used as a part of this evaluation report.

This report is organized around the following questions:

Project Activities Section II	1. Did the ATE/PPF workshops attract physics faculty interested in strengthening their capacity to better prepare students for a technology-driven workforce? 2. In what ways did the ATE/PPF workshops meet the criteria for high quality physics workshops? 3. In what ways did the ATE/PPF workshops promote understanding of technician education and workforce development? 4. Did the workshops address the professional development needs of the physics faculty?
Plans for Implementing Workshop Content Section III	1. How many participants, upon closure of the workshop, indicated that they plan to implement materials/activities/teaching strategies from the workshop? 2. After participants returned to their classrooms, how many confirmed their plans to implement workshop content in their classrooms? How many students and courses are influenced by these changes? 3. What problems might be encountered? 4. Will reform-based assessments be adopted?
Implementation of Workshop Content Section IV	1. What activities/resources were implemented in the participants' classrooms or teaching situations in AY 2007-2008? 2. To what extent were the implementations successful? 3. Is there evidence that participants' maintained their motivation to change classroom practices?

New Faculty Training Conference

The New Faculty Training Conference was conducted as a pilot program to determine how to organize and conduct a professional development program for new physics faculty members at two-year colleges. A descriptive report of the first two phases of the NFTC effort is reported in Section V of this report. [Note: Some information from the NFTC participants is included in Sections II and III of this report.]

About the Evaluator

Karen L. Johnston, PhD Momentum Group, Fort Worth, TX, offers services to individuals and institutions engaged in improving physics education. She has over twenty-five years experience in physics teaching before retiring as a professor in the Department of Physics at North Carolina State University and over fifteen years experience as an evaluation consultant.

SECTION II

Project Implementation

The goal of the ATE/PPF workshops is to engage physics faculty from high schools and two-year colleges in intensive, high quality workshops that focus on physics instruction for technology students. All of the ATE/PPF workshops are designed to engage the participants in using the activities/materials in ways that would promote adaptation and implementation in their own classrooms. The workshop content is relevant in a wide array of introductory physics courses and intended to be of value to instructors in high school or two-year colleges.

The workshop content and materials were identified and selected by the PIs based their knowledge of physics curricular materials and their demonstrated track record as effective in teaching physics. Both PIs are well informed about materials/resources appropriate for preparing a technical workforce are integrated into the workshop curricula, and both understand how these materials/resources can and should be integrated into physics courses. In addition, the PIs are among the most active two-year college faculty members in the larger physics professional community. Their background, experience, and collegial connections placed them in a position to select a group of workshop leaders able to deliver a very high quality professional development experience.

For the 2007-2008 academic year and Summer 2007 workshops, O'Kuma and Desbien selected workshop leaders who were: (1) skilled in modeling instructional practices that focus on student learning; (2) capable of organizing and conducting a series of activities aimed at producing maximum participation from the workshop participants; (3) enthusiastic about physics and physics teaching; (4) modeled engaging teaching styles; and (5) capable of explaining fundamental physics using a wide array of technology tools for all student audiences, including students in technician programs.

The New Faculty Training Conference (NFTC) was offered to new two-year college faculty members during Year Two of the ATE/PPF project. The NFTC was conducted as a pilot program shares similar goals to the New Faculty Workshops conducted by AAPT and APS for new physics and astronomy faculty at four-year colleges and universities and funded by NSF. The NFTC differs from the other ATE/PPF workshops in a couple of ways. A primary difference is that the participants at this conference were all new physics faculty members at a two-year college. The NFTC is the only ATE/PPF workshop that did not have a blend of high school and two-year college teachers on the participant roster.

Recruitment Plan

Question: Did the ATE/PPF workshops attract physics faculty interested in strengthening their capacity to better prepare students for a technology-driven workforce?

Participants were recruited to the workshops using a variety of methods including direct mailings to individuals, two-year colleges and schools. Membership lists from the American Association of Physics Teachers and other sources were used to identify potential participants. Additional efforts were undertaken to identify and solicit applications from new physics faculty at two-year colleges for the NFTC. The recruitment efforts were successful in providing a good mix of high school and two-year college faculty at all of the workshops and were very successful in identifying and selecting thirty new physics faculty members for the NFTC.

In addition to the usual information requested on an application, participants were asked specific questions about students in technical programs in the applicant's physics courses and at the institution. Applicants were expected to provide a statement of interest and expected impact of the workshop. The application required a statement of institutional support for the applicant's attendance and partial support for travel. The signatory administrator provided additional information about the institution's technological/technical programs that include a physics component. Thus, the application requested the kind of information that allowed the project staff to select participants where there was evidence of their interest in using physics instructional tools to provide more effective instruction for all physics students, including students in technical programs. The recruitment and selection process was well aligned with the goals of the NSF ATE program.

Including participants as teams from the same school is a well-accepted practice in many professional development initiatives, particularly those whose goal is to influence changes in teaching practices and the classroom learning environment. The ATE/PPF selection process encouraged and favored teams from the same school or same district since this was a likely indication that the participants would be better able to initiate change at their institutions and be more motivated to sustain the changes. In Year Two, the ATE/PPF program had 2 teams[4] at the DVTS, DVTS-MBL, and TIP workshops and 5 teams at the ISIP-LC. Also, one participant from a team from one of the two-year colleges attended the DVTS workshop while the second team member attended the DVTS-MBL workshop.

The application process was designed to make it easy for participants to apply for more than one workshop at the same time. The reason for this is to encourage applicants to consider a more substantial commitment to professional development in a short (6 month-18 month) time frame. Since the goal of the ATE/PPF workshops is to foster change, this feature of the application process is considered to be a way to work more extensively with faculty who, for whatever reason, are not as skilled in using technology tools or

[4] Both DVTS and DVTS-MBL had 3 teams when the count includes teams from the host site.

interactive engagement in their classrooms. This process resulted in several participants attending more than one workshop during these first two years of the project.

The website for the project, www.physicsworkshops.org provides overviews of all workshops and contains essential information for participants regarding workshop logistics. This appears to work well as a communication vehicle between the project staff and the workshop participants.

Written information was mailed to the participants prior to the workshop. When queried on the Final Day Workshop Evaluation (FDWE) on the value of the pre-workshop mailings with the following question: *"Did the workshop pre-materials help prepare you for the workshop?"*, the participants provided ratings of 4.32 (ACIP), 4.53 (DVTS), 3.71 (DVTS-MBL), 3.67 (ISIP-LC), 4.08 (NFTC), and 4.35 (TIP) on a 5-point scale where "5" indicates "excellent". In addition, participants were asked specifically about the workshop pre-materials, and they provided many thoughtful comments. The comments suggest that the participants find these materials to be valuable for the most part, and at the same time they want to be provided with materials that are relevant to the workshop content. The project staff might consider reviewing the role of the pre-workshop materials and code the materials to let participants know if the reading materials "essential" preparation, "useful" background information, or perhaps "interesting, but not essential" as they prepare for the workshop.

"Interesting, useful preparatory material." [DVTS participant, FDWE]

"[I] found them [the materials] extremely useful in giving me the basic background to better understand the material presented at the workshop." [DVTS participant, FDWE]

"Pre-materials were too late [and] too technical. I was trying to prepare for two days of substitute teaching and read at the same time." [ISIP-LC participant, FDWE]

"Emphasize pre-workshop materials so that we could spend less time covering "basics" during the workshop and more time on actual material." [DVTS participant, FDWE]

"More outline and references pertain to what will actually be done, i.e. some of our readings were not really useful." [DVTS participant, FDWE]

"I liked being able to read background information that was relevant at home." [TIP participant, FDWE]

Workshop Quality

Question: In what ways did the ATE/PPF workshops meet the criteria for high quality physics workshops?

Professional development workshops are intended to provide participants with experiences and resources that are meaningful for their teaching situation. To be high

quality and effective workshops should provide: 1) content that reflects current and accurate scientific knowledge; 2) content that is presented at a level appropriate to the participants; 3) content that is presented using sound pedagogical practices; 4) content that has an intended purpose for the participants' classroom or teaching situation; and 5) sufficient time allocated to present the content. In addition, the logistics of the workshop needs to show evidence of planning to meet the needs of participants and presenters. The teaching facilities needs should be well suited to the activities and the equipment should be adequate for the number of participants and functioning as intended.

As stated in the evaluation report for Year One, the PIs engaged in a thorough review of existing physics curricular materials with an eye toward those that would be appropriate to implement in physics courses for students in technology programs prior to the first workshop in October 2006. The PIs conduct extensive discussions with each workshop leader prior to the workshop to insure that they adapt their work to the intensive 3-day workshop format. Workshop leaders focus the activities on participant engagement and rarely lecture. To date, participants at all workshops and conferences compliment the project repeatedly for the high quality content and the exceptional workshop leaders.

Although many considerations were made when the PIs selected the suite of topics for the ATE/PPF workshops, the capacity exposing active learning techniques through the content was one of the most important considerations. The table below offers a thumbnail sketch of the workshop content.

Table 1: Workshop Descriptions

	Workshop Descriptions[5]
Adaptable Curriculums for Introductory Physics (ACIP) April 12-14, 2007 Florence-Darlington Technical College, Florence, SC	Overview of two curricula (ICP/21 and Spiral Physics), an algebra-based physics and an algebra-based or calculus-based physics, respectively. In ICP/21 a learning cycle is repeated throughout the materials, and in Spiral Physics concepts are cycled through repeatedly throughout the course with incremental increases in complexity. Participants will work through a representative sample of curricular materials including explorations, experiments, problem solving, assessments, etc.
Data Visualization Techniques and Strategies (DVTS) June 28-30, 2007 Mt. San Antonio College, Walnut, CA	Video-based motion analysis for applications in laboratory, projects and homework. Participants will make digital video clips, including movies of one- and two-dimensional phenomena. Participants will gain experience in using Logger Pro 3.4 software (Vernier Software and Technology) and Global Positioning System (GPS) technology as tools for understanding motion.
Data Visualization Techniques and Strategies-Microcomputer-Based Laboratories (DVTS-MBL) October 25-27, 2007 Howard Community College, Columbia, MD	Use of microcomputer-based lab tools integrated with active engagement strategies to provide students with direct experience in understanding physical concepts. Participants will gain experience in using technology tools with Mac and Windows computers and experience in using activity-based physics curricular materials.

[5] Data source: http://www.physicsworkshops.org

Instructional Strategies in Introductory Physics (ISIP) February 8-10, 2007 Estrella Mtn. Community College, Avondale, AZ	Overview research-based instructional strategies that promote the development of problem solving skills, including modeling as a process of science. Participants will work with modeling tools like equations, free-body diagrams, and motion diagrams and will develop new materials to use with their students using these modeling tools. Participants will learn about modeling discourse management.
New Faculty Training Conference (NFTC)* March 6-8, 2008 Delta College, University Center, MI	Intensive overview of active learning strategies and how to integrate technology tools in physics classrooms and labs to promote more effective instruction. Activities conducted in a workshop environment are buttressed by the findings of physics education research, i.e. developing student understanding of physics. Thorough introduction to ICP/21, MBL , Discourse Management and assessment tools. Designed for new physics faculty members at two-year colleges.
Tools for Introductory Physics (TIP)* April 17-19, 2008 Estrella Mtn. Community College, Avondale, AZ	Hands-on experience in video-based motion analysis in a wide range of applications. Overview of Spiral Phyiscs, Digital Video Analysis, and a video analysis based laboratory program. Participants will use Logger Pro 3.5 software to analyze video clips.

*Some evaluation results from this workshop are not included in this report, i.e. Post-Implementation Questionnaire not yet administered to these participants.

The topics addressed in these workshops represent a broad overview of many research-based curricular resources in physics, all of which could be integrated into any general physics courses and any physics courses in technician education programs. In addition, the ACIP and TIP workshops presented extensive experiences with complete courses: Spiral Physics and ICP/21. All of the workshops provided ample opportunity for participants to learn more about using technology tools in teaching, particularly in ways that allow students to develop their own understanding about a physics concept. When asked on the Final Day Workshop Evaluation [FDWE] about "the best thing about this workshop," participants cited numerous items. Some of the citations include:

"I love the video analysis sessions. This will enable me to do several lab activities in my classroom. I was weak in E&M. This session really opened up my understanding about E&M." (sic) [TIP participant, FDWE]

"Interactive Lecture Demos. Video analysis. Wealth of material to take home." [DVTS-MBL participant, FDWE]

"Learning about video analysis. I fully expect it to change the way I approach mechanics." [DVTS participant, FDWE]

"TIPERS and ideas I can use to improve learning." [ISIP-LC participant, FDWE]

"Project-based problems." [ACIP participant, FDWE]

"…understanding a more logical way to teach physics without "extra baggage" which was [exemplified by] Spiral Physics." [TIP participant, FDWE]

Even when participants offered a comment that reflected a sense of an unmet expectation with the workshop content, the comment was couched with a sense of understanding the challenges in conducting such an intensive workshop. For example, in response to the question of what he/she "liked least about the workshop" one participant offered the following comment:

"I had thought these would be more detailed on Modeling. But realize now that would be a 2 week workshop." [ISIP-LC participant, FDWE]

The workshops are presented by a talented group of developers and/or instructors who use these materials/resources/strategies in their teaching. The workshop instructors have been actively involved in professional development on a national level, and some instructors have maintained this involvement for many years. The workshop instructors are quite skilled at what they do, and this fact is recognized by many participants and repeated frequently on the evaluation questionnaires. As in the first round of workshops in 2006-2007, several participants mentioned the presenters as what they "liked best about this workshop."

"Presenters were very enthusiastic and helpful." [TIP participant, FDWE]

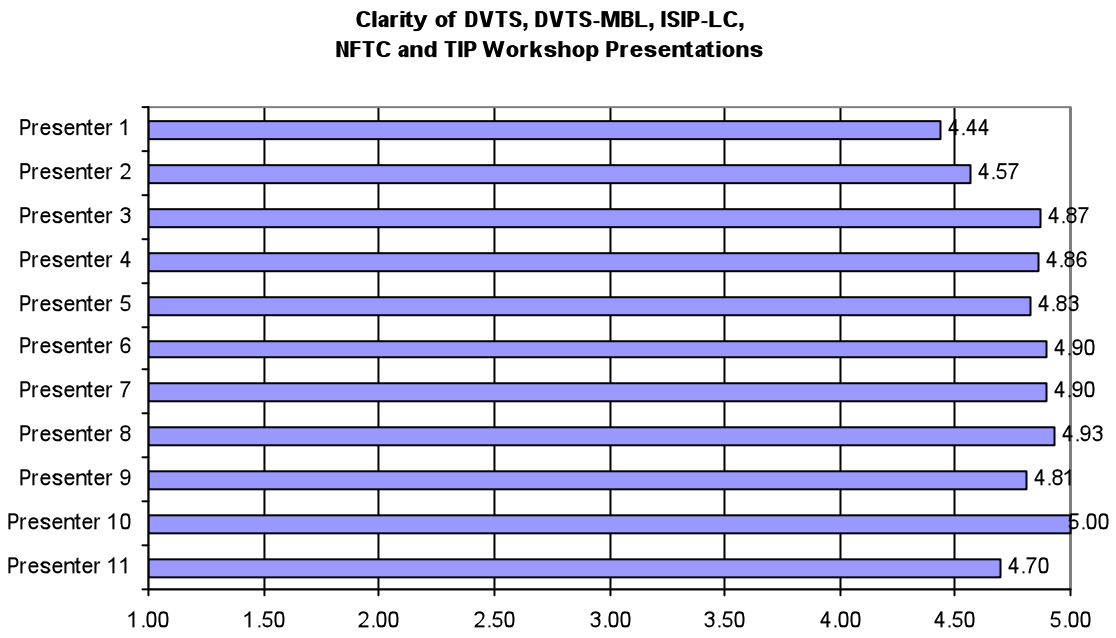
"Presenters did an excellent job. Good practical experiences were shared." [ISIP-LC participant, FDWE]

"Having top-notch presenters—the real pros—take the time and energy to improve physics education through us." [DVTS-MBL participant, FDWE]

"The ability of the presenters to model the techniques with exceptional command and sensitivity." [ISIP-LC participant, FDWE]

The Final Day Workshop Evaluation Form queried the participants about many aspects of the workshops including specific questions about each presenter: *"Were you able to understand and follow (Presenter's Name) presentation?"* Using a rating scale of 1-5, where "1" represents "poor" and "5" represents "excellent", the participants rated each presentation. Each workshop presenter received exceptionally high marks as illustrated in Chart 1.

Chart 1: Clarity of Workshop Presentations



Both O'Kuma and Desbien made presentations at each workshop and their composite ratings across the three workshops on the *"understand and follow"* question were 4.91 and 4.81, respectively.

Opportunities for small group work were integrated throughout the workshops. Each workshop provided an opportunity for the participants to work individually or in small groups to prepare something of use for their own classroom. For example, participants generally have opportunities (1) design experiments—some of which were similar to design problems in engineering technology; (2) conduct guided investigations or explorations aimed at concept development; (3) engage in "goal free" problem solving with specific emphasis on multiple representations, graphing solutions, symbolic tasks, etc. from the Spiral Physics curriculum; (4) prepare materials or review assessments that they can use with their students; and/or (5) engage in group discussions to model discourse management. White boards and PowerPoint slides were two of the primary mechanisms that participants use when reporting out from the group's work. The instructors modeled student-centered teaching practices in all of the workshops, and thus by their actions reinforced how group work could be integrated into instructional practices. Participants seem to value these opportunities for group work, and only a couple of participants ever commented about a group dynamic being less than ideal.

A few participants noted in the comments that many of the workshop activities/resources could be easily and immediately integrated into their classroom: *"I like the idea that I am coming out of here with real ideas that I can use right away."* [DVTS-MBL participant,

FDWE] and *"Everything will be used immediately in my classroom."* [DVTS participant, FDWE].

Several participants commented favorably on the opportunities to work in small groups with like-minded physics teachers. For example:

"I enjoyed spending so much time with others who teach physics. I enjoyed discussing the challenge of improving student learning." [ACIP participant, FDWE]

Responding to what did you like best about this workshop: *"The opportunity to interact with other physics educators in an open exchange of ideas."* [ISIP-LC participant, FDWE] and *"The interaction with enthusiastic physics teachers from different environments or with different backgrounds."* [TIP participant, FDWE]

At each workshop participants were informed about ATE/PPF project funds that could be used for special projects. They were encouraged develop ideas for more extensive projects and to apply for these funds. Since the funds for special projects provide an additional support structure for the participants beyond those received in the workshops, it is predicted that the special projects are likely to be a strong motivator for sustaining change in the participant's classroom. In both years, participants have taken advantage of this opportunity. Some examples include:

ASIP Workshop	Deb Hill	Project report provided on CD: Class materials (worksheets) addressing topic of speed and velocity. Student activity workshops require multiple representations—written descriptions, motion maps, x vs t graphs, and v vs t graphs. Ready to use.
ACIP Workshop	Erik Christensen	Project report provided on CD: Documents describing the implementation of Spiral Physics in a calculus-based physics class. A reported normalized gain of 28%. Documents describing implementation of ICP/21 modules.
DVTS Workshop	Pauline Seales	Project report provided on CD: Documents describing video analysis activities for projectile motion and bouncing ball/energy. Includes worksheets and videos. Ready to use.

A full report of these special efforts will be provided in the summative evaluation report.

The project received very high marks for the planning and arrangements that contributed to the overall comfort in which the workshops were conducted. See Charts 2A and 2B, pages 18-19. The ATE/PPF workshops are intensive in two ways: time and content. Typically, the workshops start at ~8:30 AM and end at ~9:30 PM including breaks and meals that were appropriately timed and adequate. As reported last year, the single aspect of the workshop commented on most frequently regarding what the participants *"liked*

least" about the workshop was the schedule, i.e. the length of the workshop day was mentioned frequently and the over-packed schedule mentioned occasionally. Approximately twenty-five percent (25%) of the participants in the DVTS, DVTS-MBL, ISIP-LC, and TIP workshops commented on the day being too long. Several of these comments offered concessions to their comment by saying such things as that it was "understandable" why the days were so long. In the previous year the ASIP, ISIP and ACIP participants reacted similarly with approximately twenty-three percent (23%) reporting that the long days were difficult. Participants who point to something specific generally say that the sessions following the evening meal are the most difficult with some mentioning the lack of sufficient personal time or enough time to sleep.

A few other participants mentioned that the schedule included too much material. For example:

"Too much in too little time." [DVTS participant, FDWE]

"The workshop schedule was a little overloaded." [TIP participant, FDWE]

When participants were asked *"how to improve"* the workshops, the issue of addressing the intense schedule was mentioned a number of times.

While shortening the day might well reduce the number of comments about this issue, it is unclear whether adjusting the schedule for fewer hours in the day would have a detrimental effect on what the PIs would like to accomplish with the participants. That the workshops demand the full attention of the participants for almost three full days with little "down" time is purposeful. The PIs want the participants to interact with one another, with the workshop leaders, and with them as much as possible in order to create a strong professional connection to the content and with other professionals. As noted in the previous evaluation report, the PIs want the participants to develop an esprit de corps during the workshop and want the participants to become professionally connected beyond the workshop.

Participants in all of the workshops express appreciation for the professional camaraderie that develops as a result of the intensive and high quality experience. When asked what they *liked best about the workshop,* some participants made the following comments:

"I enjoyed spending so much time with others who teach physics.
I enjoyed discussing the challenges of improving student learning.
I appreciated the curriculum sharing." [ACIP participant, FDWE[6]]

"I liked…the interactions with the leaders
and participants." [ACIP participant, FDWE]

"interactions with other workshop attendees…" [ACIP participant, FDWE]

[6] Comment reported previously in Year One evaluation report.

"…the people, general sharing of knowledge…this was my first workshop." [DVTS participant, FDWE]

"Interacting with others." [DVTS-MBL, FDWE]

"Seeing what other people do for instruction and talking with fellow instructors." [DVTS-MBL, FDWE]

"…sharing of peers…interacting with junior college teachers…" [ISIP-LC participant, FDWE]

"I enjoyed that the workshop encourages interaction as it was teaching interaction between students." [ISIP-LC participant, FDWE]

"Many interactions with "reformist" physics teachers—all the presenters and the class participants." [ISIP-LC participant, FDWE]

"Back and forth exchange between leaders and participants. You create an atmosphere that encourages. The admitted "shy" to be comfortable asking questions or expressing their opinions." [ISIP-LC participant, FDWE]

"I very much enjoyed interacting with other physics teachers." [TIP participant, FDWE]

Through their written comments, as noted in those above and some below, the participants offer credit to the PIs and workshop leaders for creating this positive climate at the workshops. Again, from the participants' responses on *"what they liked best"*:

"The friendly environment that was created by the positive attitude of the workshop leaders." [TIP participant, FDWE]

"The enthusiasm of the host and leaders is both infectious and inspiring!" [DVTS participant, FDWE]

"Dedication and expert knowledge of presenters." [DVTS participant, FDWE]

With the exception of the NFTC, the ATE/PPF workshops are offered to both high school and two-year college faculty. Since the content is introductory physics and the pedagogical strategies are ideal for the full array of introductory courses in physics, there are few, if any, challenges to the workshop leaders in teaching to both groups. Only the ISIP-LC workshop had a participant roster that was weighted more heavily toward one group, high school teachers. One of the ISIP-LC participants commented that he/she would have preferred a different mix noting on *"how to improve"* the workshop that, " *Maybe more junior college instructors versus high school teachers would have made a difference."* The ratio of high school affiliated participants to two-year college

participants at the ACIP workshop was 11 HS / 7 TYC; DVTS 7 HS /11 TYC ; DVTS-MBL 7 HS/ 7 TYC ; ISIP-LC 17 HS / 4 TYC ; and TIP 11 HS / 13 TYC. [Note: A few workshop included participants from the professional associations or from school districts or colleges/universities where the individual was responsible for in-service teachers. These individual are not included in the counts above.]

Charts 2A and 2B illustrates the positive regard expressed by the participants for the planning and accoutrements of the workshops to the following questions:

- Did you like the hands-on workshop format?
- How do you feel about the workshop organization?
- How were the (Name of site) facilities for this workshop?
- How do you rate the food?
- How do you rate your lodging?
- Did you enjoy the post-workshop evening interactions?

Chart 2A: Ratings of Workshop Logistics and Environment

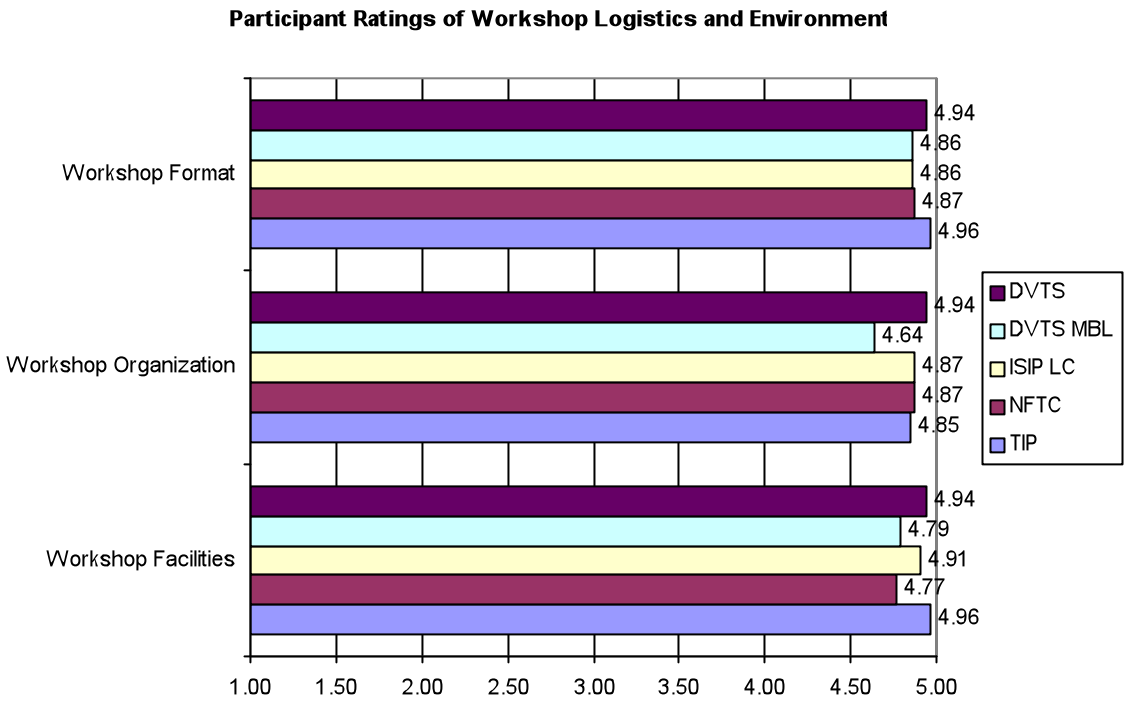
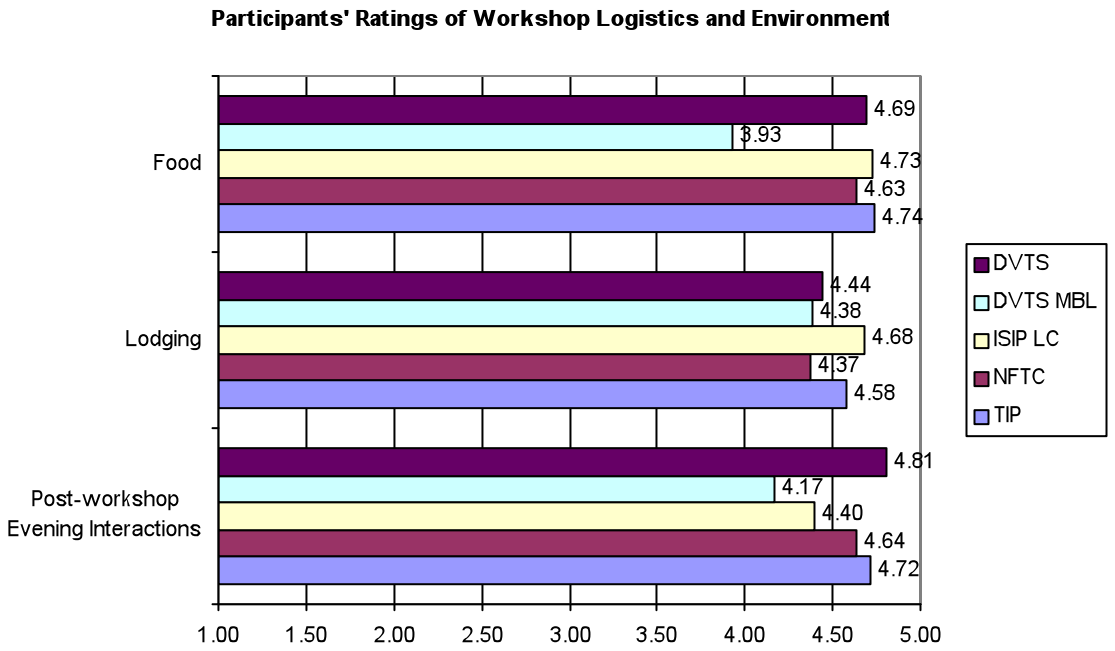


Chart 2B: Ratings of Workshop Logistics and Environment



Technician Education

Question: In what ways did the ATE/PPF workshops promote understanding of technician education and workforce development?

Specialized technician education programs that emphasize physics are offered at each of the three community colleges where the workshops were conducted. These programs were described by host faculty members and/or other personnel (administrators, scientists/technicians) associated with the programs in special sessions dedicated to technician education. The specific topics, etc. for these technician education sessions are illustrated below.

Table 2: Focus on Technician Education

	Description	Time
ACIP[7]	Technical Education and Tour (ESAB)	1.5 hours
	SCATE Projects—student work in ATE courses	~1 hour
	SCATE (South Carolina ATE Center)/Technological Education	1 hour
DVTS	Conceptual Tools for Technical Education	1 hr
	Tour of Science Complex	1 hr
	Geospatial Technology/Activities on Geospatial Technology	2 hr/4-6 hrs
DVTS-MBL	Technician Education integrated in all sessions	Throughout workshop

[7] Previously reported in the Year One evaluation report.

ISIP-LC	Technology and its Use in Physics	1.5 hr
TIP	Technology Education and its Use in Physics	1.5 hr
	Clickers and Project Based Physics	1.5 hr

On the Final Day Workshop Evaluation Form Workshop participants were asked to rate the extent to which their knowledge of technician physics education was increased. At each workshop, the participants gave high marks to this component of the workshop, with ACIP receiving a 4.84 rating, DVTS a rating of 4.65, DVTS-MBL a rating of 4.36, ISIP-LC a rating of 4.05, and TIP a rating of 4.81 on a "1" to "5" scale where "1" is "poor" and "5" is "excellent."

When participants were asked rate the value or usefulness of the workshop sessions, they responded with the following composite ratings to the technician education sessions:
[Note: Once again the rating scale was "1" to "5" with "1" being "poor" and "5" being "excellent."]

Table 3: Ratings of Technician Education Sessions

How valuable or useful were each of the following sessions?		
ACIP[8]	Field trip to ESAB (emphasis on applications of physics in industry)	4.47
	Description of SCATE and Engineering Technology	4.11
DVTS	Conceptual Tools for Technician Education	3.67
	Field Trip to Pioneer	5.00
DVTS-MBL	MBL Sessions and Related Work Sessions	4.58*
ISIP-LC	Technology and its use in Physics	3.94
TIP	Technology Education and its Use in Physics	4.26

*Composite score

[8] Ibid.

Workshop Value

Question: Did the workshops address the professional development needs of the physics faculty?

Instructors who take time away from their classes and time away from their private life to attend professional development workshops are usually highly motivated. The high marks that the ATE/PPF workshops receive across all measures on the Final Day Workshop Evaluation Form indicates that workshop content and pedagogy match the needs and expectations of the participants. The high marks also suggest that the PIs and the workshop instructors know exactly what challenges and motivates the participants.

At the end of the workshop, the participants completed a short questionnaire[9] prepared by the external evaluator in addition to the project's internal evaluation questionnaire. The participants were asked to indicate the extent to which the workshop was successful in *"targeting their needs in their current teaching situation."* Participants were given four choices: "very successful"; "moderately successful"; "slightly successful"; or "not at all successful." Table 4 illustrates the results.

Table 4: Value of Workshops to Participants' Teaching Situation

	Percentage of participants indicating that the workshop was "very successful" in meeting professional development needs					
	DVTS N=17	DVTS MBL N=14	ISIP LC N=21	NFTC N=30	TIP N=27	All Workshops N=109
Taught at a level appropriate to my knowledge, skills, and interest	100%	85.7%	71.4%	96.7%	88.9%	89.0%
Content meaningful to my current teaching situation	82.4%	85.7%	81.0%	80.0%	88.9%	83.5%
Content, instructional strategies, and laboratory work adaptable to my current teaching situation	82.4%	78.6%	71.4%	83.3%	88.9%	81.6%
Responsive to my professional development needs	94.1%	64.3%	90.5%	83.3%	92.6%	86.2%

All of the participants (100%) **in the workshops ACIP, DVTS, DVTS-MBL, and NFTC** indicated that the workshops were "very successful" or "moderately successful" on the four measures noted in Table 3. One participant in the ISIP-LC workshop indicated reported that the workshop was merely "slightly successful" in providing content meaningful (Measure #2) and adaptable (Measure #3) to his/her current teaching situation. This participant is not in a traditional teaching situation and instead works with

[9] The Post-Workshop Questionnaire (external evaluation) was administered in addition to the Final Day Workshop Evaluation Form (internal evaluation).

teachers during in-service professional development workshops. Two participants, one from ISIP-LC and one from TIP, reported that the workshops were "slightly successful" in teaching content at a level appropriate to their knowledge (Measure #1).

The underlying intent of content-driven professional development workshops like the ATE/PPF workshops is to encourage participants adapt and implement new content and more effective instructional strategies learned in the workshops in their own classrooms. One thread of the ATE/PPF project is to monitor and assess the success participants have in implementing change and then sustaining that change. It is expected that if the workshops are of sufficiently high quality and if the content and pedagogical strategies are aligned with what the participants perceive as useful, within their skill level and doable with current resources they have, then the likelihood of implementing change and sustaining that change is increased.

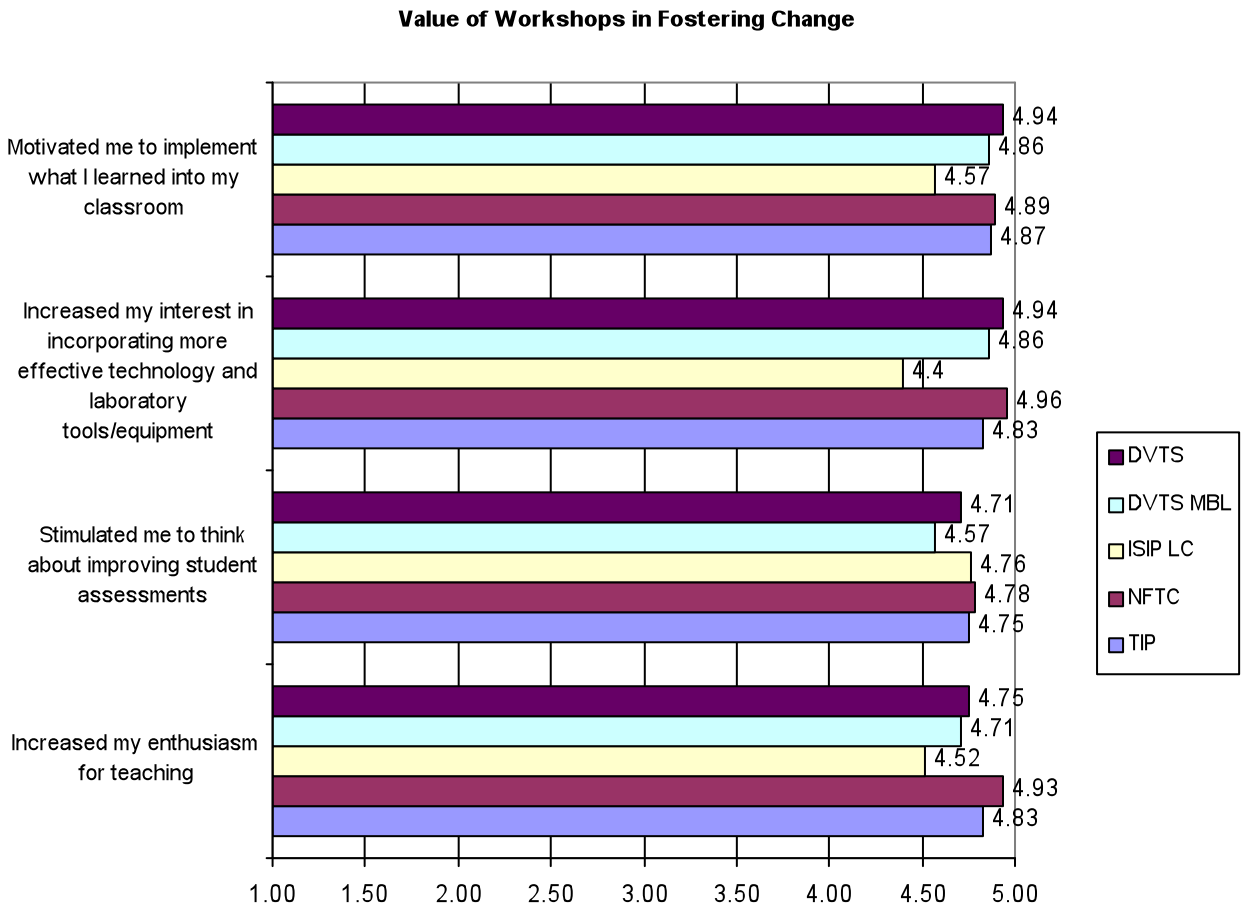
On the Post-Workshop Evaluation questionnaire, participants were queried about the likelihood they would implement what workshop content in their own classrooms or teaching situations. Chart 3 illustrates the responses on four measures related to the participants' implementation plans. The specific questions were:

To what extent do you agree or disagree with each of the following statements concerning the impact of the [Name] workshop on you professionally,

1. *The workshop has motivated me to implement the ideas I learned into my own classroom.*
2. *The workshop has increased my interest to incorporate more effective technology and laboratory tools/equipment in my courses.*
3. *The workshop stimulated me to think about ways I can improve student assessments.*
4. *The workshop increased my enthusiasm for teaching.*

The rating scale for these measures was a "1" to "5" scale, where "1" indicated "Strongly Disagree" and "5" indicated "Strongly Agree."

Chart 3: Value of Workshop in Fostering Change



When asked to respond to the statement "*My students would benefit from an appropriate adaptation of the workshop content into my classroom or laboratory"* **ninety-one percent (91%)** in these responded that the workshops were "very successful"[10] in this regard. This suggests that by implementing workshop content, the teachers' students receive a secondary benefit from the ATE/PPF workshops.

Every measure suggests that all participants exit the workshops with a strong motivation to bring what they have learned to their students. Not only do participants report an intent to immediately implement new strategies into their teaching, particularly the use of alternative assessments such as Ranking Tasks and tools for student engagement such as the White Boards, but most are committed to more major changes in how they teach fundamental concepts using various technology tools.

[10] This was the highest rating that participants could select.

SECTION III

Participants' Plans for Implementing Workshop Content

At the outset of the project, the PIs outlined a number of things they wanted to accomplish with these series of workshops. The most important goal was for the workshops to have an impact on teachers, their physics classes and the students in those classes. The PIs wanted to encourage implementation of the reform-based activities/materials and effective pedagogical practices in the classrooms of every—if at all possible—participant. However, their experience with professional development workshops tempered their exceedingly high expectations, and they acknowledged that:

- *if 90% of the participants exit the workshops with plans to implement activities/materials or teaching strategies from the workshop, and*
- *if 60% of the participants attempt a significant implementation plan and follow-through with their plans for implementation, and*
- *if 30% of the participants sustain that implementation after the project's completion,*

then the ATE/PFF workshops would meet their personal goals for a successful project.

These benchmarks are the target goals for measuring the effectiveness of the project. It is against these benchmarks that the project will be compared in the summative evaluation.

Question: How many participants, upon closure of the workshop, indicated that they plan to implement materials/activities/teaching strategies from the workshops?

When teachers have a positive experience in a professional development workshop, it is expected that they will be motivated to integrate what they have learned into their teaching situation. To determine if this premise held true for the ATE/PPF program, a post-workshop evaluation immediately following the workshop queried participants about their motivation to make changes. On a short Post-Workshop Questionnaire, participants were asked to respond to the following: *"The workshop motivated me to implement the ideas I learned into my own classroom."* The average rating for the participants in each workshop was above 4.8 on a 5-point scale, where "5" indicated "Strongly Agree" for four of the five workshops[11], [see Chart 3, page 23]. Only the ISIP-LC workshop received a lower rating (4.57).

In addition to indicating their motivation for change on the Post-Workshop Questionnaire, the participants were asked whether they planned to implement workshop activities in their classes or other instructional settings, and **all respondents** with the

[11] DVTS, DVTS-MBL, NFTC, and TIP. Results for ACIP were reported in Year One.

exception of one, confirmed that they would do so. The single exception responded that he/she might implement workshop activities. The table below illustrates range of workshop activities/resources that the participants plan to implement in their classes or instructional settings.

Table 5: Workshop Activities/Resources Identified for Adaptation and Implementation

	Participants Planning to Implement Workshop Activities	Type of Material/Activity, etc.	Frequency Counts for specific activities/materials
DVTS	100% (N=17)	Incorporate video analysis in mechanics	9
		Expand use of GPS with labs	6
		Initiate or expand use of Webcams	3
		Purchase technology-based equipment	3
		Incorporate video analysis in electrical circuits labs	2
		Expand use of technology—no specifics	1
DVTS MBL	100% (N=14)	Incorporate workshop activities/materials—no specifics	4
		Incorporate or continue to use ILD's	4
		Incorporate or continue to use video analysis	4
		Initiate or continue to use MBL	3
		Incorporate interactive engagement strategies	1
		Integrate technology-based labs and demos	1
		Purchase technology-based equipment	1
		Share workshop materials, etc. with other teachers	1
ISIP LC	95.2%* (N=21)	Incorporate or continue to use TIPERS, specifically Ranking Tasks	6
		Incorporate or continue to use White Boards	4
		Share workshop activities, materials, teaching philosophies, etc. with other teachers	4
		Incorporate or continue to use TIPERS	3
		Incorporate alternative problem solving strategies, e.g. modeling techniques, different schema	3
		Incorporate circle discussion format	2
		Incorporate constructivist teaching strategies and other workshop strategies	1
		Plan a local workshop on modeling	1

*One participant reported that he/she might implement activities from the workshop. This participant is an outreach specialist who works with teachers rather than a classroom teacher. The participant indicated on the Post-Implementation Questionnaire that some workshop activities/materials were shared with teachers in his/her region.

	Participants Planning to Implement Workshop Activities	Type of Material/Activity, etc.	Frequency Counts for specific activities/materials
NFTC	100% N =30	Incorporate or continue to use computer-based technology/MBL	14
		Integrate or continue to use ICP 21 materials/practices	7
		Incorporate discourse management/student discussions	7
		Incorporate or continue to use TIPERS, Ranking Tasks specifically	5
		Prepared a proposal to purchase technology-based equipment	3
		Incorporate graphical problem solving, e.g. geometric approach	3
		Incorporate group work/hands-on work	3
		Incorporate or continue to use White Boards	3
		Incorporate workshop activities/materials—no specifics	3
		Reflect on teaching strategies/viewpoint	2
		Incorporate or continue to use TIPERS	2
		Implement journaling with students	1
		Purchase and integrate CASTLE materials	1
		Incorporate more demonstrations	1
		Use on-line homework	1
		Revise specific labs/activities using ICP 21 ideas	1
		Begin requesting formative feedback from students on conceptual understanding	1
		Join AAPT	1
TIP	100% N=27	Incorporate video analysis	14
		Incorporate Spiral Physics activities	6
		Incorporate or continue to use TIPERS, Ranking Tasks specifically	4
		Purchase technology-based equipment	2
		Incorporate or continue to use TIPERS	1
		Incorporate or continue to use computer-based technology/MBL	1
		Implement workshop strategies—no specifics	1
		Prepared a proposal and/or received a grant to implement activities and strategies	1
		Integrate workshop project into courses	1

Courses and Students

Question: After the participants returned to their classrooms, how many confirmed their plans to implement workshop content in their classrooms? How many students and courses are influenced by these changes?

Following the workshop, the participants were queried again[12] via electronic mail about their plans to implement the workshop content into their classrooms. Participants were asked to: (1) list the courses in which workshop content would be implemented; (2) estimate the number of students in the courses; (3) indicate when the implementation would occur; (4) describe the barriers for implementing workshop content; and (5) identify any assessment tools that would likely be a part of their implementation plan. Table 6 below illustrates the range of courses in which the workshop content is or will be implemented along with estimates of the students to be affected by this implementation.

Table 6: Implementation Plans—Courses and Students

	Participants/ Respondents	**Courses in which Workshop Content will be implemented**	**Number of Students in these Courses**
ACIP*	$N_p = 19$* $N_r = 12$	**Courses for high school students:**	
		Conceptual physics	-
		General physics (algebra based)	227
		AP Physics B	50
		AP Physics C	12
		Other: (chemistry/physical science)	75/15
		Courses for college students:	
		Introductory/conceptual physics	60
		College (algebra based) physics	64
		University (calculus based) physics	48
		Courses for teachers:	
		Pre-service courses	-
		Professional development courses	-
*ACIP workshop was conducted in April 2007, and some data for this workshop was reported in the Year One evaluation report. Additional participants responded to the evaluator's request for information in Spring 2008. The information from the ACIP participants is updated in this Table. One ACIP participant (N=20) was unable to attend the workshop; so N_p=19.			

[12] Implementation Plans Questionnaire

	Participants/ Respondents	Courses in which Workshop Content will be implemented	Number of Students in these Courses
DVTS	$N_p = 17$ $N_r = 12$	**Courses for high school students:**	
		Conceptual physics	85
		General physics (algebra based)	209
		AP Physics B	-
		AP Physics C	-
		Other:(phys sci / prin of engineering / honors physics)	70/15/120
		Courses for college students:	
		Introductory/conceptual physics	435
		College (algebra based) physics	267
		University (calculus based) physics	213
		Astronomy	48
		Courses for teachers:	
		Pre-service courses	-
		Professional development courses	-
DVTS MBL	$N_p = 14$ $N_r = 10$	**Courses for high school students:**	
		Conceptual physics	-
		General physics (algebra based)	377
		AP Physics B	123
		AP Physics C	24
		Other: (geophysics, non-math)	36
		Courses for college students:	
		Introductory/conceptual physics	280
		College (algebra based) physics	146
		University (calculus based) physics	40
		Courses for teachers:	
		Pre-service courses	-
		Professional development courses	-

	Participants/ Respondents	Courses in which Workshop Content will be implemented	Number of Students in these Courses
ISIP LC	$N_p = 22$ $N_r = 11$	**Courses for high school students:**	
		Conceptual physics	210
		General physics (algebra based)	520
		AP Physics B	131
		AP Physics C	-
		Courses for college students:	
		Introductory/conceptual physics	-
		College (algebra based) physics	-
		University (calculus based) physics	44
		Others: Intro to physics prerequisite course	44
		Courses for teachers:	
		Pre-service courses	-
		Professional development courses	-
NFTC	$N_p = 30$ $N_r = 20$	**Courses for high school students:**	
		Conceptual physics	-
		General physics (algebra based)	-
		AP Physics B	-
		AP Physics C	46
		Courses for college students:	
		Introductory/conceptual physics	363
		College (algebra based) physics	732
		University (calculus based) physics	584
		Astronomy	63
		Physical Science	171
		Other: Applied Physics	200
		Courses for teachers:	
		Pre-service courses	-
		Professional development courses	-

	Participants/ Respondents	Courses in which Workshop Content will be implemented	Number of Students in these Courses
TIP	$N_p = 27$ $N_r = 15$	**Courses for high school students:**	
		Conceptual physics	-
		General physics (algebra based)	574
		AP Physics B	52
		AP Physics C	19
		Other: (physical science/calculus physics)	55/12
		Courses for college students:	
		Introductory/conceptual physics	268
		College (algebra based) physics	269
		University (calculus based) physics	639
		Courses for teachers:	
		Pre-service courses	-
		Professional development courses	-

Since all participants did not respond to this second query about implementation plans, even after a follow-up request, it is likely that the number of students influenced by their instructor's participation in the ATE/PPF workshops illustrated in Table 7 differs from the true value. The summative evaluation will attempt to secure actual impact numbers from all participants.

Table 7: Student Impact Numbers by Level and Courses (Estimate)[13]

Courses for High School Students	
Conceptual physics course	295
General physics (algebra based) course	1907
AP Physics B and C courses	467
Courses for College Students	
Introductory/conceptual physics course	1406
College (algebra based) physics course	1478
University (calculus based) physics course	1568
Courses for teachers	
Pre-service courses	-
Professional development courses	-
Total for Typical Physics Courses	7121

The participants who serve as science consultants, science supervisors, or professional development experts for their school districts indicated that they had the opportunity to influence all science teachers in their district. The number of in-service teachers who benefited from these workshops was not available at the time of this report.

Implementation Challenges

Question: What problems might be encountered?

The participants indicated the usual types of barriers for implementing what they learned into their classes. However, participants in the DVTS-MBL, ISIP-LC, NFTC, and TIP workshops reported that they anticipated "no problems" in implementing workshop activities or strategies in their classrooms as the *most frequent* response. By the time some of the participants reported on the Plans for Implementation Questionnaire, many of them had already implemented workshop activities or strategies. Some participants who had equipment such as video cameras prior to the workshop reported having "no implementation problems", while a few others reported having the usual troubleshooting problems one encounters when implementing the new/revised activities that use these technology tools. Participants at the DVTS workshop cited difficulties in using the GPS units seven (7) times, including simply having time to learn to use the GPS unit.

Other barriers to implementation which were cited: securing more equipment, including funding for such equipment (7 citations); personal challenges in making changes in teaching styles, including need for continued training (5 citations); teaching environment

[13] Ibid.

(lab configuration or short class periods (3 citations); and difficulty implementing discourse management (2 citations). Various types of "resistance" were cited both student resistance, particularly to mid-semester changes and administrative (5 citations).

That 29 out of 60 respondents[14] indicating that they did not anticipate any barriers to implementing the workshop content in their classrooms bodes well for the long-term impact of the workshops in supporting participants' efforts to change classroom practices.

Student Assessments

Question: Will reform-based assessments be adopted?

A large fraction of the participants who responded to the query about implementation plans were already engaged in using or planning to use research-based assessments in physics. The Force Concept Inventory was the most frequently cited assessment instrument that the respondents planned to use. Table 8 below illustrates the number of respondents indicating a plan to use specific assessments. Note: Some respondents indicated plans to use multiple assessments.

Table 8: Plans for Using Research-based and Other Assessments

		ACIP*	DVTS	DVTS MBL	ISIP LC	NFTC	TIP
Research-based assessments	FCI	5	4	3	4	10	7
	FCME	0	0	0	0	0	1
	TUG-K	0	0	0	0	0	1
	MBT	2	0	1	0	0	0
	CSEM/E&M	1	0	0	0	3	1
	DIRECT	0	0	0	1	0	0
	MPEX	1	0	0	0	0	0
	Assessment on Waves	1	0	0	0	0	0
	Ranking Tasks	1	8	4	10	11	6
	TIPERS	0	0	1	1	5	0
National Exams	AP Exams	1	0	0	0	0	0
	AAPT Physics Exam	0	0	0	0	0	0
Other	Conventional classroom tests	0	0	0	0	0	0
	District Assessments	0	0	0	0	0	0
	Physlets	0	0	0	0	0	0
	Concept Inventory	1	0	0	0	0	0
	ALPs and others	0	0	0	1	0	0
	Lawson test	0	0	0	0	1	0
	Not sure about assessment	2	2	3	1	2	0
	No plans to use special assessments	0	4	2	0	0	1
	Yes, not specific about assessment	0	2	2	0	4	3
	Unspecified attitude assessment	0	0	1	0	0	0

*ACIP results were reported in the evaluation report for Year One. These numbers have been revised to included responses from participants who completed Plans for Implementation Questionnaire in May 2008.

[14] NFTC participants not included.

Only 60 participants (out of 110 or 54.5%) responded to the evaluator's second query about specific implementation plans. However, these participants were specific about what activities/resources they had selected to implement. The less than desirable response rate is likely due to several factors, the primary one being the participants' busy teaching schedules. Timing the delivery of the evaluation questionnaires is a challenge for the external evaluation given that once faculty return to their classrooms, the demands of teaching and home life are rightfully their highest priorities.

SECTION IV

Implementation of Workshop Content

In Year One and the current year of the ATE Program for Physics Faculty, the all of the activities in all of the workshops were directed toward motivating participants to implement more effective teaching strategies using technology tools and research-based curricular materials into physics classes. Each workshop offered time for participants to develop an activity for their classroom using what they were learning at the workshop. Many examples of teaching strategies described or modeled by the workshop leaders were strategies that participants could implement immediately, while other activities, particularly adapting a curricular package, e.g. ICP/21, or purchasing equipment would require more planning time.

Through the encouragement of the project instructors, participants were guided on how to shift from teacher-centered (e.g. lecturing) to student-centered classrooms. All of the teachers in the six workshops[15] discussed in this report exited the workshop indicating a high motivation to change. For example, a participant at the ISIP-LC workshop reported on the Post–Workshop Questionnaire that he/she intended to implement: *"as many [activities/materials] as I can…white boards immediately, TIPERS more, use of representational tools. I will continue to believe that conceptual understanding will last longer than 'test prep' and as such pursue it with these new ideas and strategies, and replace those methods that do not work."*

The extent to which the workshops influence significant and long-lasting changes depends on many factors including such things as the willingness of the teacher to tolerate the uncertainty experienced when implementing even small changes in the middle of a semester or the large effort needed to improve local resources or facilities to allow for a more student-centered classroom environment or most-problematic of all challenges: student resistance to change. Another ISIP-LC participant captured a couple of the most important challenges for sustainability (paraphrased in Table 12, page 40):

"Money is always the biggest challenge, but this year, in particular I am working with a group of students who are extremely resistant to free thought and any assignment that requires a mental effort or … gasp… one that more than one solution may apply. The unique resistance of this group has been the biggest conundrum in the whole process. That is why I hope to have more success next year when the kids know no other expectation. Dwain did warn us to wait, but I was too excited."

As noted in the Year One evaluation report, the ATE/PPF participants were highly motivated to implement changes upon exiting their workshops. On the Post-workshop Questionnaire, the participants in the ASIP (November 2006), ISIP (February 2007) and

[15] ACIP (April 2007), DVTS (June 2007), DVTS MBL (October 2007), ISIP LC (November 2007), NFTC (March 2007) and TIP (April 207).

ACIP (April 2007) workshops gave high marks to each workshop on all measures. As a specific example, ninety-five percent (95%) of the ASIP participants, ninety-two percent (92%) of the ISIP participants, and ninety percent (90%) of the ACIP participants reported that the workshop was "very successful" in offering content was meaningful to their current teaching situation[16]. Though not reaching the ninety percent (90%) level, similar results can be reported in Year Two, with over 80% of the participants (N=109) attending Year Two workshops indicating that the workshops were "very successful" in offering content meaningful to their current teaching situation (see Table 4, page 21). Tables 5 and 6 (pages 25-27) describe the participants' intended plans for implementation and predicted impact of the changes on courses and students.

On the Post-Implementation Questionnaire (PIQ), participants from the ACIP, DVTS, DVTS-MBL and ISIP-LC workshops were asked to rate the extent to which they agreed with the following statement: *"Attending the workshop supported my efforts to implement teaching strategies that have been demonstrated as effective into my classes."* Although the response rate was lower than desired, participants responding to the PIQ gave high marks[17] to the workshops along this measure with ratings of 4.43 (ACIP), 4.46 (DVTS), 4.57 (DVTS MBL) and 4.8 (ISIP LC). As mentioned previously, when compared to the responses to a similar question on the Post-Workshop Questionnaire, *(" The workshop has motivated me to implement the ideas I learned into my own classroom)*, the participants expressed a slightly more favorable response with ratings of: 4.89 (ACIP) 4.94 (DVTS), 4.86 (DVTS MBL), 4.57 (ISIP LC).

Some participants anticipated or experienced barriers to successful/speedy implementation. The anticipated barriers are described on page 31, with securing the necessary technology tools as a common theme. Even with these challenges, the participants' comments integrated throughout this report and those found in Participant Commentary (Section VI) of this report suggest that the participants' are highly motivated to make changes in their teaching.

However, encouraging participants to communicate with project personnel after the workshop is frequently a challenge, and yet it is the only way to secure an accurate picture of what actually occurs when the participants return to their classrooms. Maintaining that communication for a sufficiently long period to understand the scope and impact of the change(s) and gauging the likelihood that the changes will be sustained compounds the problem of understanding the impact of a workshop. Nonetheless, that is the evaluation challenge for the ATE/PPF project. The external evaluation has not yet achieved the response rates necessary to secure a complete picture of how much the participants' courses were changes as a result of their participation in the workshops. The external evaluator will continue to work with the PIs to determine the most productive ways to secure good response rates and accurate and complete implementation information.

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[16] Table 4, page 17, Year One external evaluation report.

[17] Participants used a 5-point rating scale where "1" represented "Strongly Disagree" and "5" represented "Strongly Agree."

Classroom Implementation AY 2007-2008

Question: What activities/resources were implemented in the participants' classrooms or teaching situations in AY 2007-2008?

In May 2008 participants who attended the ACIP (April 2007), DVTS (June 2007), DVTS MBL (October 2007), and ISIP LC (November 2007)[18] were asked to describe[19] the activities/materials from the workshop were introduced to their students with the following questions:

1. *Describe or list one of the activities/materials from the [name of workshop] that you introduced to your students.*
2. *Did you encounter any particular challenges? How did you handle the challenge?*
3. *What did you learn from observing your students?*

Tables 9, 10, 11, and 12 illustrate the responses. Several participants from the DVTS-MBL workshop reported that implementation would likely occur in the 2008-2009 academic year.

All of the respondents to the Post-Implementation Questionnaire indicated that they intend to continue using the activity/materials that they have implemented to date. From an ISIP-LC participant shares the strength of this commitment:

"I will absolutely continue using it (and others as I learn them and can incorporate them) because I know better than the students what they really need for skills to be successful in college or the workplace. I believe that the best thing I can do for them is to get them thinking and keep them thinking, but man! what a challenge."

Table 9: Classroom Implementation—ACIP Workshop (conducted April 2007)

ACIP WORKSHOP
Implementation Activities and Participants' Observations

Participant	Activities/materials implemented to date (May 2008)	What challenges did you encounter? What did you learn from observing your students?
1*	Incorporated laboratory activities. Altered student project work to be more inclusive of other disciplines.	Large number of students per class (i.e. 32 in rooms designed for 25) resulting in groups larger than desired. Assembling necessary equipment, i.e. making, substituting and ordering. Increased student discussion and increased retention of content as measured by assessments.

[18] Since the NFTC and TIP workshop were conducted during the middle to late part of the Spring 2008 semester and participants were likely to make only minimal implementations, information on the implementation actions for these participants will be included in the Year Three evaluation report.
[19] Post-implementation Evaluation Questionnaire.

Participant	Activities/materials implemented to date (May 2008)	What challenges did you encounter? What did you learn from observing your students?
2*	Used the Forces and Motion module (ICP 21) and the Math Toolkit. Ranking Tasks.	No challenges listed. The students enjoyed the modules and developed a deeper understanding of the concepts being taught. The ranking tasks helped me assess the students' mastery of concepts.
3*	Used TIPERS to some extent.	No challenges since students are open to different ways of teaching. Observed that students become more engaged when they have ownership of the learning.
4*	Used the Spiral Physics curriculum in preparatory level classes with 3 lecture hours (no associated lab), in calculus based introductory physics for engineers, and in algebra based introductory physics for life science majors.	Greatest challenge was that students were frustrated early in the quarter that they were unable to find similar problems in other texts on-line. . In response, acknowledged that motion diagrams are an unusual component of Spiral Physics and illustrated how standard textbook problems could be solved using motion diagrams. Life science majors seemed to appreciate Spiral Physics less than the other two groups, who grew to love the problems, for the most part. Will likely use another text for the life science students. Unsuccessful in encouraging other members of the department to use materials.
5*	Activity 1 in rotational kinematics using video analysis and an additional activity conducted by my group at the workshop.	Students had to be accurate and careful in recording data. It was a good lesson. The students were more involved and liked the idea of using video analysis. *"It was great when the results came and we could define concepts through the data obtained."*
6*	Video analysis. Introduced circular motion activities into my classroom, including having a bird flying in circles.	Challenge to convert video into the correct format—it took a few trials. Used the information from the workshop to address the challenge. Students are more enthusiastic in learning physics.
7*	Ranking Tasks.	Since students have a tendency to search the textbook for possible answers and tend to write full paragraphs that state nothing related to the question, the ranking tasks are good because the student is forced to determine the pattern and appreciate the solution. Would reemphasize the question and ask students to give valid reasoning. Students appreciated the class more because they know there is a reason for everything. They can identify the "given" and understand what they need to solve for.

Table 10: Classroom Implementation—DVTS Workshop (conducted June 2007)

DVTS WORKSHOP
Implementation Activities and Participants' Observations

Participant	Activities/materials implemented to date (May 2008)	What challenges did you encounter? What did you learn from observing your students?
1*	Video analysis of all types of motion. GPS used with individual students doing independent studies.	Encountered difficulty with the GPS, but workshop leader (Sharma) resolved our difficulties. Students enjoyed the challenge and novel approach to understanding a topic.
2	None implemented to date. Plans to implement in Fall 2008.	
3*	Activity based problem solving activities (M. Mason's instructional materials)	Once we got computers in the labs, we were able to implement the activity-based problem solving activities. Students are overworked and have demands from other classes. Initially, they do not buy into more time consuming instructional methods. It was only through improved test scores that students became enthusiastic about activity-based classwork. From observing my students: They are masters at finding shortcuts (i.e. getting exercise done in less time). However, most of the time they came up with "great stuff" that I wouldn't have thought of. This invigorates me and my students.
4*	Video capture for projectile motion. Video capture for student projects on impulse/force on running shoes.	Working with software to extract consistent numbers can be difficult. Allowing more time to deal with problems. Students loved it. Projectile motion was often mentioned as the best thing we did all year in my class evaluations.
5*	Video analysis of kinematics motion.	Getting video cameras to interface with network computers (still working out the issues). Getting GPS to link up with network computers (still unresolved). Students enjoyed video analysis and could relate to concepts far better than with simulations or other hands-on activities.
6*	Introduced Logger Pro and improved work with sensors.	Group project using Logger Pro helped students helped students understand an entire experimental process. Students enthusiastically worked with the technological tools.
7*	Developed new labs (projectiles, conservation of momentum, centripetal force) using video analysis.	Receipt of equipment was delayed causing a delay in teaching the topics until second quarter. Students LOVED the equipment and video analysis. Needed to provide a lot of guidance so that they did not miss the point of the lab, particularly true of conservation of momentum. May rewrite this lab and developed new ones on constant velocity and acceleration.

Participant	Activities/materials implemented to date (May 2008)	What challenges did you encounter? What did you learn from observing your students?
8	No implementation to date. Plan to work with colleague to use cameras and implement Vernier MBL activities in an algebra-based course.	Obtained digital cameras in April 2008.
9*	GPS Analysis of automobile efficiency.	Implementation required purchasing GPS units, teaching students to use the units and Trackmaker software, and analyzing results. We worked together to complete these tasks. Students are very good at learning to use new software and equipment.
10*	Integrated GPS and Google Earth in physics and astronomy. Used video analysis software to analyze motion in physics labs.	Encountered technical challenges that my lab tech and I were able to resolve. Students enjoyed the process of making videos and analyzing them. I think they were able to draw a better connection between equations and physical observations.
11*	Developed and experimented with video capture for Behr Free Fall lab and other activities—tested some portions with classes, but not a full implementation.	Not applicable. Probably will continue to use activity once problems are resolved.
12	No comment.	
13*	Using GPS in analyzing motion. Digital Video Analysis. Student groups using GPS units to collect motion data for analysis.	No challenges experienced in introducing activities as projects. Borrowed GPS units from a college. In process of purchasing other technology-based equipment. From observing students I have learned that they are more interested, curious, and more involved when doing engaging activities.

Table 11: Classroom Implementation—DVTS MBL Workshop (conducted October 2007)

DVTS MBL WORKSHOP
Implementation Activities and Participants' Observations

Participant	Activities/materials implemented to date (May 2008)	What challenges did you encounter? What did you learn from observing your students?
1	No implementation to date. Anticipates implementation in next academic year.	
2	No implementation to date. Anticipates implementation in next academic year.	
3	No implementation to date. Anticipates implementation in next academic year.	
4*	Ranking tasks. Immediately implemented four ranking tasks in three different classes.	No challenges. Needed to explain what a ranking task was and how to answer it. Emphasized that the explanation was more important than the answer. Students had to think to answer the question, i.e. they had to comprehend material in order to answer the question. Received a student comment that he/she liked the ranking tasks.

Participant	Activities/materials implemented to date (May 2008)	What challenges did you encounter? What did you learn from observing your students?
5*	Implemented use of Logger Pro more frequently in my classes, including using it with demonstrations.	Set up for activities is time consuming the first time, but anticipate this will be less time consuming with future uses. When talking through a demonstration using Logger Pro, I learned students don't always see and learn what I think they should when they do their own labs.
6	No implementation to date. Anticipates implementation in next academic year.	
7*	Implemented video tracking of pool ball rolling off the table. Analysis clearly illustrated the independence of horizontal motion from the vertical motion.	PC computers were not as friendly for video capture as the workshop Mac's. Lab experience forced students to analyze the system instead of merely illustrating the phenomenon.
8	No implementation to date.	

Table 12: Classroom Implementation—ISIP LC Workshop (conducted November 2007)

ISIP LC WORKSHOP
Implementation Activities and Participants' Observations

Participant	Activities/materials implemented to date (May 2008)	What challenges did you encounter? What did you learn from observing your students?
1*	Implemented Ranking Tasks previously. Implemented several Conflicting Contentions (TIPERS) in topics in current electricity.	Time management issues in block schedule. Particularly difficult when task took longer than anticipated which had a negative impact on the planned homework assignment, etc. Pleased to observe that if given choice between two alternatives, some students (freshmen) are able to argue for a third alternative. Attempted to use Ranking Tasks as formative assessments and as a way to give feedback to students. This was time consuming and students seemed to ignore feedback.
2*	Implemented vector approach to solving projectile motion problems.	Students who were skilled in using multiple formulas felt more comfortable with that approach while students who had struggled with the multiple formulas loved the new approach. Need to make sure that I present materials in multiple ways for all learners, but my limited background makes this difficult at times.
3*	Immediately implemented White Boards and classroom interaction. Incorporating these strategies at the beginning of the year with students will insure that students are aware of the expectations.	Money is the biggest challenge. Students' resistance to open thinking and problems with multiple solutions. The student resistance has been the largest challenge…the workshop leaders cautioned us about this. From observing my students I learned "that I am unique among my peers at this school in attempting to make thinkers out of my students."
4	Will implement activities in summer workshops with teachers.	

Participant	Activities/materials implemented to date (May 2008)	What challenges did you encounter? What did you learn from observing your students?
5*	Implemented practices learned on teaching projectile motion. Incorporated White Boards for class discussions.	Once students have memorized the formulas, they are very reluctant to solve problems without them. To overcome this, students had to practice, practice, practice more with the new methods until they were comfortable with it. I would like more professional development in order to become more comfortable with these methods of instruction. After students became comfortable, the old method became obsolete.
6*	Ranking Tasks and White Boards.	Student resistance was very strong, and I addressed this by talking with the students and the reasons for trying new approaches. I learned that students had very little experience thinking rather than just regurgitating.
7*	Incorporated a practical activity as a discovery activity (i.e. predicting time a remote controlled plane needed to make 15 revolutions) where students had no prior knowledge of the concepts in uniform circular motion.	Students had difficulty transferring prior knowledge of forces.
8	Incorporate learning into in-service programs with teachers.	
9[NR]	White Boards. Ranking Tasks. Other TIPERS. Schema for free body diagrams. (Instructed evaluator to use information from the respondent's Implementation Plans and Activities.	No comment.
10*	Ranking Tasks. While Boards.	Students were frustrated when they were not given the answers and expected to provide reasons for their responses. To handle this, I permitted them to express their frustration, but still expected them to provide their reasoning. I observed that students would usually figure things out, if given enough time.
11*	Increased the number of group discussions in class. Incorporated Ranking Tasks.	No challenges listed. Students resist group discussions at first, but come around after some time. Ranking tasks are good to check students' understanding and they are actively involved in the tasks.

"Ranking tasks are great formative assessments and white boarding puts the onus on the students to understand what they are learning, in order to explain it to others." (ISIP LC participant)

Measuring Success

Question: To what extent were the implementations successful?

After an intensive professional development workshop like the ATE/PPF workshops, teachers are motivated change how they teach by: (1) replacing an old activity with a new activity, (2) employing a new resource or technological tool, (3) asking students to interact at higher level than previously was expected, (4) using formative assessments to gauge the extent of students' understanding, or (5) in a few cases, revamping the entire curriculum by adopting a non-traditional text materials, (i.e. selecting materials other than a standard textbook as the guide for the course.

Most major adaptations involve trial and error, and through that period teachers generally experience a sense of uncertainty about the new way of teaching. Students often react negatively, at least at first, to change, particularly when the responsibility of learning is shifted toward them in the more student-centered classroom. The literature reports a fair amount of student dissatisfaction with reform-based pedagogy even when the students acknowledge improved understanding. However, as one of the participants pointed out: *"Students are so overworked with other classes and other commitments that they don't buy into a more time consuming teaching methodology at first. Only by showing that it improved their test scores were we able to get student enthusiastic about activity based classes rather than traditional lecturing."* [DVTS participant, Post-Implementation Questionnaire, paraphrased in Table 10, page 38] Observations reported by the teachers when they implemented workshop content (see Tables 9 and 12, pages XX) confirm that student resistance to change is a critical concern.

The workshop leaders, while encouraging change, always temper their remarks to the teachers about making big changes too rapidly or when students have already become accustomed to a particular set of expectations (i.e. changing in the middle of a semester).

Using a few repeated queries about "how things went", there are indications that change is occurring even in the face of student resistance. The teachers also offer insights into how the they have remained committed to the process of changing, particularly in the area of engaging students more actively. For example*: "Once students have memorized formulas, they are very reluctant to solve problems. To overcome this, students had to practice, practice, practice more with the new methods until they were comfortable with it."* [ISIP-LC participant]

Even with the modest response rates on the Post-Implementation Questionnaire[20], the participants' responses suggest that their efforts to engage students more actively in learning by implementing workshop content into their courses were rewarded. Specifically, participants were asked about the extent to which they agreed with the following statement:

[20] See response rate on Table 13.

"When I implemented activities/materials from the workshop into my classes, my students were more engaged in learning."

Participants responded as follows:

	Strongly Agree	Agree	Not Sure	No Response
ACIP	4	3	-	-
DVTS	6	4	1	-
DVTS MBL	3	1	-	3
ISIP LC	3	6	-	1

One hundred per cent (100%) of the ACIP, DVTS-MBL, and ISIP-LC respondents "Agree" or "Strongly Agree" with the statement.

To secure a slightly different view of how the participants viewed their implementation efforts, they were asked directly to rate the extent to which they thought the implementation was successful. The results are illustrated in Tables 13 and 14.

Table 13: Level of Success in Implementing Workshop Content

	Percentage of respondents indicating that the implementation of the new activity was "very successful"				
	ACIP	DVTS	DVTS MBL	ISIP	All Workshops
New activity encouraged students to be more engaged than previous activity	71.4% N=7	88.8% N=9	66.7% N=3	12.5% N=8	59.3% N=27
New activity addressed physics content at a level appropriate to students' background, knowledge and skills	85.7% N=7	66.7% N=9	100% N=3	12.5% N=8	59.3% N=27

All of the respondents in the ACIP, DVTS, DVTS MBL workshops indicated that the implementations were "very" or "moderately" successful and most (87.5%) of the respondents from the ISIP LC workshop rated the implementation as either "very" or "moderately" successful. It should be noted most of the respondents from the DVTS MBL workshop indicated that they were planning to implement activities in the 2008-2009 academic year; only three respondents reported they had implemented activities from the workshop to date.

Table 14: Profile of Responses on Implementation and Students

	Very Successful	Slightly Successful	Moderately Successful	Not at all Successful
New activity encouraged students to be more engaged than previous activity (N=27)	59.3%	37.0%	3.7%	0%
New activity addressed physics content at a level appropriate to students' background, knowledge and skills (N=27)	59.3%	37.0%	3.7%	0%

Student Assessments

As with the ASIP (2006) and ISIP (2007), the DVTS, DVTS MBL, ISIP LC, NFTC and TIP workshops dedicated time to discussing various formative and summative student assessments, including research-based instruments such as the FCI, TUG-K, etc. and alternative assessments (e.g. journals). At the NFTC, participants had an opportunity to take the FCI during the workshop. The instrument was scored and returned to participants allowing the workshop leaders to discuss the purpose and use of the instrument. Participants are provided with a CD with various assessment tools, a resource to a similar one offered to instructors who attend a more extensive workshop on assessment at AAPT national meetings.

Tables 15 and 16 illustrate the participants' perception of the relative degree of success when participants implemented various student assessments.

Table 15: Ratings on the Value of Student Assessments

	Percentage of respondents indicating that the implementation of the assessment was "very successful"				
	ACIP	DVTS	DVTS MBL	ISIP LC	All Workshops N=21
Student assessment used provided the formative feedback I needed.	83.3%	60%	0%	28.6%	47.6%
Student assessment used suggests that this new activity helps students learn the specific concept better than previous activity	80%	50%	66.6%	14.3%	47.6%

Table 16: Profile of Responses on Value of Student Assessments

	Very Successful	Moderately Successful	Slightly Successful	Not at all Successful
Student assessment that was used provided the formative feedback I needed (N=21)	47.6%	47.6%	4.8%	0%
Student assessment that was used suggests that this new activity helps students learn the specific concept better than previous activity (N=21)	47.6%	47.6%	4.8%	0%

Participants were asked about the extent to which they agreed with the following statement.

"When I implemented formative student assessments with a particular learning activity, the assessment provided me with valuable information about my students' learning prior to major tests."

Participants responded as follows:

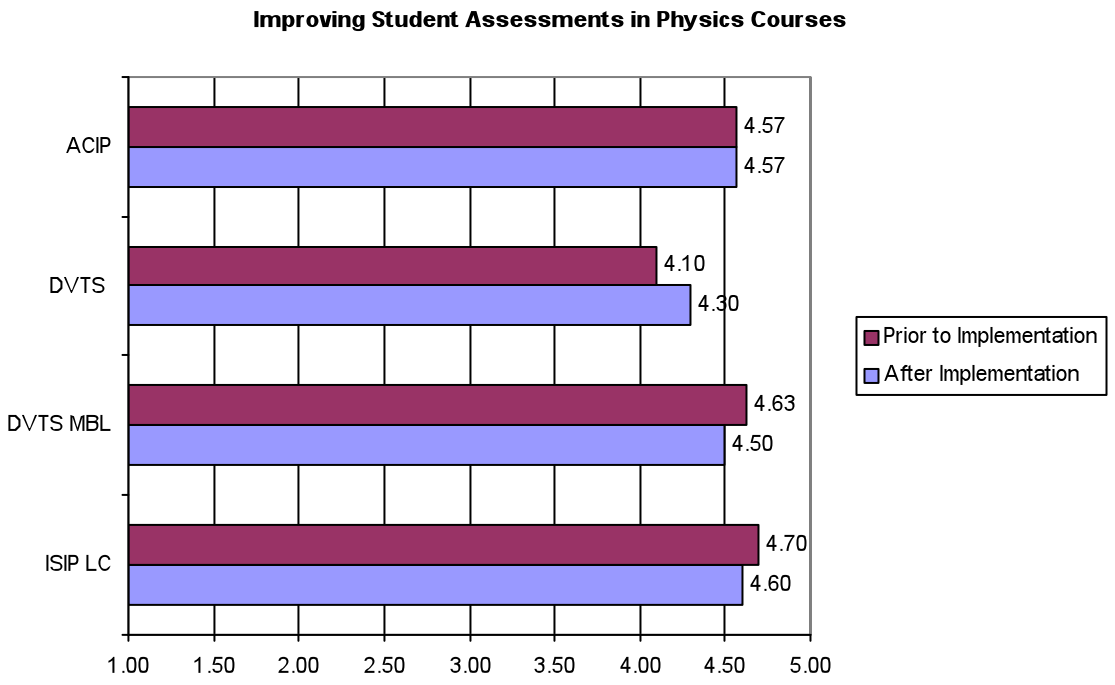
	Strongly Agree	Agree	Not Sure	Disagree	Not Applicable	No Response
ACIP	3	3	-	-	1	-
DVTS	1	1	2	2	6	1
DVTS MBL	0	2	2	-	3	-
ISIP LC	3	5	-	-	2	1

As mentioned earlier, many of the participants in the DVTS workshop conducted in June 2007 stated that they would not be implementing what they learned until the following (2008-2009) academic year. Thus, as noted in the table above, few of them were able to report on the implementation of formative student assessments.

Participants were asked on two occasions to rate the extent to which the workshops stimulated them to improve the student assessments that they use in their courses. Specifically, they were asked to rate on a 5-point scale, where "5" indicated "Strongly Agree," the extent to which they agreed with the following statement:

The workshop stimulated me to think about ways I can improve student assessments that I use in my physics courses.

Chart 4: Effect of Workshops on Encouraging Changes in Student Assessments



Note: Chart illustrates results from paired samples of respondents on post-workshop and post-implementation questionnaires. .

Ranking Tasks are the most frequently cited assessment that participants use or plan to use in their classes. The ease with which these can be integrated into classes is the likely reason for their popularity. As stated by an ISIP-LC participant, *" Ranking tasks are great formative assessments…"*

The queries about what participants learned from using student assessments were not sufficiently refined to establish a clear sense of how the research-based assessments such as the FCI are used or the details of what the instructor learned from the assessment.

Maintaining a Commitment to Change

One of the premises of the ATE/PPF workshops is to encourage the participants to be active agents in improving physics teaching. Attending professional development workshops is a first step. Attempting and then succeeding with change in one's classes is a second step. Maintaining active involvement in the physics teaching community by continuing to attend workshops or becoming involved in professional organizations locally or nationally is a third element. Even with excellent workshops, the enthusiasm to implement workshop content can fade over time. Other demands can crowd out the desire to put what one has learned into action. Lack of resources or uncertainty about the

stresses that changing things will bring about are two other reasons that limit teachers from moving toward more student-centered classrooms.

Question: Is there evidence that participants maintained their motivation to change classroom practices?

The ATE/PPF workshops, from all indications, appear to have an extremely positive influence on the participants. On two occasions[21] participants were asked about the workshop's effect on their enthusiasm for teaching.

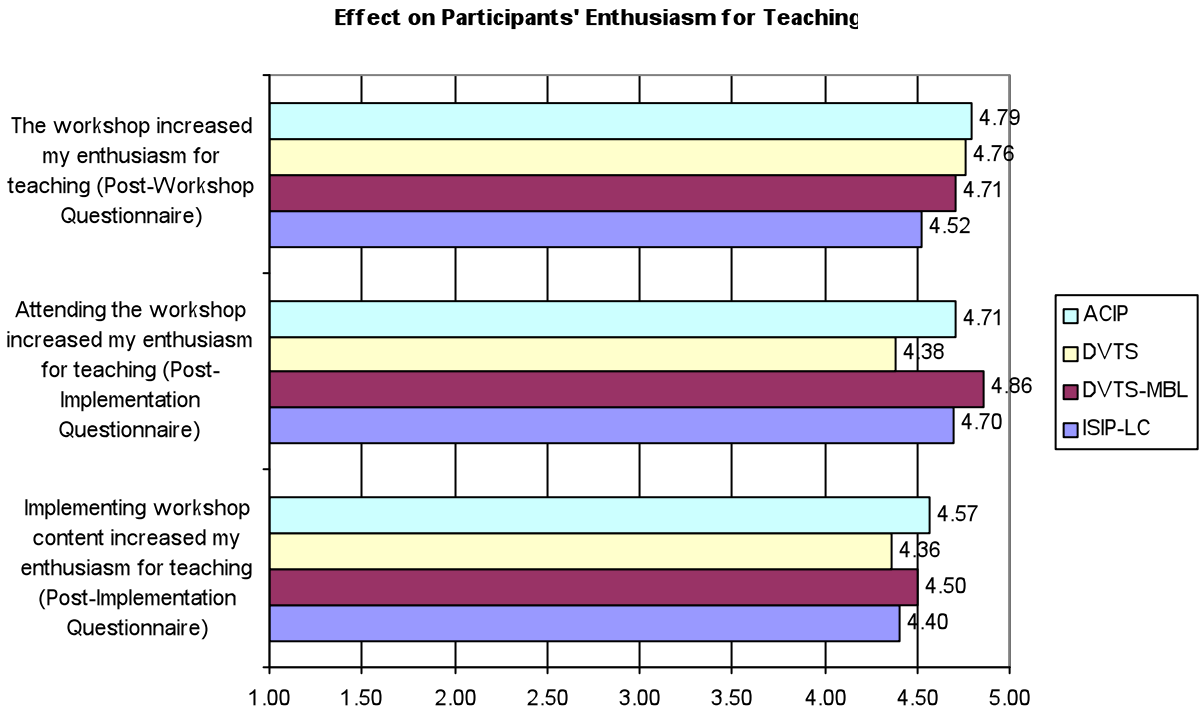
Specifically, the teachers were asked to rate the extent to which they agree or disagree with the following statements:

Post-Workshop Questionnaire (at the workshop's closure)	*The workshop increased my enthusiasm for teaching.*
Post-Implementation Questionnaire	*Attending the workshop increased my enthusiasm for teaching.*
Post-Implementation Questionnaire (May 2008)	*Implementing activities/materials from the workshop increased my enthusiasm for teaching.*

Chart 5 illustrates the strength of the ratings[22] when teachers were asked these questions. Both attending the workshop and the act of implementing workshop content into classes seem to have a positive effect on the participants' enthusiasm for teaching.

[21] Post-Workshop Questionnaire and Post-Implementation Questionnaire.
[22] Once again this was a 5-point rating scale, where "1" indicated "Strongly Disagree" and "5" indicated "Strongly Agree."

Chart 5: Effect of Workshops and Follow-up Implementation on Participants' Enthusiasm for Teaching



Note: The number of respondents on the Post-Workshop and Post-Implementation Questionnaires differed for each workshop.

On the same two occasions participants were asked about the influence the ATE/PPF workshops had on their continued interest in attending professional development workshops. In their responses to the Post-workshop Questionnaire, immediately following the workshop, participants from each workshop were left with a favorable impression about *continuing to seek out professional development opportunities*. Ninety-five per cent (95%) of the ACIP participants, eighty-eight per cent (88%) of the DVTS participants, sixty-nine per cent (69%) of the DVTS-MBL participants, seventy-one percent (71%) of the ISIP-LC participants, seventy per cent (70%) of the NFTC participants, and eighty-nine per cent (89%) of the TIP participants "Strongly Agreed" that they planned to continue active involvement in professional development workshops.

Some weeks later on the Post-Implementation Questionnaire, participants were asked to rate the extent to which they agreed with the following statement: *"Attending the workshop and implementing new activities/materials in my classes has increased my interest to continue participating in professional development workshops."*

Respondents gave good marks[23] to the workshops along this measure with ratings of fifty-seven per cent (57%) for ACIP, sixty-four per cent (64%) for DVTS, one hundred per cent (100%) for DVTS-MBL, and seventy-eight per cent (78%) for ISIP-LC indicating that they "Strongly Agree" with the statement. [Note: The response rate for the PIQ was: N =7 for ACIP; N=11 for DVTS; N=7 for DVTS-MBL; and N=9 for ISIP-LC.

[23] Participants used a 5-point rating scale where "1" represented strongly disagree and "5" represented "strongly agree."

Section V

New Faculty Training Conference

New physics faculty members arrive at the two-year colleges from many different educational sectors. Few, if any, students enter graduate programs in physics where there is specialized training to prepare them to teach at a two-year college. The various physics education research groups at major universities certainly provide formal coursework and informal opportunities to learn about how students learn physics, but none of these programs focus on the unique needs of a new physics faculty member at a two-year college.

As described in the 2005 comprehensive study of two-year college physics programs, Strategic Programs for Innovations in Undergraduate Physics at Two-Year Colleges: Best Practices of Physics Programs[24], the two-year college physics faculty member must be prepared to teach a variety of introductory physics or physics-related courses to a diverse student population, where many of those students are in transition to the technical workforce. The array of workshops offered under the ATE Program for Physics Faculty included in Year Two a pilot project, i.e. a conference, to recruit new faculty members for a series of activities that engaged them in professional development over an ~18 month period of time.

Two major activities, pre-conference on-line interactions among participants, the Discussion Board, and the 3-day intensive conference, were conducted between January 2008-March 2008. While the Discussion Board is to continue during the summer, Fall 2008, and Spring 2009, the NFTC participants will culminate their training at with a one-day follow-up meeting prior to the 2009 AAPT Summer Meeting in Ann Arbor, Michigan.

Although the idea of a training conference for new two-year physics faculty members bears some resemblance to the NSF supported Physics and Astronomy New Faculty Workshop (NFW) conducted by AAPT and APS since 1996, the goals and activities of the two endeavors differ in some major ways. The NFW is intended to be a single intervention that is primarily conducted by physics education research faculty members who have been actively involved in developing curricular materials for, primarily, introductory physics courses. The larger number of attendees (up to ~85 in 2003) demands a more traditional approach to "sharing" information. The NFTC is structured for participants to spend a significant amount of time using MBL tools, working through selected samples of research-based curricular materials, and preparing drafts of materials/resources they have developed or adapted for use in their own classrooms. The NFTC is intended to actively engage each participant in the learning materials/resources/tools that they can use with their students. Another important difference between the NFW and the NFTC is the role of the workshop leaders and PIs.

[24] Strategic Programs for Innovations in Undergraduate Physics at Two-Year Colleges: Best Practices of Physics Programs, Mary Beth Monroe, Thomas L. O'Kuma, and Warren Hein, 2005. NSF Award #0203862.

In the NFTC, the goal is to engage the participants in on-going communications/interactions with the PIs and workshop leaders. Of course, this does not occur in every case, but evidence cited in this report and in the year one evaluation report suggests that participants develop a collegial relationship with the PIs and workshop leaders that is strong enough to encourage them to maintain some level of communication after the workshop. The NFTC content includes extensive discussion of research-based student assessments, and participants exit the conference with a wealth of written and electronic materials to put to use immediately. In summary, the NFTC is closely aligned with the teaching situation of the participants, while the teaching roles of the participants at the NFW may span a wider spectrum of courses, including graduate courses.

Pre-conference Preparation

Scott Schultz, Associate Professor of Physics, Delta College (MI) and the PIs planned for the NFTC over many months discussing not only the conference structure, but also ways in which the participants could be prepared for the experiences they would have at the conference. Schultz assumed the typical roles of a conference host by making the local arrangements and working with campus colleagues to insure a conference that ran smoothly, start to finish. In addition, Schultz organized and conducted a Discussion Board with NFTC participants over a 2-month period prior to the conference. Conference participants were divided into two groups (A and B) for the Discussions, and fellow workshop leader Todd Leif, Cloud County Community College (KS) and Schultz each moderated the discussions for one of the groups.

Using an electronic course management resource at Delta College called Educator, www.delta.edu/educator, each participant was encouraged log in and participate. The discussions were organized around a series of physics education articles illustrated in Table 17.

Table 17: Discussion Board Research Articles

		Group A	Group B
		Frequency Count* (Discussant Count**)	Frequency Count* (Discussant Count**)
Week 1	Cultivating the capacity for formal reasoning: Objectives and procedures in an introductory physical science course. A. B. Arons, AJP, Vol. 44 (9), 1976.	8/18/6 (13)	11/20/3 (12)
Week 2	Learning to think like a physicist: A review of research-based instructional strategies, Alan Van Heuvelen, AJP, Vol. 59 (10), 1991.	6/19/7 (13)	8/7/0 (11)
Week 3	Common sense concepts about motion, Ibrahim Abou Halloun and David Hestenes, AJP, Vol. 53 (11), 1985.	5/9/2 (9)	8/13/0 (11)
Week 4	Learning motion concepts using real-time microcomputer-based learning, Ronald K. Thornton and David R. Sokoloff, AJP, Vol. 58 (9), 1990.	5/18/0 (11)	8/11/2 (11)

Week 5	Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses, Richard R. Hake, AJP Vol. 66 (1), 1998.	5/5/0 (8)	6/9/0 (10)

*Frequency Count: Total Independent Posts/Total Replies/Total Subthread
**Discussant Count: Total number of unique participants or leaders contributing posts, responses, or subthread.

Over fifty per cent (50%) of the NFTC participants provided at least one **initial** post to the Discussion Board, and only eight (8) of the participants failed to provide at least one post, initial or response. From several participants who were unable to participate indicated during the conference that they had wanted to participate, but time did not permit.

The transcripts of the posts provide a wealth of information from the participants. These transcripts are not analyzed as a part of this evaluation.

The articles that were selected for the Discussion Board served as the backbone for the large group discussion on physics education research on the first day of the conference and as references throughout other discussions during the three days. During the formal session on physics education research guided by Schultz and Leif, selected comments made by the discussants were shared with the entire group as launching points for an extended discussion. Using the comments and ideas that emerged from the Discussion Board worked was extremely successful in shifting this session from a lecture by the session leaders—though after seeing Schultz and Leif in action for three days, one can hardly imagine either of them holding forth in lecture mode—to a genuine discussion with significant involvement by the participants. Within the first twenty minutes of this session almost half (50%) of the participants had contributed a comment.

The participants' commentary about the Discussion Board on the Final Day Workshop Evaluation is mixed. Fourteen (14) participants made no comment; three (3) participants mentioned that time was a factor for them, e.g. not enough time to participate as much as he/she would like; and the rest of the participants who commented reported a positive experience or had a suggestion for making it easier for them, e.g. e-mail articles directly, provide summaries or shorter articles.

Without a doubt the setting up the Discussion Board, selecting topics and articles, and conducting the discussions over an extended period was a time consuming endeavor. For the workshop leaders, having an opportunity to listen to participants' ideas about teaching and learning prior to meeting them provides valuable insights into how the participant may respond to the kind of teaching encouraged by the conference activities. For the participants, developing an idea of the expectations of the conference by reading some of the most influential and frequently cited articles in physics education research sets the stage for their interactive engagement. One participant summarized it best,

"It was a great preparation for the conference. It help me to prepare for the "philosophy" of the conference." [sic]

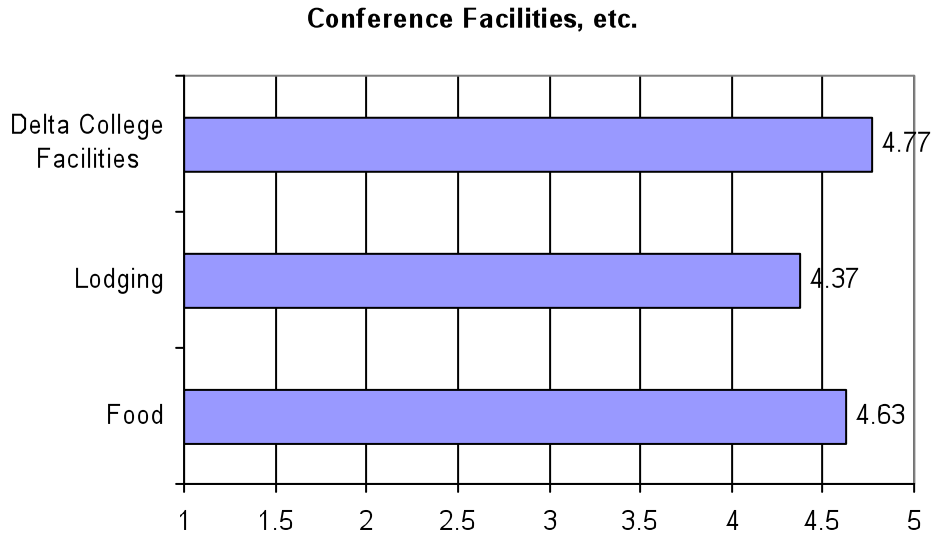
The pre-conference work paid off in preparing the participants for the level and intensity of work that occurred at the NFTC.

Conference and Feedback about the Conference

The New Faculty Training Conference was conducted on the Delta College campus, University Center, Michigan on March 6-8, 2008. Thirty faculty members representing two-year colleges in twenty (20) states attended the full conference. Some participants were from technical colleges while others were from institutions with strong academic transfer programs. The participant roster included a diverse mix (age and ethnic background) of individuals with eighteen (18) men and twelve (12) women. The teaching faculty included six individuals: Dwain Desbien, Todd Leif, Thomas O'Kuma, Sherry Savrda, Scott Schultz, and Michael Faleski. Scott Schultz served as host for the conference. Warren Hein, NSF DUE Program Officer and on-leave Associate Executive Officer (AAPT) also attended. The external evaluator attended the conference as well.

The facilities were excellent, with a classroom and three laboratory areas available at all times for the conference. The laboratory rooms were connected or adjacent to the equipment storage area and internet access was readily available. On the Final Day Workshop Evaluation, the participants gave high marks to the conference on all aspects of the conference venue.

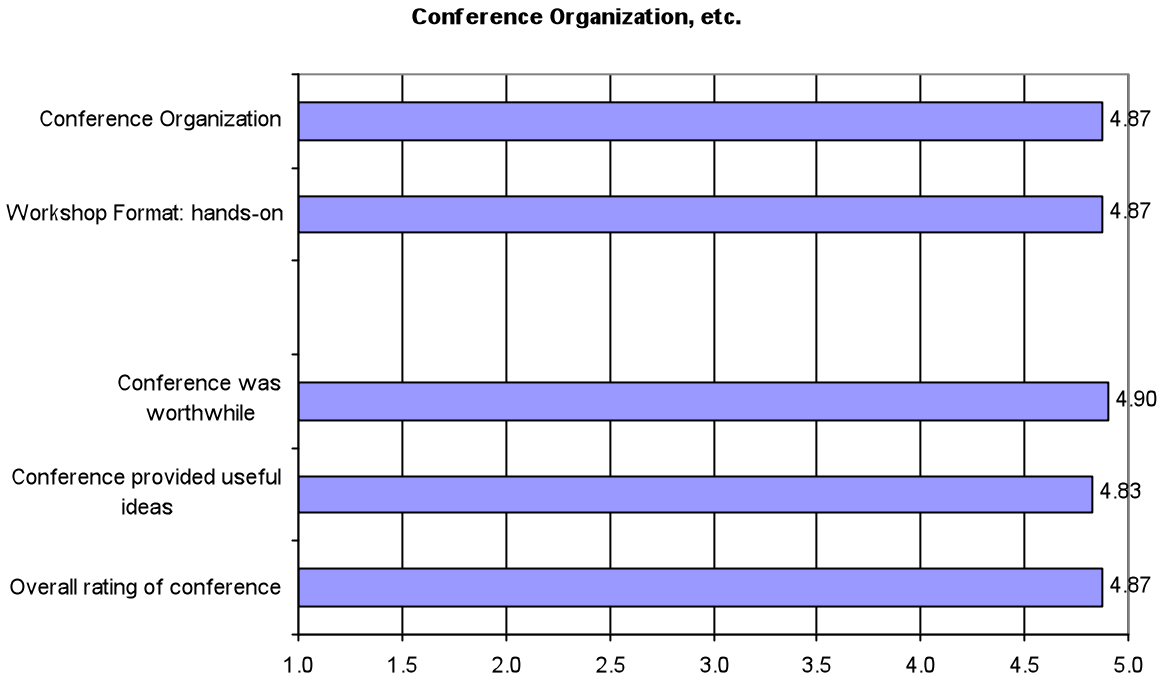
Chart 6: NFTC Conference Facilities, etc.



The conference organization and content also received high marks from the NFTC participants as noted in Chart 7. When participants commented about the hands-on format of the workshop, i.e. many opportunities to work with the materials and tools, the comments were positive. A few participants, as with the other conferences, noted that the

days were long and a lot of material was covered in too short of a period of time. A couple of participants thought the work should be scheduled for four days instead of three.

Chart 7: NFTC Organizational Elements



The content of the conference centered primarily on: (1) technology tools, i.e. numerous ways to use MBL and other technology tools; (2) ICP/21 curriculum; (3) discourse management; (4) research-based assessments, including TIPERs and instruments such as the FCI, TUG-K, etc.; and (5) physics education research and its implications for classroom instruction. Other content that was scheduled included: (a) overview of the unique role of two-year college physics programs in higher education; (b) role of NSF in STEM education; (c) overview of initiatives within the two-year college community; and (d) role of physics professional organizations and their role in the community of physicists.

Throughout the conference, whether in the large or small groups, the atmosphere was one of openness. Participants were encouraged to ask questions or make comments, and they did. The evaluator observed that within three hours of the conference opening over eighty percent (80%) of the participants contributed comments to the general discussion. Within a single thread of a discussion, i.e. cognitive development, one-third of the participants offered substantive comments. Even in one of the opening sessions when Tom O'Kuma presented an overview of what we know about physics students and

physics education in general and in the two-year colleges, participants were invited into the conversation when he posed a series of "how many" questions.

During a scheduled panel discussion, participants had ample opportunity to ask many practical questions about textbooks, topical coverage, role of homework, etc. and make comments about their own teaching practices. Two participants commented on the Final Day Workshop Evaluation that the panel discussion was the least productive aspect of the conference.

The workshop leaders were an exceptionally talented group of people. The depth and breadth of their knowledge of how to integrate technology tools in physics teaching, teach for conceptual and analytical understanding, integrate the findings of physics education research into one's classroom practices was evident in every session of the conference. The personal styles of the workshop leaders, while different, contributed to the climate of openness in the conference. When the right opportunity presented itself, each of the leaders would inject elements of their own beliefs about the teaching/learning paradigm into the discussions. Some examples from the evaluator's contemporaneous notes include:

The students' common sense beliefs are not always wrong. As a teacher we must help students recognize what ideas are right, but incomplete. [Scott Schultz]

"When students are puzzled, they are ready to learn." Each physics idea is cycled through repeatedly [in the ICP/21 modules] and students are allowed to experience cognitive dissonance to see how their perceived notions are often insufficient to describe a physical phenomenon. [Sherry Savrda]

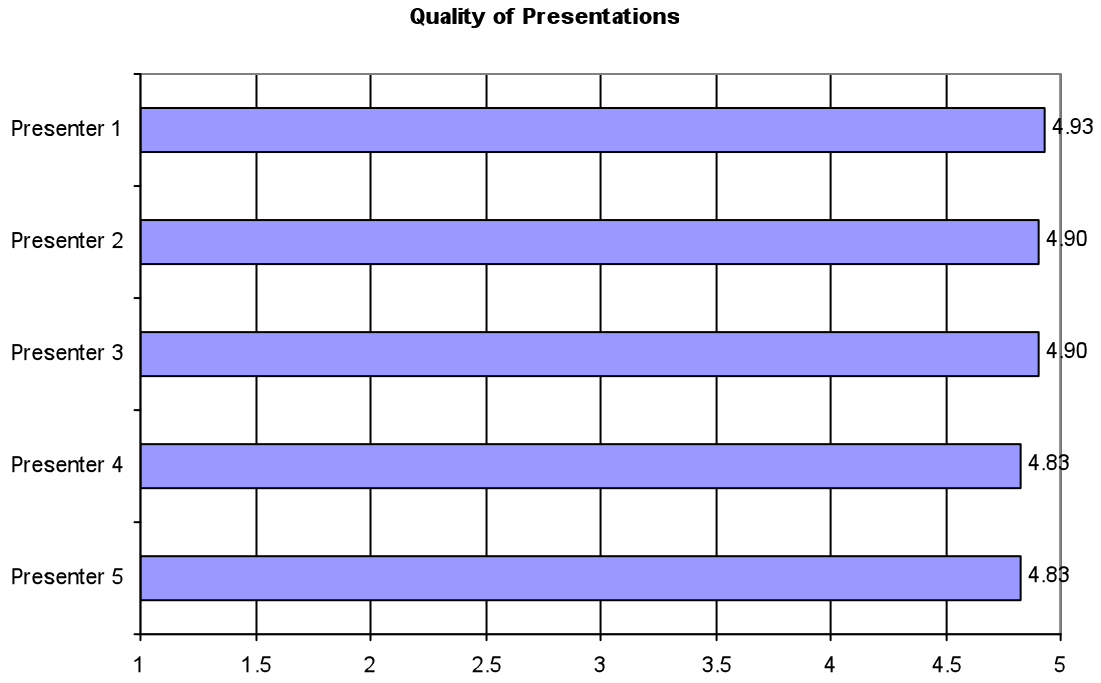
Regarding discourse management: *Seeding a group with a question gets the process started, and students are more willing to question one another than their instructor.* [Dwain Desbien]

If we spend more time making sure students understand the conceptual underpinnings of x vs t and v vs t graphs in kinematics, then the ideas can be readily applied in rotational motion without having to go over the basics again. [Todd Leif]

The participants gave high marks to each of the presenters at the conference as illustrated in Chart 8. Participants at all of the ATE/PPF conference are complimentary of the workshop leaders, and at the NFTC one participant said it best when asked what he/she liked best about the conference:

"The harmony of the leaders group, their willingness to help and the effort they put into the whole program." [NFTC participant, FDWE]

Chart 8: NFTC Quality of Presentations



On the first day of the conference, participants were presented with an overview of the three primary topics for instruction, MBL, ICP/21 and Discourse Management. They were asked to select two of the areas where they would spend a more extensive period (~3.5 hours) in hands-on activities. Most participants were accommodated in their first and second choices, and all participants were promised and received notes on from the session they were not able to attend. This arrangement worked well for the group size, but as expected—since participants find all of the content valuable—some expressed a desire to have had the opportunity to attend all three of the sessions.

Section II of this report characterizes the implementation plans of the participants at the NFTC. These participants will be queried during the 2008-2009 academic year to solicit more information on the changes that have occurred in their classrooms.

Participants left the conference with an extensive library of resources—what one might consider a very good starter set of materials for their teaching and professional development. Besides the permission to use a select set of ICP/21 materials and MBL resources, participants received the following: [This list is not exhaustive.]

1. Teaching Introductory Physics by Arnold Arons
2. Ranking Task Exercises in Physics by Thomas L. O'Kuma, David Maloney, and Curtis Hieggelke
3. E& M TIPERs by Curtis J. Hieggelke, David P. Maloney, Stephen E. Kanim, and Thomas L. O'Kuma
4. Physics in the Two-Year Colleges by Michael Neuschatz, etc., AIP Publication
5. Strategic Programs for Innovations in Undergraduate Physics at Two-Year Colleges: Best Practices of Physics Programs by Mary Beth Monroe, Thomas L. O'Kuma, and Warren Hein

6. 75 Celebrating 75 Years of Excellence in Enhancing the Understanding and Appreciation of Physics Through Teaching, an AAPT document
7. Copies research-based assessments: TUG-K, FCI, MBT, FMCE, DIRECT, CSEM
8. Slides for the Overview of Physics Education by Thomas O'Kuma
9. Copies of the American Journal of Physics and other AAPT materials

Section VI

Participant Commentary

Participants at the ATE/PPF workshops provide glowing comments about the workshops, in general, the opportunity to engage in professional development work with enthusiastic, like-minded physics professionals, i.e. workshop leaders, PIs, and other participants.

Overall Quality of Experience

"To be a part of these awesome workshops is a blessing. I grow as a professional in both innovative strategies to approaching content and to engage students in learning." [ACIP participant]

"It is great to learn new ways to teaching physics with people that are excited about teaching. Thank you for the opportunity to grow professionally." [ACIP participant]

"Excellent workshop. I came out with many tools which will allow me to be a better teacher and make physics more real to my students. The people presenting the material were very knowledgeable. I feel very lucky to have been able to attend this workshop. It was a very well organized workshop. Thanks to all the staff!" [ACIP participant]

"Everything about my experience with the workshop was beneficial, and I appreciate the follow up support and interest of the workshop developers and leaders. Thank you." [ACIP participant]

"The workshop was great and it's very likely that I'll sign up for another one. Thanks for providing this." [DVTS participant]

"This was a fabulous workshop. I would recommend it to anyone. The instructors do an outstanding job and the content is very relevant." [DVTS participant]

"It was an excellent professional development experience." [DVTS participant]

"Thank you for the experience at the DVTS workshop and all the professional people who interacted with the attendants." [DVTS participant]

"The DVTS workshop was excellent. I have learned new teaching techniques and ideas." [DVTS participant]

"I thought this workshop was excellent. It was very encouraging to work with other physics teachers who are so committed to their profession. It was also a quick way to learn about new tools that are available for teaching physics without having to hunt around on my own." [DVTS MBL participant]

Providing Physics Preparation for Instructors in Other Science Areas

"As a biology major, I was asked to teach physical science and have struggled the first year, better last year, and now very appreciative of physicists. I realize that having my horizons broadened on to learning the basics of physics, and I am truly humbled. My biology is better and applying things like pressure in the arteries, the pumping of the heart, the rate of just everyday things n the world of biology and chemistry make more sense." [ACIP participant]

"I attended this workshop to help us prepare for an algebra based physics course for freshmen that will begin next year. (I currently teach Earth Science.) I believe the experience and material I received will be extremely beneficial." [DVTS MBL participant]

Immediate Value of Workshop to Participants' Classrooms

"I found the workshop material very useful and was able to implement them into my curriculum." [ACIP participant]

"I implemented many of the activities with great success." [DVTS participant]

"The material presented is immediately useful in the classroom. The concepts help students retain material that would otherwise be forgotten." [DVTS MBL participant]

"As the previous [ATE] workshops, this one was very beneficial. I could use the material upon returning to my classroom. However, the days were long, maybe too long. I felt the last couple of hours of each day were not productive. The facilities were very nice and the services (food, transportation were very good. I will definitely look forward to another workshop." [DVTS MBL participant]

"This workshop provided me with talents and treasures that I could employ immediately in my classroom." [DVTS MBL participant]

Comments Offering a Suggestion

"I do so appreciate the one (ACIP workshop) in Florence more so than the recent one (TIP) only because the recent one [was] composed of more college people than high school." (sic) [ACIP/TIP participant, email]

"I really like the video capture potential, but wish there was more in 'Logger Pro' on using this and would be nice to have some sample labs like Logger Pro has for other material." [DVTS participant]

Section VII

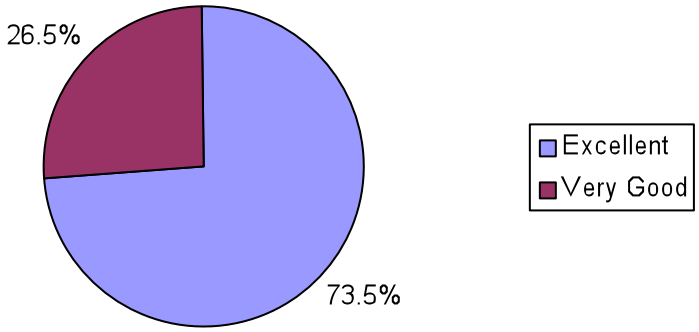
Summary Comments and Recommendations

The ATE/PPF workshops continue to provide excellent professional development experiences for high school physics/physical science teachers and two-year college physics faculty members. The content-rich experiences, the hands-on format, the collegial atmosphere, and the overall attention to every detail of the workshop experience appears to be the formula for success. The workshops are productive and, at the same time, enjoyable for both participants and workshop leaders.

Technology tools and multiple resources are brought to bear on fundamental—but often vexing for students—physics concepts with the idea that by using the tools of technology students develop a more robust understanding of ideas. Physics education supports this premise, and participants report an enthusiasm for adapting these ideas into their teaching portfolio. Participants who already have some experiences with technology tools in teaching continue learning how to use the technology tools more effectively in physics instruction.

The workshop leaders are experienced and confident as they work with participants in modeling interactive engagement as the gold standard for effective classroom practice. Not only do the workshop leaders exude enthusiasm for the subject and for teaching, but also they've convinced the evaluator during the two site visits (April 2007 and March 2008) that they like nothing better than spending three intense days with other physics teachers doing physics that can improve classroom/laboratory instruction. The participants acknowledge commitment of the workshop leaders and express appreciation, time and again, for their efforts and for this professional development experience.

When the ACIP, DVTS, DVTS-MBL and ISIP-LC participants were asked to rate the quality of the workshop on the Post-Implementation Questionnaire, the ratings were high in spite of the modest response rate.



As with the Year One evaluation report, there is little that can be done to improve this well-honed formula for success. The ATE/PPF workshops have:

(1) the right people--given their experience in physics, their skill as teachers, and their breadth and depth of knowledge of physics education research-- organizing and conducting the workshops;
(2) participants who are dedicated teachers and eager to learn more effective practices;
(3) content-rich, technology-driven hands-on experiences;
(4) a ratio of workshop leaders to participants that promotes collegiality; and
(5) attention to the details at the workshop venue.

That said, the following suggestions are presented for consideration:

- The one recurring theme in the participants' comments is the long day, particularly having work sessions after dinner. Acknowledging that working together after dinner contributes to building the sense of collegiality and affords more time to accomplish all of the workshop objectives, the evaluator recommends that the PIs consider whether shifting the dinner hour by ~45 minutes later and scheduling ~30 minutes of meeting time after dinner at the hotel would still allow the workshop objectives to be accomplished.

- To insure a successful level of participation at the NFTC meeting in Ann Arbor next summer, the project staff will likely need to encourage the participants to put the date on their calendar when the 2008-2009 academic year begins. While the information about this follow-up meeting was outlined in the written materials and mentioned at the conference, a personal follow-up may increase the likelihood of full participation.

- Continue to monitor working groups, insuring that an instructor "checks-in" with each group during start-up and at least one more time during the activity. Perhaps one of the instructors could "step-back" periodically while the groups are working and "survey" what is occurring with each group just to insure that everything is going smoothly. [Note: This suggestion is not offered as a remedy to a problem. It is offered simply as a reminder of a strategy that keeps the workshop staff aware of what's happening with the group as a whole while participants are working in smaller groups.]

- In the recruitment process, continue to seek a balance between high school and two-year college participants.

With respect to the standards set by the PIs for this project, nothing has changed since the Year One evaluation report. The program addresses the on-going need for high quality professional development programs for the community of physics teachers in high

schools and two-year colleges. Every component of the program is carefully considered and expertly executed to achieve excellence. The participants are respected for what they bring to the experience. The shared goal of improving students' understanding of physics unites the participants and the instructors in this exemplary program.