ATE Program for Physics Faculty

Thomas O'Kuma
Lee College

Dwain Desbien
Estrella Mountain Community College

NSF Award 0603272

Interim Evaluation Report
Year One: June 1, 2006-May 31, 2007

July 2007 Draft
September 2007 Final

Report prepared by: Karen L. Johnston, Ph.D.
Momentum Group
1836 Hillcrest Street
Fort Worth, TX 76107-3931

Table of Contents

Charts and Tables

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 first year of the project, June 1, 2006 through May 31, 2007[1]. In formative evaluation, recommendations regarding future project activities are offered as suggestions for improving the project and are presented in Summary Assessment and Recommendations (page 43) in this report.

In Year One of the ATE/PPF project, three workshops were conducted at various sites. These workshops were: Adaptable Simulations for Introductory Physics (ASIP), Lee College, TX; Instructional Strategies in Introductory Physics (ISIP), Estrella Mountain Community College, AZ; and Adaptable Curriculums for Introductory Physics (ACIP), Florence-Darlington Community College, SC.

During Year One, the primary external evaluation activities conducted by Momentum Group included the following:

- Conducted preliminary discussions about the project and evaluation with PIs.
- Prepared the Evaluation Blueprint for the ATE/PPF.
- Consulted with the PIs on several occasions (telephone/face-to-face)
- Prepared Post-workshop Questionnaire used with ATE/PPF workshop participants.
- Prepared and administered the Plans for Implementation Questionnaire to participants in the ASIP, ISIP, and ACIP workshops.
- Observed the Adaptable Curriculums for Introductory Physics at Florence-Darlington Community College, South Carolina.
- Prepared and administered the Implementation Evaluation Questionnaire to participants in the ASIP and ISIP workshops.
- Prepared an interim evaluation report for the project.

[1] This period, while not matching the official funding and reporting dates for the project, provides a sensible starting and ending date for the project activities in Year One for the purposes of this report.

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 are used in this report. The PIs were thoughtful and diligent about forwarding unsolicited comments by workshop participants to the external evaluator. These unsolicited comments, coupled with those secured independently by the evaluator, are included in this report.

In addition to the internal evaluation instrument, the Post-workshop Questionnaire, 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 in the 2007-2008 academic year, the data from the Post-Implementation Questionnaire 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 ACIP workshop a full complement of workshop materials was given to the evaluator during the workshop. The PIs offered a full complement of workshop materials from the ASIP and ISIP workshops to the external evaluator, but these extensive sets of materials from ASIP and ISIP were not needed or used as a part of this evaluation report.

[2]An additional 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.

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 ASIP, ISIP, and ACIP workshops meet the criteria for high quality physics workshops? 3. In what ways did the ASIP, ISIP, and ACIP 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 2006-2007? 2. To what extent were the implementations successful? 3. Is there evidence of the participants' continued motivation to change?

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. The 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 curricula were identified and selected by the PIs based a demonstrated track record as effective in teaching physics. Materials/resources on preparing the technical workforce are integrated into the workshop curricula. The workshop leaders are selected for their: (1) skills in modeling instructional practices that focus on student learning; (2) talents in organizing the series of activities for maximum participant participation; (3) engaging teaching styles; and (4) ability to explain the relevance of a wide array of physics concepts and teaching strategies to all student audiences, including students in technician programs.

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.

In addition to requesting the usual information, the application to the workshops 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. In addition, 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. A detailed analysis of the scope of the participants' engagement in technological/technical education will be presented in the summative evaluation. Thus, the application itself requested information that allowed the project staff to select participants where there was evidence of an alignment with the goals of the NSF ATE program.

The 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. Including participant in teams from the same school is a well-accepted practice in professional development initiatives intended to influence changes in the teachers' classrooms. The selection process for the ATE/PPF project encouraged and favored teams of teachers 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. The participant roster included 6 teams at ASIP, 8 teams at ISIP, and 1 team at ACIP.

Another positive feature included in the application process was the option of applying for more than one workshop at the same time—a process that encouraged applicants to consider a more substantial commitment to professional development by applying to two different content workshops. The process resulted in several participants attending more than one workshop during Year One.

The website for the project, www.physicsworkshops.org, was available early in the Fall 2006, and this website provides overviews of all workshops and details essential information for participants regarding workshop logistics. Written information was mailed in a timely manner to the participants prior to the workshop. When queried[4] on the Final Day Workshop Evaluation on the value of the pre-workshop mailings, the participants provided ratings of 4.29 (ASIP), 3.74 (ISIP), and 4.32 (ACIP) on a 5-point scale where "5" indicates "excellent".

Workshop Quality

Question: In what ways did the ASIP, ISIP and ACIP 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.

Upon funding notification, 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. Relying on their extensive experience in physics education from both teaching and research perspectives, the PIs "sampled" a number of potential topics at the 2006 Summer AAPT Meeting (Syracuse, NY) and talked with several curriculum developers whose product is regarded as effective and suitable for student-centered teaching environments. The PIs conducted discussions with each potential workshop leader to insure that they would be able to adapt their work to an intensive 3-day workshop that focused on participant engagement and not lecture. In addition, the PIs discussed the need to identify specific activities within the workshop content that would be appropriate for and applicable to students in a

[4] Question: *"Did the workshop pre-materials help prepare you for the workshop?"*

variety of technology programs. Judging from the responses of participants at all three workshops on the Final Day Workshop Evaluation Form[5], the PIs' protocol for identifying high quality content for the workshops fulfilled its intention.

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[6]
Adaptable Simulations for Introductory Physics (ASIP) November 16-18, 2006, Lee College Baytown, TX	Concept development through interactive computer simulations. Participants learn to modify simulations and create new simulations of physics phenomena. Participants learn to integrate simulations into existing courses in a manner that promotes student understanding of concepts. Participants work with Physlets and Open Source Physics resources.
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.
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.

*Evaluation results from this workshop are not included in this report.

The topics addressed in these workshops represent an excellent survey of research-based curricular resources in physics that would fit well into all general physics courses and physics courses in technician education programs. While many participants cited specific

[5] Evaluation questionnaire developed by the project staff and used for internal purposes. Results of this questionnaire were made available to the external evaluator along with copies of each participant's questionnaire to confirm the validity of the results.
[6] Data source: http://www.physicsworkshops.org

things they learned in the workshops, only one participant mentioned that a portion of the workshop content (ISIP) was not new to him/her.

"I already knew the techniques which I would call classroom management couple with the idea of students developing their conceptual framework…I thought we would gain more insight into the actual models and how to create classroom situations for students to discover and establish these. I knew the tools already." [ISIP Participant]

Most participants, even when they acknowledged prior experience, commented that they gained new pedagogical knowledge. For example,

"*Gave me something (ideas) to work on to improve instruction and get students to talk, ideas that I can share with other physics faculty."* [ISIP Participant]

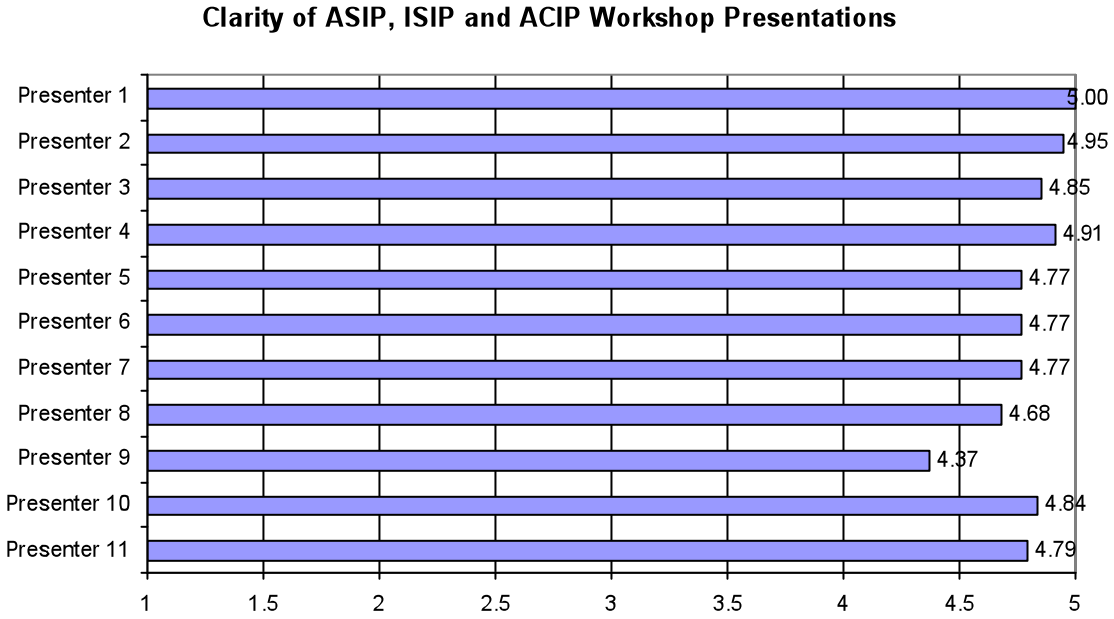
The workshops are presented by a talented group of developers and/or instructors who use these materials/resources/strategies as a regular part of their physics courses. Most of the workshop instructors for ASIP, ISIP, and ACIP have been actively involved in professional development on a national level, and some instructors have maintained this involvement for many years. All but two (2) of the eleven (11) instructors—excluding the PIs—have made presentations (invited, contributed or posters) and/or conducted workshops or tutorials at the national AAPT meetings during the past four (4) years.

Both PIs have excellent credentials, and each maintains an active profile and record of workshop delivery at national AAPT meetings. Since July 2004 there were seventy (70) instances[7] where the ATE/PPF instructors have individually or collaboratively made presentations or conducted workshops—twenty-nine (29 or 41%) of these activities were professional development workshops.

The Final Day Workshop Evaluation Form queried the participants about every aspect 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.

[7] The activity profile for each individual ATE/PPF instructor was developed, and the totals above represent the number of workshops, etc. to which each instructor contributed. These total counts include "double" counts when two ATE/PPF instructors collaborated on the same event.

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 4.88 and 4.73, respectively. When asked on the Final Day Workshop Evaluation Form what they liked *"best about this workshop,"* participants expressed praise for the presenters, including the PIs. For example,

"The leaders and 'resource people' were tops." [ASIP Participant]

"Patient leaders…they were never upset." [ASIP Participant]

"Speakers were very knowledgeable." [ISIP Participant]

"The passion of the presenters to show us that physics could reach all students." [ACIP Participant]

Opportunities for small group work were integrated into many of the workshop presentations, and 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, in the ACIP workshop focusing on the ICP/21[8] and Spiral Physics curricula

[8] ICP 21: a NSF-funded curriculum for the algebra-based physics course; Spiral Physics a course for calculus-based physics.

provided multiple opportunities for groups to: (1) design experiments—some of which were similar to design problems in engineering technology; (2) conduct guided investigations or explorations aimed at concept development; and (3) "goal free" problem solving with specific emphasis on multiple representations, graphing solutions, symbolic tasks, etc. White boards and occasionally PowerPoint slides were two of the primary mechanisms that PIs encouraged the groups to use when reporting out from the group's work. And, in the ASIP workshop the participants were given time to create simulations they could use with their students. In the ISIP and ACIP workshops, time was allocated for participants to work on developing materials that could be used directly with students. 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.

One ISIP participant noted in his/her comments that many of the workshop activities/resources could be easily and immediately integrated into their classroom, *"Just about every session there were awesome take home points. Some were teaching philosophies, others were activities or assessment ideas."* An ASIP participant stated that there were *"hands on applications* [that could] *be used immediately."* Another participant (ASIP) commented, *"The time to work individually and in small groups was appreciated."*[9]

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. The success rate of these special efforts will be reported in the summative evaluation.

The project also received high marks for the planning and arrangements that contributed to the overall comfort in which the workshops were conducted. The workshops were intensive, starting at ~8:30 AM and ending ~9:30 PM. Breaks and meals were appropriately timed and adequate, with only on participant commenting on the need for more break time (ISIP workshop)[10] and many participants commenting on the high quality of the meals.

While the days were long, participants commented on but did not criticize the rigorous schedule on any of the post-workshop evaluations. When asked: "What did you like least about the workshop?"[11], approximately 23% of participants mentioned the schedule and the following comments represent their sentiments:

"Long hours (but they were well worth it)." [ASIP Participant]

[9] Final Day Workshop Evaluation Form
[10] Commentary from the Final Day Workshop Evaluation Form.
[11] Final Day Workshop Evaluation Form

"Going until 9:30 PM at night was a little rough on me personally, but I did know and understand the time requirements going in." [ASIP Participant]

"The day is long and I think I stop processing after some point." [ISIP Participant]

"Little long, change from 8:30-9:00. But every minute was fun." [ACIP Participant]

At the workshop (ACIP) attended by the evaluator, the participants did not leave early or "disappear" during the day or evening sessions. A real esprit de corps developed quickly and was sustained throughout the three days of the workshop. Judging from the comments made by participants at the ASIP and ISIP workshops, it is likely these groups experienced the same camaraderie observed by the evaluator at ACIP. When asked what they *liked best about the workshop*[12], some participants made the following comments regarding the esprit de corps:

"Collegiality, new ideas, community." [ISIP Participant]

"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]

"How helpful (and non-judgmental) everyone was." [ASIP Participant]

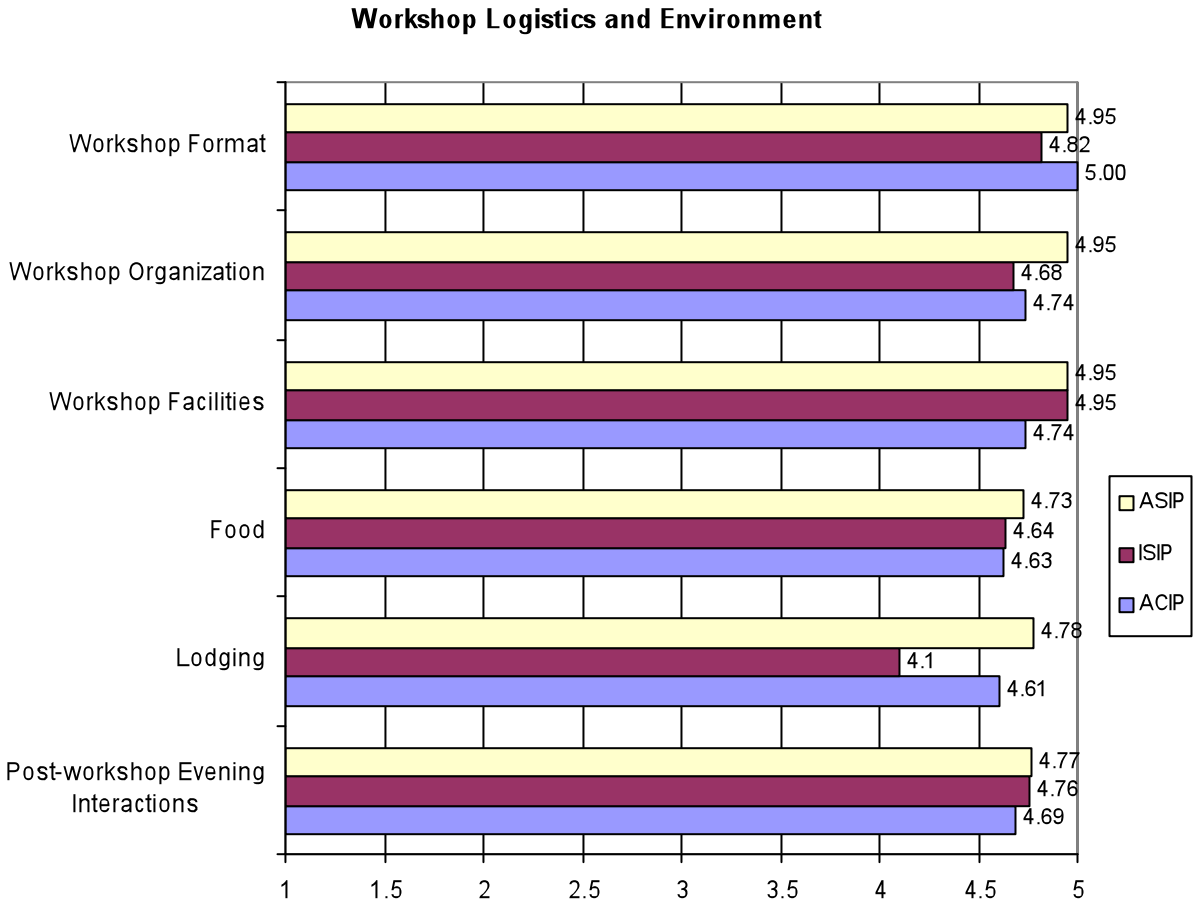
"…Working with other instructors and workshop leaders." [ASIP Participant]

One participant (ACIP) commented that a more favorable mix of participants from two-year colleges would have been desirable, and another participant (ASIP) mentioned that *"some group interactions were strained."* [Note: The ratio of high school affiliated participants to two-year college participants at the ACIP workshop was 11 HS/ 7 TYC.] Chart 2 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?

[12] Ibid.

Chart 2: Ratings of Workshop Logistics and Environment



Technician Education

Question: In what ways did the ASIP, ISIP and ACIP 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
ASIP	Process Technology	1.5 hours
	Technological Education	1.5 hours
	Conceptual Tools for Technician Education	1.5 hours
ISIP	Radiation Protection and Health Physics	~ 1 hour
ACIP	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

The evaluator noted that at the ACIP workshop, comments about and insights into technician education were integrated into other sessions where the participants were working on problems, explorations, experiments, etc.

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 ASIP receiving a 4.77 rating, ISIP a 4.41 rating, and ACIP a 4.84 rating 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?		
ASIP	Process Technology Session	4.41
ISIP	Radiation Protection Program Session	4.29
ACIP	Field trip to ESAB (emphasis on applications of physics in industry)	4.47
	Description of SCATE and Engineering Technology	4.11

While the ratings for the sessions that focus directly on technician education at the host site are all very good, a few less positive comments were received about these sessions on the Final Day Workshop Evaluation Form. Only a few participants, (N<5), mentioned these sessions on the evaluation question: *"What I liked least about the workshop."* For example, the field trip during the ACIP workshop required a short ride from the campus

facilities to the ESAB site, and judging from the few comments, the participants may have felt that the time would have been better spent on their group projects.

The evaluator found the ESAB field trip to be informative and an activity that added value to one's understanding of why learning physics is important for students in technology education. The people who conducted the tour were quite skilled at describing how technology, computers and physics are used in a variety of engineering technology jobs. While there was little opportunity for interactive engagement in a tour such as this, the chance to "see physics in the workplace" and talk with people who work outside of an academic setting is a valuable aspect of the ATE/PPF workshops.

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[13] 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.

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

Table 4: Value of workshops to participants' teaching situation

	Percentage of participants indicating that the workshop was "very successful" in meeting professional development needs			
	ASIP N=22	**ISIP N=26**	**ACIP N=19**	**All Workshops N=67**
Taught at a level appropriate to my knowledge, skills, and interest	81.8%	100%	94.7%	92.5%
Content meaningful to my current teaching situation	95.5%	92.3%	89.5%	92.5%
Content, instructional strategies, and laboratory work adaptable to my current teaching situation	95.5%	88.5%	94.7%	92.5%
Responsive to my professional development needs	95.5%	96.2%	100%	97%

All of the participants (100%) **in all of the workshops** indicated that the workshops were "very successful" or "moderately successful" on the four measures noted in Table 3.

The underlying intent of content-driven professional development workshops like these are 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, then the likelihood of implementing change and sustaining that change is increased.

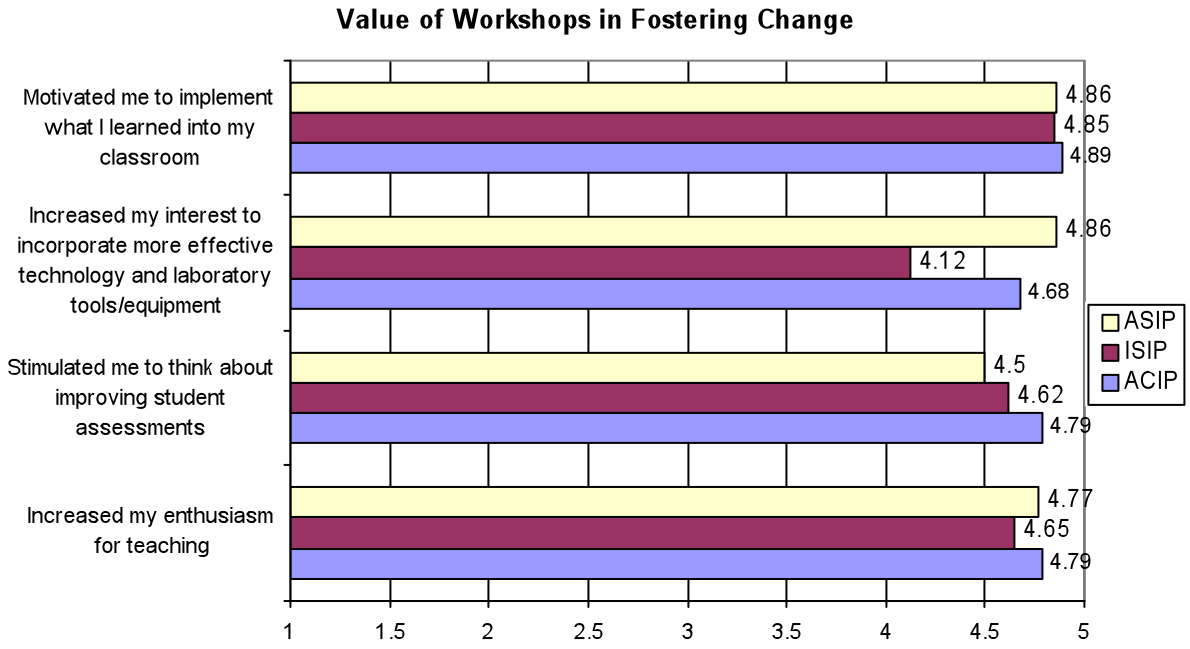
On the Post-Workshop Evaluation questionnaire, participants were queried about the likelihood they would implement what workshop content in their own classrooms or teaching situations. Chart 3 illustrates the responses on four measures related to the participants' implementation plans. The specific questions 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"* **all participants** in **all three workshops** responded that the workshops were "very successful"[14] in this regard. This suggests that by implementing workshop content, the teachers' students receive a secondary benefit from the ATE/PPF workshops.

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

SECTION III

Participants' Plans for Implementing Workshop Content

In the initial planning meeting for external evaluation, the PIs outlined a number of things they wanted to accomplish with these series of workshops. One theme emerged time and again during this initial evaluation discussion: The PIs wanted the workshops to have an impact on physics classes and the students in those classes. They 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.

In essence, then, the PIs have established these benchmarks as 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?

At the end of the workshop, participants were highly motivated to make changes in their instructional practices as noted by their rating of the statement: *"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", [see Chart 3, page 18]. 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** (N=67) with the exception of one[15], confirmed that they would do so. The table below illustrates range of workshop activities/resources that the participants plan to implement in their classes or instructional settings.

[15] This participant is not in an instructional setting. He is the Executive Officer of the American Association of Physics Teachers.

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**
ASIP	100% (N=22)	Physlets in prelab, lab, lecture, or discussion	8
		Modify physlets/develop simulations	4
		Applets (e.g. from B. Lamore's list)	5
		Simulation developed in workshop	1
		Major curriculum revision for lab (integrate simulations extensively)	1
		Implement Optics simulation	1
		Develop hands-on student activities	1
		Ranking Tasks	2
		TIPERS	1
		Assessments: FCI or unspecified	2
ISIP	100% (N=25)*	Students working in groups (e.g. discussion circles)	11
		Interactive engagement/instruction focused on student activity	9
		Modeling and Discourse Management	7
		Curriculum development work (e.g. open-ended lab experiments, activities for thermodynamics	3
		White Boards as a learning tool	10
		Graphical Tools	2
		Ranking Tasks	7
		TIPERS	7
		Journals as an assessment tool	1
ACIP	100% (N=19)	Implement ICP/21 Curriculum	2
		Implement the Spiral Physics Curriculum	3
		Adapt and implement some ICP/21 activities, etc.	8
		Adapt and implement some Spiral Physics activities, etc.	6
		Implement more interactive learning opportunities/active learning	6
		Ranking Tasks	3
		Project learning opportunities	2
		Other: shorter tests	1
		Other: revise homework	1

*N=26 for the ISIP workshop. One participant not in a classroom teaching situation that would permit implementation.

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?

Approximately 3-4 weeks following the workshop, the participants were queried again[16] 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
ASIP	$N_p = 22$ $N_r = 9$	**Courses for high school students:**	
		Conceptual physics	348
		General physics (algebra based)	518
		AP Physics B	63
		AP Physics C	-
		Other: (TAKS[17]/ICP)	59/500
		Courses for college students:	
		Introductory/conceptual physics	42
		College (algebra based) physics	67
		University (calculus based) physics	37
		Courses for teachers:	
		Pre-service courses	48
		Professional development courses	325
ISIP	$N_p = 25$* $N_r = 12$	**Courses for high school students:**	
		Conceptual physics	-
		General physics (algebra based)	345
		AP Physics B	108
		AP Physics C	20
		Other: (chemistry/astronomy)	40/60
		Courses for college students:	
		Introductory/conceptual physics	10
		College (algebra based) physics	92
		University (calculus based) physics	166
		Courses for teachers:	

[16] Implementation Plans Questionnaire
[17] Texas Assessment of Knowledge and Skills™

		Pre-service courses	8
		Professional development courses	311
ACIP	$N_p = 20$ $N_r = 9$	**Courses for high school students:**	
		Conceptual physics	-
		General physics (algebra based)	185
		AP Physics B	50
		AP Physics C	12
		Other: (chemistry)	75
		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	-

*N=26 for the ISIP workshop. One participant not in a classroom teaching situation that would permit implementation.

Since all participants did not respond to this second query about implementation plans, even after a follow-up request, it is possible that the number of students influenced by their instructor's participation in the ATE/PPF workshops illustrated in Table 7 is lower than 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 (Predicted)

Courses for High School Students	
Conceptual physics course	348
General physics (algebra based) course	1048
AP Physics B and C courses	253
Courses for College Students	
Introductory/conceptual physics course	112
College (algebra based) physics course	223
University (calculus based) physics course	251
Courses for teachers	
Pre-service courses	56
Professional development courses	636

Other	
Outreach experiences (summer programs) for pre-college students	250
Chemistry courses (high school)	115
Astronomy courses (high school or college)	84
Total	3376

One participant indicated that workshop content would be implemented in specialized courses to prepare students for the state's end-of-year exam (TAKS) and an ICP[18] course with the former affecting ~60 students and the latter ~500 students. A small number of students (N=~25) in a physical science course would also derive benefits from their instructor's implementation of workshop content.

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. In one case, the number of teachers that this participant worked with was large (N=~300) and these teachers taught over 10,000 students. Neither the internal or external evaluation plan queries these second-tier teachers about their implementation of any workshop content, and thus, no claims can be made regarding the extent to which ATE/PPF workshop content is integrated into these teachers' classrooms.

Implementation Challenges

Question: What problems might be encountered?

The participants indicated the usual types of barriers for implementing new materials or strategies into their classes. The most frequently cited barriers to implementation were: time (9 citations); equipment—adequate number of computers/sensors or access to the internet (4 citations); and difficulty implementing strategies in large classes (4 citations). Two participants from the ASIP workshop expressed concern about how to integrate the content into their existing curriculum and technical problems in getting simulations to work in their classroom environment. The concern with "computer equipment or internet access" was cited by more participants in the ASIP workshop than in the other two workshops while "difficulty implementing workshop strategies in large classes" was cited most often by participants in the ISIP workshop. Each of the following concerns were cited by one participant:

- limited classroom space
- lack of background of students (for students in a teacher preparation program)
- money

[18] Integrated chemistry and physics.

- difficulty in making copies of materials for students (access to copy services)
- concerns about articulation agreements with transfer institutions
- expectations from students and parents
- need to make curriculum conform to district requirements

Perhaps the most promising result was that 10 respondents indicated that they did not anticipate any barriers to implementing the workshop content in their classrooms.

Student Assessments

Question: Will reform-based assessments be adopted?

A large fraction of the participants who responded to the query about implementation plans (N=30) were already engaged in using or planning to use research-based assessments in physics. The Force Concept Inventory was the most frequently cited assessment, with 43% of the respondents indicating plans to use the instrument. 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

		ASIP	ISIP	ACIP
Research-based assessments	FCI	4	5	4
	TUG-K	1	2	0
	MBT	0	0	2
	CSEM/E&M	1	3	1
	MPEX	0	0	1
	Assessment on Waves	1	0	1
	Ranking Tasks	4	1	0
	TIPERS	2	1	0
National Exams	AP Exams	1	0	1
	AAPT Physics Exam	1	0	0
Other	Conventional classroom tests	1	0	0
	District Assessments	2	0	0
	Physlets	1	0	0
	Concept Inventory	0	0	1
	Not sure about assessment	2	3	2
	No plans to use special assessments	4	2	0

Only 30 participants (out of 66 or 45%)[19] 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.

One of the PIs (Desbien) has queried participants independently to learn about participants' plans to use workshop content in their courses as a part of a collateral study within the project to examine transfer of learning and sustainability of changes in participants' classrooms. This is discussed in more detail in Section V (page 39) of this report.

[19] N=67, but as noted earlier one participant from ISIP was excluded from this evaluation query since he is in an administrative position with no teaching responsibilities.

SECTION IV

Implementation of Workshop Content

Quality professional development workshops can motivate teachers to change their instructional practices. Planning and time are essential for shifting from teacher-centered to student-centered classrooms. Having a resource or instructional strategy that one can immediately implement upon returning to the classroom, such as introducing whiteboard for group discussions/problem solving or embedding a physlet into a laboratory activity, are the simple kinds of changes that can reap rewards and provide the impetus for continuing change. However, more substantive changes—such as adopting a curriculum like ICP/21 or Spiral Physics—require significant planning, time for trial and error, and sometimes improving local resources or facilities to make the change feasible.

As noted earlier in this report, the ATE/PPF participants were highly motivated to implement changes upon exiting their workshops. On the Post-workshop Questionnaire, the participants gave high marks to each workshop on all measures. For example, over 90% of the participants (N=67) stated that the workshop content was meaningful to their current teaching situation[20] and that the material was taught at a level appropriate to their knowledge, skills, and interest[21]. Tables 5 and 6 (pages 21-22) describe the participants' intended plans for implementation and predicted impact of the changes on courses and students.

On the Post-Implementation Questionnaire, participants from the ASIP and ISIP 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."*

Both groups of participants gave high marks[22] to the workshops along this measure with ratings of 4.69 and 4.65 for the ASIP and ISIP respondents, respectively.

The barriers they anticipated are described on pages 23-24. Participants' comments integrated throughout this report and those found in Participant Commentary section of this report illustrate the participants' strong motivation 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

[20] Table 4, page 16.
[21] Ibid.
[22] Participants used a 5-point rating scale where "1" represented "Strongly Disagree" and "5" represented "Strongly Agree." ASIP workshop $N_{respondents}$ = 13; ISIP workshop $N_{respondents}$= 17.

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.

Classroom Implementation AY 2006-2007

Question: What activities/resources were implemented in the participants' classrooms or teaching situations in AY 2006-2007?

In May 2007 participants who attended the ASIP (November 2006) and ISIP (February 2007) workshops were asked to describe[23] 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 ASIP/ISIP 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 and 10 illustrate the responses.

Table 9: Classroom Implementation—ASIP Workshop

ASIP WORKSHOP
Implementation Activities and Participants' Observations

Participant	Activities/materials implemented to date (May 2007)	What challenges did you encounter? What did you learn from observing your students?
1	None to date. Planning implementation in AY 2007-2008.	
2*	Activities in virtual labs. Scheduled students in computer lab once per week for remainder of semester. Prepared a proposal for funding to develop applets to teach energy for students in physics classes and students in engineering/computer science.	Recalling information from the intense workshop. "Truthfully, not much that I did not already realize. The computer is the classroom of tomorrow and having the ability to utilize it in this manner makes learning more relevant and fun."
3*	Used suggested Physlets, but have not modified the physlets…trying to identify physlets ready for use. Ranking Tasks.	Helping students understand how to do a ranking task. Students found RTs difficult, but "they like that they help them to understand concepts. Students like interacting with the computer applets."
4* (only with IT help)	Physlet explorations.	Some fonts did not display. Worked with IT department for assistance. Speculates that these challenges are why other physics faculty have shied away from implementing new technology. Students have "increased focus, motivation, and overall levels of engagement."

[23] Post-implementation Evaluation Questionnaire.

Participant	Activities/materials implemented to date (May 2007)	What challenges did you encounter? What did you learn from observing your students?
5*	Physlets. PhETs—used to simulate conditions similar to the lab. TIPERS. Ranking Tasks. (Works with in-service teachers)	Network and website availability—handled the challenge by downloading Physlets and PhETs and stored on laptops and downloaded Applet support files so Physlets would work offline. Observed that some students and teachers improvise and others do only what they are instructed to do. "Simulations are not as good as real demonstrations or labs, but they do give students experience that they could not otherwise get because of availability, expense, or danger." Interested in seeing TIPER tasks identify concept problems students have.
6*	Problem solving strategies. Two laboratory investigations.	Time constraints at the end of the year. Students found it difficult to adapt to changes in the curriculum later in the year.
7*	Physlets—introduced to all physical science and physics teachers in school district through staff development workshops.	Some Java applets do not display correctly. Working on installing same version of Java on all computers in district. Observed that students are more comfortable with physlets than teachers.
8*	Physlets.	Technology access at schools. Observed that "interaction and then answering questions puts more stress and more learning is envolved [sic]." Will continue using these: "The effort is worth the learning."
9*	Simulations from ActivPhysics On-Line site. Developed simulation on Newton's Laws—real world versus ideal world for pushing boxes across a floor.	Too many students (4-6) at each computer station requiring continual prodding to keep students on task. Will be resolved when we move to facility with more lab stations. Observed that some students were engaged and others. "Those who were actively participating seem to do better on the exams, especially with the more conceptual/application of principle style of questions."
10*	Physlets. Physlet-based electric field lab.	No challenges. Students appear to like using physlets.
11	None to date. Computer ability has limited ability to apply workshop content. "I would highly recommend the workshop to anyone who is capable of applying the resources immediately or would be interested in seeing how the materials can be used after they become more proficient."	
12*	Developed formative assessments using TIPERS tied to simulations. Used PRS to implement these assessments.	Adapting TIPERS to a multiple-choice format and finding simulations in the topic of modern physics. Addressed this by selecting TIPERS that could be easily adapted to the multiple-choice format. Reconfirmed that these activities illustrate the disconnect between the use of language by a physicist and the students.
13*	Redevelop Ranking Tasks and TIPERS for conceptual physics students and look for age-appropriate physlets.	Adjusting materials for 9th grade students required rewriting much of the materials. Students love having the ability to play with and re-access the material.

* Indicates a plan to continuing using workshop content.

Table 10: Classroom Implementation—ISIP Workshop

ISIP WORKSHOP
Implementation Activities and Participants' Observations

Participant	Activities/materials implemented to date (May 2007)	What challenges did you encounter? What did you learn from observing your students?
1*	Ranking Tasks and modeling.	Students were first "taken aback" but quickly realized that their learning was based on discovery. Observed that student interaction increased. They were enthusiastic about their learning, and it was enjoyable to watch them reason things out when working on Ranking Tasks.
2*	Whiteboard and group discussions. Ranking Tasks.	Time constraints required halting discussions, and it was difficult to get the students to stop their discussions. Since more time is required for discussions, students had to be responsible for learning other topics on their own. Observed increased participation in group discussions than whole class discussions.
3*	Physics journals for assessment—able to give immediate feedback to students while reviewing journals.	Students not initially motivated to do the writing, but this improved as the term continued. Observed that students needed explicit examples of what to include in a physics journal. Journals provide much more insight into student's learning and where I need to direct my attention.
4*	TIPERS and Ranking Tasks. More student-to-student interaction: discuss answers with one another, support answers, etc.	Size of class prohibits use of whiteboards and other group work. Worksheets are an alternative, but also challenging to monitor. Difficult to observe so many groups in a large class (N~60).
5*	Circle groups. Goal-less problems. Class problem solving sessions.	Only challenge is planning time. Observation: "Given the right circumstances, even the quietest students will open up and share their ideas with the rest of the class." Note: "These have forever changed the way I conduct my classroom group discussions and problem solving sessions.
6	Plan to implement in AY 2007-2008.	
7*	Rules of the Game activity and other games appropriate for different levels of students. Provided to all high school science teachers in district.	No problems encountered.
8*	Activities (unspecified) introduced to teachers in a workshop.	Technology always poses challenged. Observed that teachers in the workshop were interested in using physlets.
9*	Already experience with Modeling Instruction, and plan to implement Discourse Management in coming academic year. Already using TIPERS and Ranking Tasks.	No problems encountered. Observe better participation and involvement; improvement on conceptual questions such as "when switch 1 is open and switch 2 is closed, how does the current flow through bulb C change?'

Participant	Activities/materials implemented to date (May 2007)	What challenges did you encounter? What did you learn from observing your students?
10*	Jeopardy problems coupled with solving for unknowns, drawing physics sketches, and describing a reasonable physical situation.	Challenge in helping students understand this problem solving method. Observed learning transfer for free body diagrams when students encountered objects on inclined planes. Students enthusiasm and confidence have increased, and they interact more when drawing sketches and describing the physical situation. "It has given my students a new way of not just solving problems in physics, but to "think physics."
11*	White board modeling.	Challenge—"keeping my input to a minimum." Observed that "they learn much better when they can teach each other the concepts with as little input from me as possible."
12*	Modeling discourse. Ranking Tasks. TUG-K as pre/post-test.	Students who are used to being told what to learn have difficulty in learning to construct models. This is done by not allowing their "wait time" for the teacher to tell them what to do. Had to exert a "fair degree of control about behavior and how they were allowed to act during the discourse." Observed with the TUG-K: "our average gain was a .7 with a low of a negative number." Observed: "Our biggest gain of knowledge was ours—kids learned the content better." (9^{th} graders)
13*	Expanded time used to teach using motion graphs. Increased amount of time used for white boarding and circle discussions.	Whiteboard were too small to contain all of the information that students wanted to put on the board. Gave each group two boards. Observation: It is a challenge for students to believe that these instructional strategies will benefit them. Already apprehensive, this adds to the students' apprehension.
14	Plan to implement in AY 2007-2008.	
15*	Ranking Tasks. White boards for improving questioning.	Challenge: insuring students remain on the right track without divulging answers. Observed that students approach problems differently and must be able to see the "big picture" so that you don't inadvertently redirect an "acceptable path to the solution." "The students seem to develop problem solving strategies that are better than if I just give equations/problems."
16*	White boarding. Worksheets. Ranking Tasks—will structure whole class using RTs in Fall 2007.	Biggest challenge was introducing changes in the middle of the year. Observed that students liked being presented with material in a new way; seemed engaged with material/activity; and seemed to be able to learn in a new way.
17*	Science journaling in all physics classes where students list the daily agenda, answer questions from class, and write a reflection of the day's learning.	Not used to reviewing journals and didn't review them as often as I should. Students were uncomfortable with the journaling and I attribute this partly to implementing 2/3 of the way through the year, to my unfamiliarity with the process, and partly to students' unfamiliarity with the process.

Measuring Success

Question: To what extent were the implementations successful?

When instructors change how they teach by: (1) replacing an old activity with a new, (2) employing a new resource or technological tool, (3) asking students to interact at higher level than previously was expected or (4) revamping the entire curriculum by adopting non-traditional text materials, uncertainty about the "new way of doing things" can influence how the teacher (and ultimately their students) react to the change. The literature reports a fair amount of student dissatisfaction with reform-based pedagogy even when the students acknowledge improved understanding. Instructors are naturally cautious about making big changes too rapidly or when students have already become accustomed to a particular set of expectations. Queries about "how things went" are reasonable ways to take a reading on the instructor's comfort level with the changes he/she made. And, repeating these queries periodically gives a reasonable measure of whether change is occurring. The challenge with repeated queries is usually diminished response rates from participants.

Some of the observations reported by the teachers when they implemented workshop content (see Tables 9 and 10, pages 27-30) confirm the uncertainties, and give insights into how the teachers remained committed to the process of changing, particularly in the area of engaging students more actively.

Regarding problems with the Physlet explorations (some fonts not displayed)… one participant speculates that these difficulties are the reason why other physics faculty have shied away implementing new technology. [ASIP Participant]

"Interaction and then answering questions puts more stress [on what is being presented] and more learning is evolved [sic]" [ASIP Participant]

"…it was difficult to get the students to stop their discussions. Since more time is required for discussions, students had to be responsible for learning other topics on their own." This teacher also observed increased participation when students were in groups compared to whole class discussions. [ISIP Participant]

"Given the right circumstances, even the quietest students will open up and share their ideas with the rest of the class." [ISIP Participant]

"*Students who are used to being told what to learn have difficulty in learning to construct models."* [ISIP Participant]

"I am going to use interactive journaling and have both a more formal structure for the journaling and also stress the reflection more than I did last year." [ISIP Participant]

Even with the modest response rates on the Post-Implementation Questionnaire[24], 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:

"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	Disagree	Strongly Disagree	No Response
ASIP	7	4	1	0	0	1
ISIP	6	7	0	0	0	0

Ninety-two per cent (92%) of the ASIP respondents and one hundred per cent (100%) of the ISIP 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 11 and 12.

Table 11: Level of Success in Implementing Workshop Content

	Percentage of respondents indicating that the implementation of the new activity was "very successful"		
	ASIP	ISIP	Both Workshops
New activity encouraged students to be more engaged than previous activity	45% N=11	57% N=14	52% N=25
New activity addressed physics content at a level appropriate to students' background, knowledge and skills	91% N=11	79% N=14	84% N=25

[24] Response rate for ASIP, N=13 (59%) and for ISIP, N=17 (68%). The lower than desirable response rate is likely due to several factors. The primary reason is likely that the Post-Implementation Questionnaire was administered at the close of the academic year, and teachers have intense pressure on their time.

Table 12: 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=25)	52%	44%	4%	0%
New activity addressed physics content at a level appropriate to students' background, knowledge and skills (N=25)	84%	12%	4%	0%

Student Assessments

The workshop 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). Participants were 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.

The evaluator observed at the ACIP workshop that the workshop instructors repeatedly mentioned different types of student assessments, their use, and the importance of using good assessments. The evaluator speculates, given her knowledge of the workshop content, that the other two workshops also encouraged the participants to use meaningful formative and summative student assessments. Tables 13 and 14 illustrate the participants' perception of the relative degree of success when participants implemented various student assessments.

Table 13: Rating the Value of Student Assessments

	Percentage of respondents indicating that the implementation of the assessment was "very successful"		
	ASIP	ISIP	Both Workshops
Student assessment used provided the formative feedback I needed.	83.3% N=6	58.3% N=12	66.7% N=18
Student assessment used suggests that this new activity helps students learn the specific concept better than previous activity.	62.5% N=8	75.0% N=12	70.0% N=20

Table 14: Profile of Responses on Value of Student Assessments

	Very Successful	Slightly Successful	Moderately Successful	Not at all Successful
Student assessment that was used provided the formative feedback I needed. (N=18)	66.7%	22.2%	11.1%	0%
Student assessment that was used suggests that this new activity helps students learn the specific concept better than previous activity* (N=20)	70.0%	20.0%	5.0%	5.0%

* Comment from ISIP Participant: She/he "had to rate [this item] as *not at all successful* due to the assessment, not his/her gut intuition." She/he continues to say, "The workshop took place during the semester, and implementing things in the middle may have had a negative impact. I had the lowest FCI gains I have ever had. But it my intension (sic) to work on my delivery and to incorporate the ideas right from the start of a semester in hopes that my scores will improve."

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
ASIP	3	4	2	0	3	1
ISIP	3	6	2	1	4	1

In summary, approximately three-quarters of the respondents in both ASIP and ISIP agreed or strongly agreed with this statement.

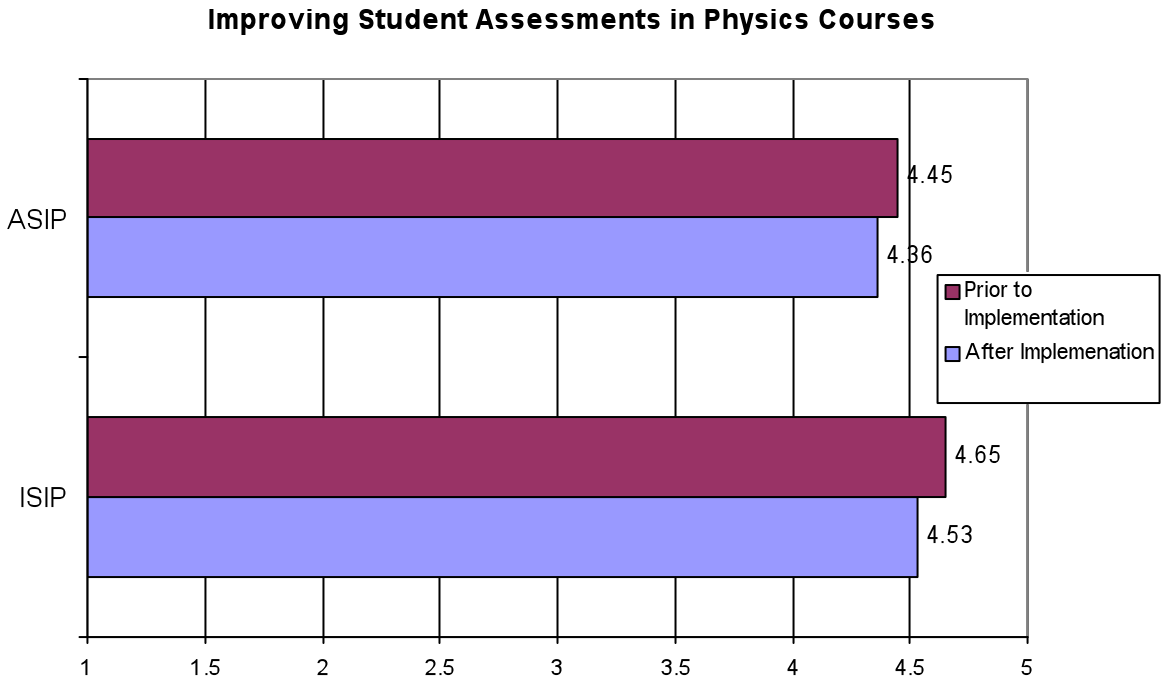
Participants were asked on two occasions[25] to rate the extent to which the workshops stimulated them to improve the student assessments that they use in their courses. Specifically, they were asked to rate on a 5-point scale, where "5" indicated "Strongly Agree," the extent to which they agreed with the following statement:

[25] First query: Post-Workshop Questionnaire; second query: Post-Implementation Questionnaire, administered ~10 weeks after the ISIP workshop and ~20 weeks after the ASIP workshop.

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

Even though there was some fading of the strength of this response[26], as illustrated in Chart 4, the workshops appear to motivate the participants to think about improving the student assessments that they use in their 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, ASIP, N= 11 and ISIP, N=17.

The queries about what participants learned from using student assessments were not sufficiently refined to establish a clear sense of how the assessment was used, whether the assessment was well aligned with the specific activity implement from the workshop, or the specific details of what the instructor learned from the assessment. While investigating the student assessments used by the participants is not a primary component in understanding the extent of implementation, it would likely be useful to refine these questions. Assessing students' learning (i.e. testing and how students are graded) is a critical component in understanding the extent to which participants have reformed their courses.

[26] Information presented in Chart 4 based on paired sample of respondents for ASIP and ISIP workshops, i.e. participants who responded to both the Post-workshop Questionnaire and the Post-Implementation Questionnaire.

Continued Motivation 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.

The ATE/PPF workshops, from all indications, appear to have an extremely positive influence on the participants. On two occasions[27] 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:

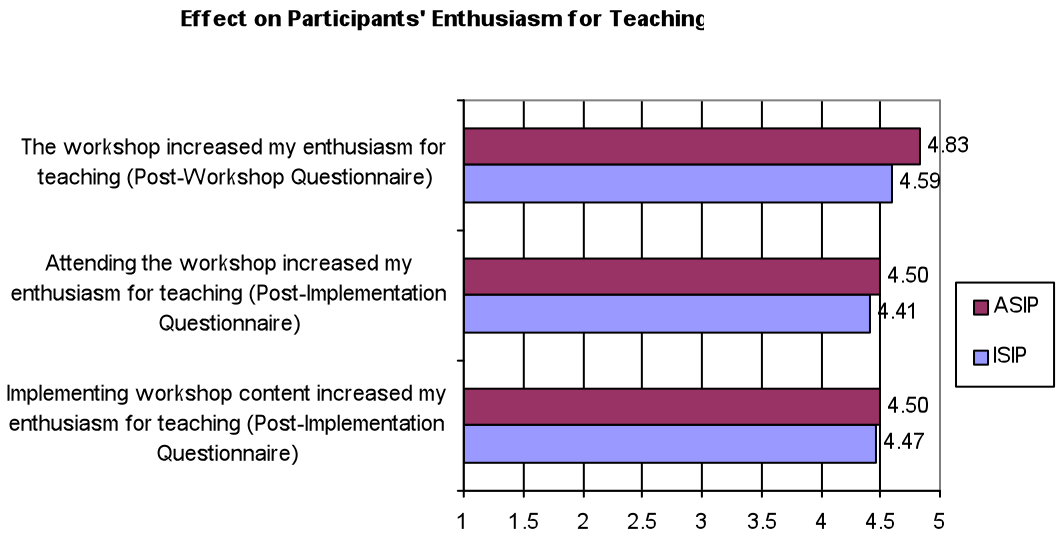
Post-Workshop Questionnaire (at the workshop's closure)	*The workshop increased my enthusiasm for teaching.*
Post-Implementation Questionnaire (~20 weeks and ~10 weeks after the ASIP and ISIP workshops, respectively)	*Attending the workshop increased my enthusiasm for teaching.*
Post-Implementation Questionnaire (~20 weeks and ~10 weeks after the ASIP and ISIP workshops, respectively)	*Implementing activities/materials from the workshop increased my enthusiasm for teaching.*

Chart 5 illustrates the strength of the ratings[28] 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.

[27] Ibid.

[28] 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[29]



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-one per cent (91%) of the ASIP participants, eighty-eight per cent (88%) of the ISIP participants, and ninety-five per cent (95%) of the ACIP participants "Strongly Agreed" that they planned to continue active involvement in professional development workshops.

Some weeks later on the Post-Implementation Questionnaire, participants from the ASIP and ISIP workshops 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."*

Both groups of participants gave high marks[30] to the workshops along this measure with ratings with eight out of ten (80%) of ASIP respondents indicating that they "Strongly Agree" and all respondents (100%) indicating "Agree" or "Strongly Agree." With ISIP, ten out of sixteen (63%) participants indicated that they "Strongly Agree" and all respondents (100%) either "Agree" or "Strongly Agree" with the statement.

[29] Information presented in Chart 5 based on paired sample of respondents for ASIP and ISIP workshops, i.e. participants who responded to both the Post-workshop Questionnaire and the Post-Implementation Questionnaire.

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

Section V

Potential for Sustaining Change in Participants Classrooms

As mentioned earlier in this report, one of the PIs (Desbien) is conducting a collateral study on how workshop content can be transferred by the participants to their students and how changes in instructional practices and teaching resources can be maintained after the enthusiasm for the workshop event has faded and the project has been brought to closure.

The participants are queried independent of the evaluation to learn about their plans to use workshop content in their courses and as a follow-up to determine whether participants need additional assistance with their implementation. Periodically, Desbien write the participants electronically asking the questions, when appropriate, such as:

> Did you use anything you learned in the workshop during this term? / What are your plans for using what you learned at the [Name] workshop next term?
>
> If you did use anything, what successes did you have and conversely what challenges did you encounter? [Alternative question set: Did you find any success using what you learned at this workshop during the spring semester? Please explain. Did you have any difficulty implementing what you learned at this workshop during the spring semester? Please explain.]
>
> Is there anything you wished you had to help you implement ideas from the workshop this term? / What can Tom and I do to help?
>
> Any suggestions you have to improve this workshop or future workshops you would like to see offered.

The information collected and compiled by Desbien is not included as a part of this report.

As a part of the project's focus on continuous improvement, the PIs and external evaluator will conduct a follow-up meeting (July 2007) to compare the internal and external findings related to the participants' use of the workshop content in their classrooms. In addition, the overlap between the evaluation and collateral study will be discussed to insure that each is securing the information needed without duplicating requests of participants.

Section VI

Participant Commentary

Participant comments support the exceptionally high ratings illustrated throughout this report. As mentioned earlier, at the ACIP workshop it was readily apparent that the participants gained so much from this intensive experience, and at closure, compliments were flowing. The atmosphere had been one of working together to learn more physics, more about teaching physics and more about students, including students in technical programs. Shortly following the workshops, a few participants spontaneously contacted the PIs to offer praise for the experience and describe how they had immediately put to use what they had learned. The PIs forwarded this information to the evaluator, and these comments warrant inclusion in this report.

"Just wanted to thank you again for the terrific workshop at EMC this past weekend. I learned a great number of new ideas during the three days of the workshop and came away from the workshop inspired to implement them right away! This morning, after my usual student white boarding session, I put all students in a circle (something I have never done before) and had them discuss their solutions between each other. I was absolutely amazed that everyone talked—even the student who sits in the back of the class and rarely says a word! My students really liked the circle concept and told me it was "cool." I also made up some thermodynamic ranking tasks and used them in lieu of lecturing. They went over well. Finally, I gave them a quiz with a WBT problem. They did great on it! Thanks for all your work and effort putting on that workshop—it really was a revelation for me and as you can see, I am actively implementing things I learned there." [ISIP Participant]

"I really want to thank each of you for my pedagogic face life, while Rome was not built in a day, I seem to be on a path that will be more productive for my students. I have used the white boards with my Physics I & II & Chem. II classes and assisted an Algebra II class were [sic] we used them with students to manipulate quadratic functions [quite fun]. ...The students responded so well [to] the circle, it was like ducks to water. I really think this learning style fits the Native American student very well. I hope to be able to grow with them with the program and be able to reap the rich benefits of student centered learning." [ISIP Participant]

"Yesterday I conducted a workshop for district IP&C teachers. ...I shared information on both Physlets and Ranking Task Exercises. I had picked specific Physlets that would be appropriate to use in the next grading period. The teachers loved them!

Next, I selected a few sample Ranking Task Exercises that would address common misconceptions I have found among the IP&C teachers. I assigned groups of teacher to different Ranking Task Exercises and had them present their answer to the entire group. This lead [sic] to a great deal of "lively conversation" about what the right answers

were. Again, the teachers thought these exercises would be excellent for their students but many realized they needed to make sure they really understood the concepts first (this realization helps to make my job a lot easier).

When conducting workshops, I do not do information dumps. I model how these materials would actually be used in a classroom. …The feedback was incredibly positive and my inbox has been full of questions about offering additional "help" sessions to work through more Ranking Task Exercises together…" [ASIP Participant]

On the Post-Implementation Questionnaire, participants were given the opportunity to provide open comments. The participants were extremely complimentary as illustrated in these comments.

General comments:

"Without reservation, I can say attending this workshop was the best professional development experience that I have had during my three years of full-time teaching. Extremely knowledgeable experts who where (sic) always open to questions and providing recommendations specific to my needs couple with hands-on activities and interaction with other participants made this a fantastic learning experience." [ISIP Participant]

"I would highly recommend this to any teacher that teaches science." [ISIP Participant]

"I loved this class even though it was a rough 3 days with lots of information, to me it was new and exciting." [ASIP Participant]

"I would (and have!) strongly recommend this workshop series to anyone connected with teaching physics." [ASIP Participant]

"This was one of the best workshops I have been to. I am glad that you will be offering this workshop again in the fall. I have several teachers in this district who will benefit from attending this workshop. It "rocks" traditional teachers' views of how physics can be taught." [ISIP Participant]

"The enthusiasm and material shared were at the highest level. The workshop met my needs and will allow me to share with the teachers I serve and my fellow physics specialist serve. I will remind all the specialist (sic) again about the opportunities and advantages of physlets." [ISIP Participant]

"The ISIP workshop was very worthwhile and I would enthusiastically recommend it to any two-year college faculty member who is interested in exploring alternative delivery styles in their courses." [ISIP Participant]

"This was a great learning experience. The change to work with physics instructors from all levels—high school through university—was great. This does not happen with the other sciences and I firmly believe this is what makes the physics teaching community and AAPT such a viable force in instructional reform." [ISIP Participant]

"The ISIP workshop has opened my eyes to a new methodology and pedagogy. My students are enjoying these methods I have learned at the workshop. "Reconstructing the problem" as they call it has made them understand physics and "think" physics. I hope to attend more workshops." [ISIP Participant]

"This workshop was the best thing to happen to teaching skills since I attend (sic) Pep over 7 years ago." [ISIP Participant]

"The ASIP workshop is a quality experience that recharges and invigorates even a mature teacher." [ASIP Participant]

"…awesome workshops and at least every physics teacher but even better every teacher would experience this revitalizing time along with hard work and an increase in research based teaching strategies." [ASIP Participant]

"The workshop was excellent. It was as many workshops very intensive…more time is needed in certain areas to attain mastery…I am a regular professional development attender…I know that PD helps me become a better teacher! I will always strive to be the best I can be." [ASIP Participant]

"I thought the workshop was extremely valuable." [ISIP Participant]

"The java scripting part was frustrating primarily due to the fact that I was unfamiliar with working on a Mac." [ASIP Participant]

"It is a much different approach than I have used in the past. I have learned a lot this year. My understanding has increased. If it affects them in a similar manner they will have a better understanding of concepts than I did at that age." [ISIP Participant]

"Other than the Modeling for High School Physics workshop in the Summer of 2001, I have never had workshops as interesting, applicable and effective as the ATE workshop I have attended. The opportunity to meet and work with other physics teachers who are interested in research-based, best-practice materials and instructional techniques has been invaluable. I would encourage anyone who is interested in improving their teaching of physics to attend these workshops." [ISIP Participant]

Commitment to/challenges of implementation:

"This was a wonderful professional development experience from which I have implemented several activities and/or concepts. I have changed by (sic) practices to

incorporate many of the things I learned at the workshop. I am looking forward to attending other such workshops in the future." [ISIP Participant]

"It was great to have hands-on experience in developing physlets and simulations. I wish I had the leaders around all the time to assist in my implementation efforts!" [ASIP Participant]

"I was able to take what I learned at the workshop and able to apply some things the very first day back at my campus! Other items, I am working into next year's curriculum. This workshop was extremely intense but a wonderful learning experience which will help me improve my pedagogy. Thank you for all your time and effort in putting on these workshops. They have made a BIG difference in helping me to better help my students succeed." [ISIP Participant]

"I no longer teach physics, but I do teach science methods courses. I had hoped to use this material in my class in the spring, but it was not possible to work it in…just could not sacrifice the time from the regular class material." [ASIP Participant]

"A follow-up workshop (maybe ASIP II) to build further skills and gain more insight into further curricular adaptations would be an excellent idea." [ASIP Participant]

"I gained many resources from the workshop, but my level of computer ability limited by ability to apply all of what was presented. I would highly recommend the workshop to anyone who is capable of apply the resources immediately or would be interested in seeing how the materials can be used after becoming more proficient." [ASIP Participant]

Value for Teams to attend the workshops:

"Three of us attended, 1 HS instructor and 2 of us from the same community college. We don't interact too much with the HS instructor, but having 2 of us from the same dept implementing the ideas really helps. In fact, the third instructor from of (sic) dept is scheduled to take the workshop next Nov. I would really encourage people from the same dept to take the workshop as a group." [ISIP Participant}

Extending the Influence of the ATE/PPF workshops

"I look forward to sharing what I learned with other teachers in my district. A follow-up workshop." [ASIP Participant]

"I have shared this experience with a chemistry professor. I explained the idea of using the whiteboard and she tried using it in her chemistry class. She found it to be very engaging for the students and she, I think, will be using it in the future." [ISIP Participant]

SECTION VII

Summary Comments and Recommendations

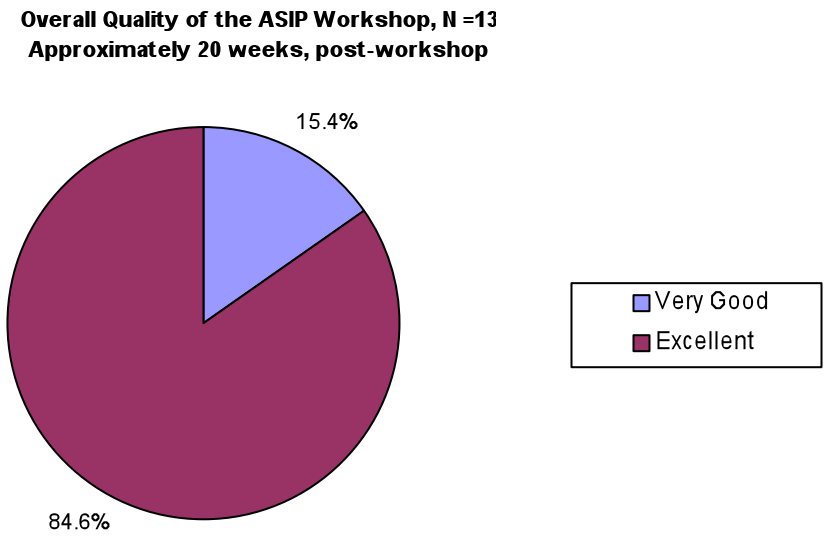
Every measure of the ATE/PPF workshops confirms that these are high quality professional development experiences for the participants. The workshop content is selected to insure that important topics and concepts in introductory physics are addressed. Attention is paid to integrating appropriate technology tools and resources into the workshops. The standard for inclusion appears to be that the technology tools and resources must be linked directly with improved student understanding. The instructors not only "talk the talk, but walk the walk" when it comes to modeling effective practices to promote interactive learning.

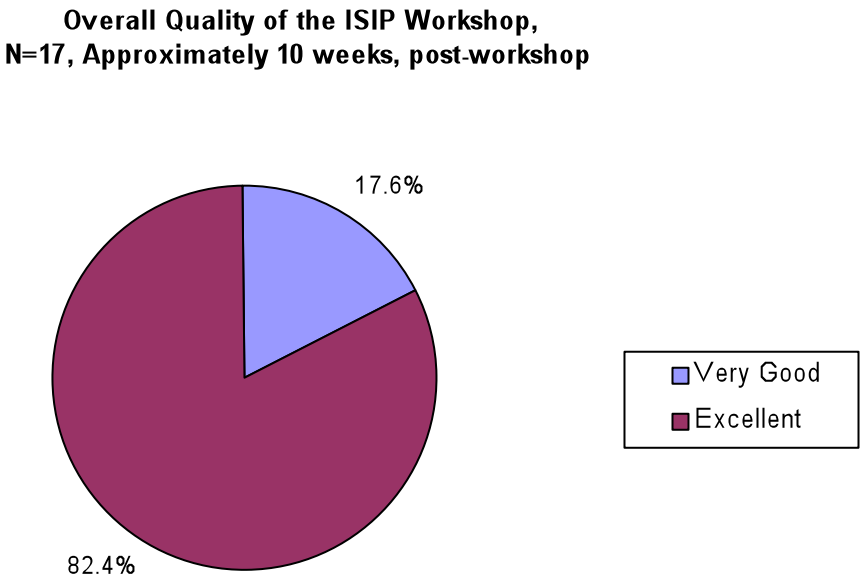
The recruitment plan achieves a good balance between high school and two-year college faculty. Judging from observations made at the ACIP workshop, the distinction between the levels of teaching is immaterial to the participants or the instructors. The focus at the workshops is always on the physics and the students' learning of physics. The selection process encourages teams of teacher, and that provides an extra impetus for teachers to make changes when they return to the classroom. The PIs appear to employ some recruitment strategies to mix faculty with regional connections with from other areas (e.g. a team of two from American Samoa attended the Florence, SC ACIP workshop). There is no doubt that the PIs manage the travel budget to maximize the benefit to physics faculty, including some who are underserved by the typical workshops offered by professional organizations at national meetings. The participants are attracted to the workshops largely because of the interesting and useful topics in physics. In addition, reputation that has been earned by these PIs for offering high quality professional development experiences provides the potential participants with the recommendation that these workshops are worth the time and effort. It is well known in the physics teaching community that if O'Kuma and Desbien are associated with the workshops, then the workshop content will be high quality.

The follow-up activities: (1) the periodic electronic communications with all participants; (2) continued interactions with participants doing major projects; and (3) communication with participants, workshop instructors and other interested parties through the Physics Workshop Project's Electronic Newsletter (circulation 200 print copies[31] and electronic availability at www.physicsworkshops.org) are all a part of the PIs' plan to insure that the ATE/PPF workshops have a last effect on the participants and in the physics teaching community.

When the ASIP and ISIP participants were asked to rate the overall quality of the workshops several weeks following their attendance, the ratings were very high as illustrated in charts that follow.

[31] Print copies distributed to all workshop participants, workshop leaders, site hosts, and other groups including some groups of attendees at the AAPT Summer Meeting 2007.





Even with the incomplete information from all ATE/PPF participants about classroom implementation efforts, it appears that the participants' students are deriving a similar benefit when teachers implement learning resources and pedagogical practices supported by the workshop, (i.e. students become more engaged in learning.)

Much of the interim external evaluation has merely confirmed what already emerged from the project's internal final day workshop evaluation: *the project is exemplary in every way.*

There are a few aspects that could be tweaked, and those changes might produce incremental or minor improvements. Here are a few suggestions:

- Continue keeping your eye on the workshop schedule and making the on-the-spot adjustments as necessary. Protect the time allocated for participants' work to development materials, etc. to take back to their own classrooms. Insure that these time slots are not late in the evening or cut short for some reason.

- Once the content of the workshop is identified, consider which component is most amenable to the evening slot of time—the fatigue factor really becomes an issue for productive work after the dinner hour.

- Review ways that information about the impact of the implementation efforts on students in technical physics courses could be teased out from the information collected from participants.

- Continue working with the participants when they are doing group activities. That the instructors, including the PIs, are so approachable is one of the workshop elements responsible for developing the esprit de corps. Find a way to insure that each group has had at least one instructor "check-in" with them during the start-up of the group work. This is particularly important when each group needs to set up equipment for the activity.

- Consider whether an external evaluation is adding any value to the project. The project is conducted at such a high level that, in the evaluator's opinion, the funds expended for on-going external evaluation might be redirected toward data collection efforts for the collateral study on sustaining change. At the very least, the requests for information about implementation for evaluation purposes and those for the collateral study can be consolidated.

When all is said and done, there is nothing left to say and do. The PIs have covered all the bases in planning, conducting and following through with these workshops, and it bears repeating, this *program is exemplary in every way.*