Annual Evaluation Report for Rural Physics Teacher Resource Agents

Covering Period from June 2002 to May 2003

Eric Banilower

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Submitted to:

George Amann
193 Primrose Hill Road
Rhinebeck, NY 12572

Jan Mader
2223 5th Avenue, SW
Great Falls, MT 59404

Warren Hein
American Association of Physics Teachers
One Physics Ellipse
College Park, MD 20740-3845

Jim Nelson
14722 Gainesborough Court
Orlando, FL 32826

Karen Jo Matsler
3743 Hollow Creek
Arlington, TX 76001

Submitted by:

Horizon Research, Inc.
326 Cloister Court
Chapel Hill, NC 27514-2296

Introduction

This report summarizes the activities and findings of Horizon Research, Inc. (HRI) in its external evaluation of Rural Physics Teacher Resource Agents (PTRA) project. The report details HRI's work and findings since June 2002. During this period from, June 2002 to May 2003, HRI has:

- Administered pre- and post-institute questionnaires to all PTRAs attending the 2002 summer institute;
- Observed the entire PTRA institute in Boise;
- Conducted a focus group interview with the PTRAs who led the 2002 rural institutes;
- Interviewed a sample of eight current PTRAs individually;
- Developed and administered a baseline questionnaire to rural institute outreach participants[1];
- Observed a sample of the rural institutes and follow-up sessions;
- Developed and administered a follow-up survey for rural institute outreach participants;
- Interviewed a sample of seven rural institute outreach participants; and
- Interviewed all four Rural Regional Coordinators.

This report is divided into four main sections. The first provides an overview of the Rural PTRA project and a description of the key questions guiding the evaluation. The second presents data on the 2002 PTRA institute, including PTRAs' perceptions of the quality of the institute and the impact of the institute on their preparedness to lead rural institutes. The third section reports data collected on the rural institutes held during the summer of 2002. These data include a description of the four rural institutes and the teachers attending them, as well as feedback from the PTRAs leading these institutes and the Rural Regional Coordinators. The final section summarizes the report and presents HRI's recommendations for the project.

Overview of the RPTRA Project and Evaluation

As stated in the grant proposal, the Rural PTRA project seeks to "serve isolated and neglected rural teachers by building on the experience, expertise, and resources of the existing PTRA program. The program will provide opportunities for these teachers to grow professionally in physics content, in the use of technology for instruction, and in established teaching strategies. Additionally these teachers will develop into a professional and supportive network."

To accomplish these goals, the project has adopted a trainer-of-trainers approach. The first tier consists of the PTRAs, typically accomplished physics teachers. At a week-long PTRA institute, the PTRAs are trained to present workshops on a wide variety of topics. Most institute workshops are six-hours in length and focus on familiarizing the PTRAs with the classroom activities in the workshop manual. The institute also provides multiple opportunities for the

[1] "Outreach participants" are those who attended the rural institutes facilitated by PTRAs.

PTRAs to network and share ideas related to the classroom and to workshop leadership. The major goal for the summer institute is to provide the PTRAs with the knowledge and skills needed to effectively lead the rural institutes for second tier participants (rural teachers).

PTRA-led rural institutes, the second tier, are typically five days long and are intended to focus on one or two core physics topics (e.g., force and motion). In addition, the project has included two day-long follow-up workshops in the model. These workshops are intended to give the rural participants an opportunity to revisit concepts and skills from the rural institute and to share and reflect on their efforts at incorporating what they learned into their classrooms.

The rural institutes also contain a strong technology component, seeking to introduce outreach participants to a number of the tools that can be used to support physics instruction, including graphing calculators and calculator/computer-based laboratory activities. The rural institutes also give rural teachers, who are often the only science teacher in their school, an opportunity to network with other science teachers. At the second tier, the project expects to have an impact on rural teachers' understanding of important physics content and their use of effective teaching strategies. Further, the project hypothesizes that these changes will lead to impacts in student learning.

The evaluation plan for the Rural PTRA project contains both formative and summative components and focuses on seven key questions:

1. How successful is the project at recruiting and maintaining a cadre of PTRAs, including teachers from the areas being served by the rural centers?

2. To what extent does the PTRA institute prepare PTRAs with the physics and pedagogical content knowledge needed to present outreach workshops?

3. To what extent does the PTRA institute prepare PTRAs with the leadership skills and professional development strategies that will enable them to design and implement extended high-quality professional development workshops that provide in-depth examination of physics content and standards-based teaching strategies?

4. How successful is the project at initiating and maintaining the network of rural centers, including recruiting, training, and providing on-going support to each Rural Regional Coordinator?

5. How successful is the project in reaching the goal of providing 108 hours of professional development (over three years) to under-served rural teachers and what is the quality of that professional development?

6. What impacts does the project have on outreach participants' attitudes, physics and pedagogical preparedness, and classroom practices?

7. What impact does teachers' participation in the rural institutes have on their students' achievement in physics?

Although it is much too early in the project to answer these questions fully data collected during the project's first year shed some light on those which deal with the preparation of the PTRAs, and which examine the impact of the project on rural physics/physical science teachers.

2002 PTRA Institute

As noted above, the goals of the PTRA summer institute is to equip the PTRAs with the knowledge and skills necessary to provide high-quality, effective professional development for rural teachers. The skills and knowledge needed by the PTRAs include:

- In-depth understanding of physics content;
- Knowledge of, and experience using, effective physics teaching strategies;
- Knowledge of effective professional development strategies/adult learning theory; and
- Skill at designing and implementing high-quality professional development.

The PTRA institute incorporates a variety of activities, including presentations by physics professors, a session in which PTRAs share a favorite classroom activity or demonstration, and opportunities for networking. However, the main component of the institute is a set of workshops which focus on various physics topics and/or teaching strategies. The majority of these workshops are six-hours long, though a few are three-hours in length. These workshops are developed by selected PTRAs, members of the project leadership, and/or other interested and knowledgeable members of the physics education community. The workshops provide opportunities for the PTRAs to experience a sample of the classroom activities included in the workshop manual, and a forum to discuss physics content, classroom practices, and issues of leadership.

In July of 2002, the project gathered 113 PTRAs, including 14 newly-recruited PTRAs, for the institute. The project offered 14 workshops during the 2002 PTRA institute, covering topics such as amusement park physics, color and color vision, laboratory interfacing devices, and plasma and fusion. This section of the report focuses on the quality and impact of the summer institute using data collected from the pre- and post-institute questionnaires, evaluator observations, and interviews with PTRAs.

The PTRAs

The pre-institute questionnaire gathered a variety of data from the PTRAs, including demographic characteristics and information on their learning needs as professional development providers. Ninety-one PTRAs responded to the pre-institute questionnaire, a response rate of 81 percent. Table 1 shows the demographic characteristics of the responding PTRAs. Two-thirds of the 2002 PTRAs were male; nearly all were Caucasian. About half teach in suburban schools, with the remaining being equally divided between urban and rural schools. Ninety-five percent taught physics and/or physical science during the 2001–2002 academic year and more than half have over 20 years of teaching experience. The majority of attendees became PTRAs prior to 1997.

Table 1
Demographic Data for PTRAs Attending the 2002 Summer Institute

	Percent of PTRAs (N= 91)
Physics/physical science in Previous Year Teaching Assignment	95
Gender	
Male	66
Female	34
Race/Ethnicity	
White	98
African-American	1
Asian or Pacific Islander	1
Hispanic	0
Other	0
Location of School	
Suburban	49
Urban	25
Rural	25
Year Originally Became a PTRA	
1985–1988	25
1992–1996	34
1997–2001	29
2002	12
Membership in Professional Organizations	
AAPT	89
NSTA	58
Years of Physics/Physical Science Teaching Experience	
0–5 Years	7
6–10 Years	11
11–15 Years	9
16–20 Years	16
21–25 Years	13
26–30 Years	18
31–35 Years	16
36 or More Years	10

The Quality and Impacts of the PTRA Institute

Prior to the summer institute, PTRAs were asked to what extent each of a number of activities would enhance their abilities as professional development providers. After the institute, PTRAs were asked to what extent these outcomes were achieved. As can be seen in Table 2, over three-quarters of the PTRAs indicated that learning strategies for helping other teachers, learning new activities for physics instruction, learning strategies for helping students learn physics, and gaining experience with new technologies would make them better professional development providers. Fewer than half thought that learning physics content or learning the logistics for arranging workshops would make them more effective professional development providers.

Table 2
PTRAs' Expectations and Outcomes Regarding the Summer Institute

	Percent of PTRAs (N = 80)	
	Would help them be a more effective professional development provider†	**Occurred during the summer institute to a great extent†**
Learn strategies for helping other teachers become better physics teachers	82	78
Learning new activities for physics instruction	81	87
Learn strategies for helping students learn physics	79	75
Gaining experience with new technologies for physics instruction	76	81
Learn how to arrange for PTRA workshops (i.e., logistical details for the workshops you will give)	40	54
Learn physics content	39	58

† Includes those who rated the item 4 or 5 on a five-point scale from 1 "not at all" to 5 "to a great extent."

Based on responses to the post-institute questionnaire[2], it is clear that the PTRAs believed the institute provided ample opportunities for learning new physics activities (87 percent), gaining experience with new technologies (81 percent), learning strategies for helping other teachers become better physics teachers (78 percent), and learning strategies for helping students learn physics (75 percent). PTRAs also indicated that learning physics content and strategies for arranging workshops occurred least frequently. This is not surprising as many of the PTRAs are well-versed in physics and have been giving workshops for many years.

Overall, the summer institute appears to have been well received by the PTRAs. When asked on the post-institute questionnaire what aspects of the summer institute were particularly good, 25 of the 71 PTRAs who responded to this open-ended question mentioned the quality of the workshops, either the quality of the instruction or the activities they received. Twenty-three pointed to the opportunity to network with other physics teachers. Some examples of PTRAs' comments are:

> *I thought that everything was organized very well. The sessions were good. Lots of new ideas and lab activities in areas that are sometimes hard to come up [with ones] for.*
>
> *The quality of the workshops I attended this year were the best I have [ever] attended.*
>
> *The opportunity to interact with other top physics teachers to share ideas and the collegial atmosphere.*

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[2] Ninety-four PTRAs returned the post-institute questionnaire, a response rate of 83 percent. HRI was able to match the pre- and post-responses of 80 PTRAs.

Responses to a question asking the PTRAs to describe the single greatest impact of the institute yielded similar findings. The most common response, given by 28 of the 82 PTRAs responding to this question, was that the institute allowed them to share ideas with other physics teachers. In the words of three PTRAs:

> *The greatest impact was visiting with other physics teachers to see how they teach various topics.*
>
> *Camaraderie, a chance to talk to others and get other versions of labs, etc.*
>
> *As a first time participant, I benefited from the discussions with other physics teachers the most. These contacts give me resources I can use throughout the year.*

These sentiments were echoed in the interviews HRI conducted with eight PTRAs after the summer institute. All interviewees mentioned specific workshops that they enjoyed and found beneficial to their teaching. All eight PTRAs also mentioned networking and the sharing of ideas with other teachers as one of the highlights of the summer institute. As one PTRA said:

> *You learn an awful lot from the people around you and the time you get to spend discussing your class work, things you do, stuff like that.*

The post-institute questionnaire asked PTRAs for suggestions for improving the summer institute and the Rural PTRA program. That no single issue was mentioned by a significant portion of the respondents is an indication of the PTRAs' overall satisfaction with the institute. The most common suggestion, mentioned by 8 of the 42 PTRAs answering this question, was that they would like the institute to have a greater emphasis on workshop pedagogy. As two PTRAs wrote:

> *I have had 10 years experience in the PTRA program and have led more than 25 workshops and worked with individual teachers as a part of my job for the last 8 years. I think more emphasis on how to present content should be the focus of the PTRA workshops. The second level should begin with content presentations that model the type of teaching behaviors that are most effective. The needs of the PTRAs are vastly different from the local workshop participants' needs.*
>
> *I feel that workshop presenters need to focus on strategies that help us to become better teachers of teachers. The content has been great! [But] I also want to help my area teachers be better physics teachers.*

As mentioned above, the main vehicles for the preparation of the PTRAs are the institute workshops. The project offered 14 workshops during the 2002 PTRA institute. Table 3 shows the title, duration, and percent of PTRAs taking each workshop (based upon the 94 responses to the post-institute questionnaire). Of these, 12 are intended to be given as outreach workshops.[3] Most PTRAs participated in six workshops during the institute, four six-hour workshops and two three-hour workshops (including *Leadership*).

Table 3
Workshops Offered during the 2002 PTRA Institute

	Duration (Hours)	Percent of PTRAs Taking Workshop in 2002 (N = 94)
Leadership	3	100
Interfacing (Vernier)	6	43
Plasma and Fusion	6	40
Make and Take	3	40
Amusement Park Physics	6	38
Color and Color Vision	6	38
Graphical Analysis	6	37
Interfacing (Pasco)	6	37
Exploratories and Practicums	6	36
Interfacing (Team Labs)	6	36
Sports in Introductory Physics	6	35
Epistemology of Physics	3	33
GPS	6	23
PhysTEC Mentoring	3	20
C3P	6	17

The post-institute questionnaire asked the PTRAs why they selected the workshops in which they participated. Of the 90 PTRAs who responded to this open-ended question, 34 indicated they chose their workshops primarily because of personal interest in the topic, either in terms of their classroom practice or their desire to offer outreach workshops on that topic. Fifteen PTRAs specifically said that they chose their workshops to enhance their ability to offer them to outreach participants. In the words of two PTRAs:

> *I felt I needed more content knowledge in the areas and some new ways to teach them.*
>
> *I chose workshops that I felt would be of most interest to me and that would be most applicable to the teachers in my area.*

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[3] The *Leadership* workshop reviewed project policies and procedures via the Workshop Leader Handbook; the *PhysTEC Mentoring* workshop explored ways in which the PTRA program could collaborate with AAPT's PhysTEC project.

Seventeen PTRAs responded that they chose their workshops because they were the only ones they had never taken before; 16 PTRAs indicated that they were assigned to their workshops by the project leadership.

The post-institute questionnaire asked the PTRAs to rate the quality of instruction of each workshop in which they participated. As can be seen in Table 4, many of the workshops were rated quite highly for their quality of instruction, including *Amusement Park Physics*, *Graphical Analysis*, and *Interfacing (Vernier)*. Only three workshops had fewer than half of the participating PTRAs rate the instruction as excellent: *Epistemology of Physics*, *Plasma and Fusion*, and *PhyTEC Mentoring*.

Table 4
PTRAs Rating Workshop Instruction as Excellent[†]

	N[§]	Percent of PTRAs
Amusement Park Physics	35	97
Graphical Analysis	33	97
Interfacing (Vernier)	39	97
Color and Color Vision	35	94
Make and take	34	94
C3P	13	93
GPS	22	86
Exploratories and Practicums	32	84
Interfacing (Pasco)	33	73
Sports in introductory physics	31	65
Interfacing (Team Labs)	31	52
Epistemology of Physics	31	48
Plasma and Fusion	37	35
PhyTEC Mentoring	17	24

[§] By design, not all PTRAs participated in each workshop; the total number responding for each workshop is included in the table.

[†] Includes those who rated the item a 4 or 5 on a five-point scale from 1 "poor" to 5 "excellent."

By matching responses from the pre- and post-institute questionnaires, HRI is able to examine the impact of the institute on the PTRAs' perceptions of their preparedness to provide these workshops to outreach participants. Participants in 11 of the 12 workshops intended to be given as outreach workshops had greater gains in their perceptions of preparedness to lead that workshop than did non-participants (see Table 5). Interestingly, many of the control groups had large negative changes in their feelings of preparedness. For some workshops, this decrease could be due to the interactions of PTRAs during down times. PTRAs often discussed their workshop experiences during meals and after hours. It is quite possible that PTRAs not taking a particular workshop, after hearing about its content, realized how much more they would need to learn about presenting a workshop on that topic.

Table 5
PTRAs' Feelings of Preparedness to Present Each of the Following Workshops by Workshop Participation†

	Percent of PTRAs			
	N§	Pre	Post	Difference
Amusement Park Physics				
Participants	26	69	88	19*
Non-Participants	50	46	34	-12
Color and Color Vision				
Participants	33	33	85	52*
Non-Participants	43	74	70	-4
Epistemology of Physics				
Participants	26	15	23	8*
Non-Participants	50	32	4	-28
Exploratories and Practicums				
Participants	27	37	81	44*
Non-Participants	50	48	16	-32
GPS				
Participants	17	24	76	52*
Non-Participants	59	29	37	8
Graphical Analysis				
Participants	30	53	93	10*
Non-Participants	46	61	43	-18
Interfacing (Pasco)				
Participants	29	59	79	20*
Non-Participants	47	64	15	-49
Interfacing (Team Labs)				
Participants	28	79	57	-22*
Non-Participants	48	64	26	-38
Interfacing (Vernier)				
Participants	35	54	97	43*
Non-Participants	42	67	62	-5
Make and Take				
Participants	31	65	81	16
Non-Participants	43	49	67	18
Plasma and Fusion				
Participants	32	13	38	25*
Non-Participants	44	5	9	4
Sports in Introductory Physics				
Participants	29	59	83	24*
Non-Participants	47	43	19	-24

† Includes those who rated the item a 4 or 5 on a five-point scale from 1 "not adequately prepared" to 5 "very well prepared."
§ By design, not all PTRAs participated in each workshop; the total number responding for each workshop to both the pre- and post-institute questionnaires is included in the table.
* The change in participants' perceptions of preparedness is statistically greater than non-participants' change (Analysis of Covariance, $p < 0.05$).

When PTRAs did not feel well prepared to offer a workshop after participating in it during the institute, the post-institute questionnaire asked them to explain why the session did not better prepare them. Twenty-five of the 67 PTRAs responding to this question indicated that they needed more time and experience with the topic and/or the workshop materials. The second most common response, given by 12 PTRAs, was that the workshop content was too advanced. As one PTRA wrote:

> *I could probably repeat what I learned in the workshop and pass out what I received, but my background is not strong and I would feel shaky.*

The PTRAs were also asked about the extent to which the institute prepared them to work with outreach participants on a number of goals. Ninety-three percent of the responding PTRAs indicated that the institute greatly enhanced their preparation to provide outreach participants with hands-on activities (see Table 6). Fewer, though still sizeable numbers of PTRAs, indicated that the institute prepared them to help outreach participants integrate those activities into their curriculum (85 percent), develop outreach participants' knowledge of core physics concepts (78 percent), or help outreach participants examine their own teaching practices and how students think about physics concepts (72 and 67 percent respectively).

Table 6
PTRAs Indicating the Extent to Which the Summer Institute Prepared Them to do Each of the Following

	Percent of PTRAs (N = 94)					
	Not at All		Somewhat		To a Great Extent	
	1	2	3	4	5	4 + 5
Provide outreach participants with hands-on activities	1	1	4	32	62	93
Help outreach participants integrate workshop activities into their curriculum (i.e., knowing when and why to use a particular activity)	2	1	12	39	46	85
Develop outreach participants' knowledge of core physics concepts	1	2	18	53	26	78
Help outreach participants examine pedagogy/teaching strategies and when/why to use them	2	9	17	47	25	72
Help outreach participants understand student thinking and/or common misconceptions	3	8	23	46	20	67

HRI also asked the PTRAs how well prepared they felt to work with outreach participants on each of these goals in kinematics and dynamics and in light and color, two core physics areas that, according to the project leadership, are likely to be addressed by the rural institutes. Overall, the PTRAs perceive themselves as being well prepared to work with outreach participants in both content areas (see Table 7). It is interesting to note that in both areas, a greater percentage of the PTRAs feel well prepared to develop content understanding, provide activities for participants to use in their teaching, and help participants integrate those activities into their units than to help outreach participants examine issues surrounding pedagogy, how students learn, and common misconceptions in physics.[4]

[4] 1-tailed z-test, $p < 0.05$

Table 7
PTRAs Feeling Well Prepared† to do Each of the Following, by Content Area

	Percent of PTRAs (N = 94)	
	Kinematics and Dynamics	Light and Color
Develop outreach participants content knowledge	95	82
Provide outreach participants with hands-on activities	93	83
Help outreach participants integrate those activities into their units(s)	91	81
Help outreach participants examine pedagogy/teaching strategies	83	69
Help outreach participants understand how students learn/common misconceptions	82	71

† Includes those who rated the item a 4 or 5 on a five-point scale from 1 "Not adequately prepared" to 5 "Very well prepared."

Finally, a series of items on both the pre- and post-institute questionnaires asked PTRAs about their feelings of preparedness to lead a variety of professional development activities. As can be seen in Table 8, a significantly greater percentage of PTRAs perceived themselves to be well prepared to lead 5 of the 6 activities after the institute than before the institute, including conducting demonstration lessons, coaching outreach teachers, and helping outreach teachers analyze student work. Although it is encouraging that the PTRAs showed gains in areas addressed by the institute such as leading extended length workshops, the fact that PTRAs also showed gains in areas not addressed at the institute (e.g., using examples of student work) cast doubt on the validity of these data.

Table 8
PTRAs' Feelings of Preparedness To Do Each of the Following†

	Percent of PTRAs (N=80)		
	Pre	Post	Difference
Conduct a demonstration lesson in an outreach participant's classroom	70	91	21*
Provide on-going support to outreach participants via electronic media (email, listservs, on-line forums, etc.)	57	78	21*
Lead a follow-up workshop using examples of student work to help teachers understand where students are in their development of a concept and decide what instruction needs to come next	45	66	21*
Lead a two to five day outreach institute focusing on one or two core physics topics (e.g., kinematics)	63	80	17*
Coach an outreach participant (i.e., observe and provide feedback on a lesson)	66	82	16*
Lead a six-hour outreach workshop	84	90	6

† Includes those who rated the item a 4 or 5 on a five-point scale from 1 "Not adequately prepared" to 5 "Very well prepared."
* Indicates a significant increase in PTRAs' feelings of preparedness (1-tailed McNemar test, $p < 0.05$).

Responses to the post-institute questionnaire appear to indicate that the summer institute is engaging the PTRAs as learners of physics content, as learners of classroom strategies, and as learners of professional development strategies. However, HRI's observations of the summer institute and interviews with a sample of PTRAs paint a somewhat different picture. Although the 2002 summer institute may have created the possibility for PTRAs to develop these skills, HRI's observations of the institute indicate that structured opportunities that would facilitate engagement on all three levels were rare. In one workshop HRI attended, the only mention of leadership came at the very beginning when the leader echoed the sentiments of the project leadership by saying to the PTRAs, "We want you to focus on three levels. During this workshop, think about the activities: (1) as a student; (2) as a teacher—how could these [activities] be better; and (3) as a leader—how you would present it." During the workshop, the PTRAs took part in the activities and discussions of the physics involved and shared ideas on how to use the activities in the classroom, but workshop leadership (the third level) was never discussed.

In another workshop, the leader made a very astute observation about teachers' real and perceived needs, "In a workshop, you need to do what teachers need, not what they think they need." However, the workshop leader did not go any further into what teachers' real needs are, or how to run a workshop that meets both types of need. At the beginning of another workshop, the leader said, "I hope you won't try to do a workshop like the one you see today" as the topics being covered were very advanced and would not be helpful to teachers without relatively strong physics backgrounds – which is not the project's target audience.

This phenomenon was not uncommon. Most of the summer institute sessions focused predominantly on physics content and activities. Using the activities in the classroom did receive some attention in the observed sessions, but almost no discussion of workshop planning or implementation occurred. When workshop strategies were raised, they tended to be about workshop logistics rather than professional development techniques. There were a couple of exceptions to this pattern, but based on HRI's observations those were few and far between.

Interviews with a sample of eight PTRAs tell a similar story. All eight interviewees indicated that the workshops had a strong emphasis on the physics content. As one PTRA said:

> *Almost all of them [workshops] did pertain to content, and strictly content.*

In regards to developing the PTRAs' knowledge of effective physics pedagogy, all interviewees indicated that the workshops as a whole touched on pedagogical issues, but this aspect of the workshops was not as strong. As three PTRAs said:

> *The intent [of the workshops] was increasing pedagogical knowledge…it was implicit, not explicit.*
>
> *That is probably the weak end. I would like to see more of that in the workshops.*
>
> *Not as much as I would have liked. The pedagogy is the part I found discussed only at the end.*

HRI also asked the interviewees about the extent to which the workshops focused on developing their knowledge of professional development strategies. Five of the eight PTRAs indicated that at least some of the workshops helped develop their knowledge in this area. When asked to give specific examples of strategies they learned for working with outreach participants, they typically could remember having some general discussions about leading workshops, but not any specific strategies.

The other three interviewees indicated that there was "precious little" focus in this area or that the workshop modeled but did not explicitly discuss strategies for working with teachers. As one PTRA said when asked about leadership strategies:

> *I don't remember ever hearing that. That's what I was looking for…I didn't know if they [workshop presenters] were supposed to be telling us those things.*

Implications

Looking across the data on the summer institute and its impacts on the PTRAs, a couple of themes emerge. It is clear that the PTRAs value the program and enjoy the summer institute. However, it also appears that many PTRAs have difficulty switching from their role as teacher to that of trainer of teachers. A large number of responses to open-ended items asked on the post-institute questionnaire and during interviews indicate that the PTRAs view the summer institute primarily as a means to improve their own classroom practice. In addition, the summer institute workshops may be fostering this sentiment as they tend to focus on having the PTRAs work through a number of activities much as if they were students learning the content.

While the summer institute model may have been appropriate in the original PTRA program, which had the goal of helping physics teachers with already strong content backgrounds infuse hands-on activities in their curriculum, it is unlikely to prepare the PTRAs to work with under-prepared high school physics and middle school physical science teachers in rural areas. The current target audience has more substantial professional development needs, including understanding the physics content, learning about the misconception research and how students learn physics, as well as mastering when and how to implement the activities found in the PTRA workshop manuals.

2002 Rural Institutes

As noted earlier, the main goals of the RPTRA project focus on improving the teaching and learning of physics/physical science in rural classrooms via the rural regional centers. The project's model is for each center to host a four- or five-day summer institute, and two day-long follow-up sessions during the school year. The summer institute is intended to focus on a small number of physics topics and provide outreach participants the opportunity for in-depth study of both the physics content and proven teaching strategies. The two follow-up sessions are intended to give outreach participants an opportunity to revisit the topic and reflect upon their attempts to incorporate what they learned into their classroom teaching.

Data for this section of the report come from a baseline questionnaire administered to all rural institute participants, HRI's observations of an entire rural institute and its two follow-up sessions,[5] interviews with a sample of outreach participants from the James Madison University (JMU) center, a follow-up survey of the JMU participants, interviews with all four Rural Regional Coordinators, and a focus group interview with six PTRAs who led portions of each institute.

Each rural regional center operates in conjunction with a local university and has a designated Rural Regional Coordinator, typically a member of the university's physics department. The coordinator's responsibilities include recruiting outreach participants, arranging facilities and equipment for the institutes, and managing all of the necessary paperwork. The coordinator makes it possible for the PTRAs to focus their energies on designing and implementing the professional development.

The RPTRA project operated 4 rural regional centers during its first year, 3 of which were continuations of "prototype" institutes created to test the logistics of this model prior to NSF funding. Table 9 shows the number of outreach participants attending each of the rural summer institutes and follow-up sessions. Overall, 67 rural teachers attended the four institutes. Fewer teachers attended the follow-up sessions held during the school year. The difficulty in getting teachers to attend the follow-up sessions, possibly due to scheduling conflicts during the school year, has implications for the project's ability to reach its goal of providing teachers with 36 hours of professional development per year (108 hours over the course of three years). Table 9 also shows that fewer than one-third of the outreach participants reached this goal. Data collected on the outreach participant questionnaire show that only 17 of the 47 participants at the three prototype sites were return participants from the previous year.

Table 9
Number of Outreach Participants per Session, by Rural Regional Center

	Number of Participants				
	Rural Institute	**Follow-Up #1**	**Follow-Up #2**	**All Three Sessions**	**At Least 36 Hours of PD**
James Madison University	20	14	11	9	12
Illinois State University†	17	15	10	6	8
South Dakota State University†	16	—	—	—	0
Coastal Carolina University†	14	—	—	—	0
Total	**67**	**29**	**21**	**15**	**20**

† "Prototype" center

During the first year of the project, the rural centers provided professional development on a variety of topics. Table 10 shows the number of professional development hours offered by the project in each topic across the rural centers. *Calculator Based Labs*, *Graphing Calculators*, and *Kinematics* comprised the majority of workshop time, followed by *Computer Interfacing* and

[5] As three of the rural centers began operating the year prior to NSF funding and these "prototype" centers were not focusing on a single content strand as new centers do, much of the evaluation during year one was focused on the James Madison University center.

Global Positioning Systems. Overall, nearly two-thirds of the professional development focused on using technology.

Table 10
Professional Development Hours, by Workshop Topic

	Total Number of PD Hours	Percent of PD Hours
Calculator Based Labs	30	22
Graphing Calculator	30	22
Kinematics	30	22
Computer Interfacing	18	13
Global Positioning Systems	12	9
Make and Take	6	4
Newton's Laws	6	4
Simple Machines	6	4

The focus on technology is somewhat surprising given that many rural teachers do not have access to graphing calculators or interfacing devices.[6]

The Outreach Participants

A baseline teacher questionnaire administered at the beginning of each rural institute collected a variety of information on the outreach participants. (A copy of the Questionnaire can be found in Appendix A.) Since the questionnaires were administered on-site at the beginning of each institute, a 100 percent response rate was achieved. As can be seen in Table 11, about half of the outreach participants were female and most were white. Seventy-eight percent taught high school during the 2001–02 academic year. Slightly over half of the participants were responsible for teaching physics, and a similar proportion taught physical science. Given the project's target audience of rural teachers, it is not surprising that nearly two-thirds of the outreach participants teach other science subjects and 1 in 5 taught non-science classes. The project drew teachers with a wide range of prior teaching experience.

[6] Special tabulations of data from the 2000 National Survey of Science and Mathematics Education indicate that only 55 percent of grade 6–12 rural science teachers have access to graphing calculators, and only 33 percent have access to computer/calculator interfacing devices.

Table 11
Demographics of Outreach Participants

	Percent of Participants
Gender	
Male	53
Female	47
Race	
White, not of Hispanic origin	88
Black, not of Hispanic origin	7
Hispanic (regardless of race)	1
Asian or Pacific Islander	0
American Indian/Alaskan Native	0
Other	0
Grade Level Taught	
High School	78
Middle School	18
Other/Not a Classroom Teacher	4
Prior Teaching Experience	
0–2 Years	24
3–5 Years	10
6–10 Years	7
11–20 Years	24
21 or More Years	36
Teaching Assignment Includes	
Physics	56
Physical Science	53
Other Science	65
Non-Science	21

Table 12 shows the number of semesters of college coursework completed by the outreach participants. Forty-seven percent of the outreach participants have taken eight or more college semesters of physics/physical science while 42 percent have taken three or fewer semesters. These data indicate that the rural institute participants were quite varied in terms of their physics content background.

Table 12
Semesters of College Coursework
Completed by Outreach Participants

	Percent of Participants			
	0	1–3	4–7	8 or More
Physics/Physical Science	10	32	10	47
Life Science/Biology	18	28	7	47
Mathematics	9	24	22	46
Chemistry	16	25	19	40
Earth/Space Science	29	41	12	18
Engineering/Technology	47	31	15	7

The baseline questionnaire also asked the outreach participants about their opinions, feelings of preparedness, and frequency of use of various teaching practices. These items were administered to a large sample of teachers in previous research, and based on the results of factor analysis, were combined into a number of composite variables. (Definitions of the composite variables, descriptions of how they were created, and reliability information are included in Appendix B.) Each composite has a minimum possible score of 0 and a maximum possible score of 100. A score of 0 would indicate that a participant selected the lowest response option for each item in the composite, whereas a score of 100 would indicate that a participant selected the highest response option for each item.

Table 13 shows the mean and standard deviation for each composite, presented here to illustrate the initial status of the outreach participants. Note that although the outreach participants have fairly positive attitudes toward *Standards*-based teaching, their lower scores on the pedagogical and physics preparedness composites may indicate that they do not have the knowledge and skills to implement *Standards*-based teaching practices in their classrooms. This hypothesis is also supported by their much higher score on the traditional teaching practices composite than on the investigative teaching practices composite. HRI will survey the participants each year to examine changes in their responses as one measure of the project's impact. Participants' responses to the individual items included in these composites as well as other questionnaire items are included in Appendix C.

Table 13
Outreach Participant Composite Scores

	Mean	Standard Deviation
Attitudes Toward *Standards*-Based Teaching	81.7	11.3
Pedagogical Preparedness	63.4	16.3
Physics Preparedness	59.3	18.1
Traditional Teaching Practices	69.0	14.5
Investigative Teaching Practices	36.5	14.4
Investigative Classroom Culture	67.5	19.0

Outreach Participant Interviews
HRI conducted telephone interviews with a sample of seven outreach participants to gather their feedback on the program. When asked why they decided to participate, four of the interviewees indicated that they hoped to improve their understanding of physics or ability to teach physics/physical science. Four participants mentioned that they needed continuing education units for recertification. As one participant said:

> *I'm teaching 8th grade physical science. I don't have a very strong background in physics and I saw this to be an opportunity to better myself in that area.*

HRI also asked the interviewees to what extent the stipend and availability of graduate credits affected their decision to participate. Five of the 7 interviewees cited the availability of graduate credit as a reason for attending. In addition, five of the participants indicated that the stipend did motivate them to attend, though for most of them it was "icing on the cake." However, the stipend was critical for one of the interviewees:

It was a whole lot easier to convince my [spouse], that I had to go for a full week. The fact that I was getting paid did affect it.

The interviewees were also asked what they were hoping to learn from the institute. Given the wide range in the participants' backgrounds, it is not surprising that they gave a wide variety of responses. Six of the seven interviewees indicated that they were hoping to improve their classroom instruction by learning about instructional strategies and receiving activities they could use in the classroom. Three mentioned a desire to strengthen their understanding of the content. One interviewee was hoping to learn how to use graphing calculators and interfacing devices in the classroom.

Overall, the interviewees had positive comments about the institute. When asked what aspects of the institute were particularly good or effective, participants cited a number of features. Three interviewees mentioned receiving classroom activities. The opportunity to network with other teachers, the quality of the instructors, the opportunity to spend an entire week on the topics, and the quality of the discussion of teaching strategies at one of the follow-up workshops were all mentioned by one or more interviewees. As three participants said:

I thought that the relationship between the instructors and participants was extremely conducive to learning. Anything that you wanted to learn, they were open to questions at all times about anything they did and how they did it [in their own classrooms]. I thought that was the best part of the institute.

The labs that we got to keep. We got a new book on labs that we could use in the classroom.

That it was one week and that was all I had to focus on all week. I liked that. Getting to know the other teachers, finding out what other people are doing, what other counties are doing.

When asked what aspect of the institute could have been better, four of the interviewees thought that the wide range of backgrounds and ability levels among the participants was problematic. The middle school teachers tended to think that the workshop was too advanced while the high school teachers thought it was too basic. As one middle school teacher and one high school teacher, both of whom attended the same institute, responded:

I felt that those of us that teach physical science were at a disadvantage. The presenters were kind of over our heads. And I know they had the other half of the class, the physics teachers, and it was challenging for them. …we were feeling kind of stupid because we didn't have that knowledge. It's not what I teach. We teach the very basics. I know that one of my friends that I met there, she is a physics teacher, and [during] some of the things, she was bored.

The group [of teachers at the institute], and it was because of the make-up of the group, ended up being mostly physical science teachers. And it would have been better for me if it had been mostly high school physics teachers because we would

> *have dealt with things on a little different level. But because of the make-up, most of the teachers there were 8th grade physical science teachers, and they were teaching to the level of that group.*

Three interviewees mentioned the focus on graphing calculators and interfacing devices as problematic. One participant reported that the institute focused too much on the details of how to use a particular brand of equipment, rather than how to use these kinds of equipment to teach physics. Another thought that the limited number of sets of equipment reduced participants' opportunity to master the technology.

The interviewees were also asked what they got out of the institute. An improved understanding of the content and activities to use in the classroom were each mentioned by three participants. Two participants indicated that the opportunity to meet and interact with other teachers gave them a resource they could tap in the future. In the words of one participant:

> *I did get some labs to take back to the classroom…some teacher resources, not just books, but teachers to get ideas from.*

Outreach Participants' Use of PTRA Activities

As mentioned above, HRI administered a follow-up questionnaire near the end of the school year to the participants of the JMU institute. The purpose of this questionnaire was to assess the extent to which the participants were utilizing the activities they received at the rural institute. (A copy of the questionnaire can be found in Appendix A.) Although only 11 participants responded, a 58 percent response rate,[7,8] the results of the survey may prove useful to the project. The respondents included 9 high school teachers, 1 middle school teacher, and 1 elementary teacher.[9] The results of the survey can be seen in Table 14. On average, participants used about one-third of the activities. Only three of the activities were used by at least half of the respondents.

The survey also asked the participants, when applicable, why they chose not to use an activity. The most common response was that they use a different activity to teach the same concept. The other common response was that the participants did not have the necessary equipment, particularly for the *Position Versus Time Graphs* activity which requires motion detectors and graphing calculators, and the *Speed and Acceleration on an Inclined Plane* activity which requires photogate timers.

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[7] In an effort to achieve a high response rate, HRI offered a $100 prize to a randomly chosen respondent, and sent follow-up messages to non-respondents. Unfortunately, these methods were not as successful as had been hoped.

[8] Although 20 participants attended the JMU institute, one was a district administrator and was not included in this data collection activity. Thus, this response rate is based upon the 19 classroom teachers that attended the JMU institute.

[9] The 19 rural teachers at the JMU institute included 10 high school teachers, eight middle school teachers, and one elementary school teacher. Thus, high school teachers are over-represented in these results.

Table 14
Outreach Participants' Use of Workshop Activities in Their Classroom

	Number of Participants (N=11)		
	Did Not Use	**Used as Written**	**Used, but Modified It**
Traveling Washer in One Dimension	9	2	0
Where Am I?	9	2	0
The Race Track Game	8	3	0
Using a Liquid Level Accelerometer to Classify Motion	8	2	1
Position Versus Time Graphs	8	1	2
Speed and Acceleration on an Inclined Plane	8	1	2
Finding the Speed and Velocity of a Car Traveling in Uniform Circular Motion	8	0	3
Measurement of Speed on an Inclined Plane	8	0	3
Traveling Washer in Two Dimensions	8	0	3
Speed of a Student	6	3	2
Acceleration of a Student	6	1	4
Finding Speed and Acceleration for Stroboscopic Data	6	1	4
Pendulums on Parade	5	2	4
Making a One-Second Timer	4	1	6
Measurement of Speed on a Level Surface	4	0	7

When participants did use an activity, they tended to modify it, rather than use it as written. The survey asked the participants to describe the modification(s) they made. The most common change was participants using pieces of an activity rather than the entire activity as it was written. Participants were also likely to substitute equipment. This response was often selected in conjunction with making the activity more low-tech. Data on modifications and reasons for not using activities for each activity can be found in Appendix D.

It is worth keeping in mind that this survey only measured the frequency with which teachers were using the PTRA activities and their reasons for not using or modifying the activities. It does not provide any insight into the quality of the outreach participants' implementation of the activities nor the extent of student learning that resulted. The student achievement study planned to begin in year two should shed some light on this question by comparing student learning gains in high and low implementing participants' classrooms.

PTRAs' Thoughts on the Rural Institute Model

During the 2002 PTRA institute, HRI conducted a focus group interview with six PTRAs involved with the four rural institutes held during the summer of 2002. The PTRAs participating in the focus group interview were, overall, very positive about the rural institute model. They saw two main benefits from this model: (1) having an extended period of time to work with the outreach participants and (2) having someone else (the Rural Regional Coordinator) manage the logistics of the institute.

All of the interviewed PTRAs thought that having the outreach participants together for more than six hours was extremely beneficial. They noted that when working with non-physics teachers, more time was needed to adequately address the activity, the content, and participants' prior conceptions. In addition, the extended period of time allowed the participants and workshop leaders to bond, creating a safe environment for the participants to investigate physics concepts.

When asked about the Rural Regional Coordinators (RRC) all of the interviewees were highly complimentary of their work. For many years, PTRAs have indicated that recruiting participants, arranging for meeting space, and completing the required paperwork was a major barrier to conducting outreach workshops. By having the RRC responsible for all of these tasks, the PTRAs were free to do what they find most satisfying—planning for and running workshops.

Although the interviewed PTRAs were very positive about their experiences working at the rural institute, they also shared a few suggestions for improving the rural institute model. These included having better information about the participants' needs and expectations prior to the institute as well as better communication, coordination, and planning among the national leadership, the RRC, and the workshop leaders. In addition, some of the interviewees described difficulties they encountered due to the mix of physics and non-physics teachers within the same institute.

Lack of communication between the PTRAs and the national leadership prior to the institute was one of the greatest concerns of the interviewed PTRAs. A number of them indicated that they were not informed of the need to do a "scope and sequence" (i.e., focus on a smaller number of related topics in greater depth rather than trying to cover a large number of topics) during the institute, and thus were not prepared to implement one.

This lack of knowledge of the scope and sequence of an institute led to a lack of communication among the PTRAs responsible for an institute. Not knowing they were supposed to have a conceptual thread running through all of the days of an institute, many of the PTRAs did not plan their workshops to tie together into a cohesive curriculum. Thus, some institutes were not as seamless as the PTRAs would have liked.

The second concern of the interviewed PTRAs was the lack of knowledge about the preparedness and needs of their outreach participants. One PTRA said that he didn't know if his participants were going to be high school physics teachers, middle school teachers, cross-over teachers, or a mix of these types. This lack of knowledge put the PTRA in an uncomfortable situation when the high school physics teachers in his group complained that the workshop was too focused on content they already knew. This PTRA felt that if he had known that the group was going to include both high school physics and middle school teachers ahead of time, he would have planned more appropriately. Data from the outreach participant interviews also indicate that the institutes were not as successful as hoped at meeting the diverse needs of participants.

Rural Regional Coordinator Interviews

After the 2002 Rural Institutes, HRI interviewed all four Rural Regional Coordinators (RRCs). The interviews focused on the role and duties of the RRC. Overall, the RRCs reported having a clear vision of what their responsibilities would include when they accepted the position. All four reported similar expectations of what their role would entail, including creating a database of schools to be used in the recruitment of participants; working with their university's conference center to arrange housing, meals, and classrooms; and helping to make sure things ran smoothly during the week of the institute.

At the same time, 3 of the 4 RRCs reported that accomplishing those tasks was more difficult and time-consuming than they had originally expected. In two cases, the RRCs specifically mentioned that working with the various college offices (both to arrange for the logistics and to receive approval for offering graduate credit) took much more time and effort than they had expected. As one RRC commented, "Our biggest surprise was the hoops we had to go through on our own campus."

Although the RRCs reported having a good idea of what they were getting into ahead of time, two RRCs commented that they would liked to have had a written set of coordinator and project responsibilities. This feeling was due in large part to their perceptions of a lack of communication from the project, particularly when having to deal with unanticipated situations.

Lack of communication from the project was a theme that came up a number of times during the RRC interviews. Each RCC mentioned that at least one request for information from the project did not receive a timely or clear response. Many of these instances were due to unanticipated issues, a common occurrence when a new project is being implemented. The lessons learned from the first year of implementation and the fact that the project has since created a list of RRC responsibilities should help alleviate this problem in future years.

Implications

Taken as a whole, three main points emerge from the data on the 2002 rural institutes. The project is attracting teachers with a wide variety of teaching assignments, physics knowledge, and pedagogical expertise, and thus different professional development needs. As a result, the PTRAs appear to be struggling with planning and implementing workshops that meet the needs of all participants. Outreach participants who lack a basic understanding of the physics content obviously need to master the concepts themselves in addition to learning the common misconceptions and effective teaching strategies for those concepts.

One approach tried by the PTRAs has been to utilize cooperative learning groups, pairing high school teachers with middle school teachers. Although this technique has great potential, it must be implemented with great care to be effective. The following example from an outreach workshop HRI observed illustrates this point. The PTRAs had assigned participants into groups containing teachers with mixed preparedness for the afternoon session. One such group included a male high school physics teacher and two female middle school teachers. A pattern in the group dynamics emerged that was repeated in each of the activities they worked on that afternoon. For each activity, the high school teacher told the other group members exactly what the purpose of the experiment was, what they should expect to happen, and what the significance of it was. He then proceeded to do the experiment himself, never giving the other group members a chance to use the equipment or to engage intellectually with the concepts. Although this case represents an extreme, HRI observed instances among other groups where the high school teacher(s) dominated the thinking and work. For example, when using the graphing software on the computer, the high school teachers often took control of the computer while the middle school teachers looked on.

Another approach that a number of PTRAs have tried is to divide their participants into two, more homogenous, groups and run two simultaneous workshops. The drawback to this approach is that it requires the PTRAs to plan and implement two separate workshops.

The second point is that the project may be overemphasizing the use of technology at the rural institutes. Based on national survey data, just over half of grade 6–12 rural science teachers have access to graphing calculators, only one-third have access to calculator/computer interfacing devices. Further, teachers that do have access to these technologies may have different brands of equipment than those utilized in the PTRA workshops. Data from the activity use survey also show that the outreach participants tend to modify the activities they receive, often making them more low-tech, an indication that they may not have access to the technology called for in the activity. Although the project hopes that exposing teachers to these technologies will encourage teachers to seek funding for their purchase, given the fiscal difficulties most states are currently facing, money for these types of purchases is likely to be scarce. The project also runs the danger of being seen as salespeople for specific brands of equipment, harming the PTRAs' credibility as professional development providers.

The third main point that emerges from these data is that fewer than one-third of the outreach participants are reaching the project's goal of 36 hours of professional development per year (with 24 hours of training coming during the rural institute and an additional 12 hours at the two follow-up workshops). The project may need to reconsider its strategy for reaching this goal, perhaps by increasing the length of workshops during the rural institute or trying different incentives to attract teachers to the follow-up workshops.

Summary and Recommendations

In its first year, the Rural PTRA project can be credited for a number of accomplishments. The project is on schedule for going to scale with the rural centers model, establishing four centers in Year One and receiving commitments for additional sites in Year Two. The project has also sold the rural center model to the PTRAs who bring considerable energy and enthusiasm to the endeavor. The project has also refined and clarified the role and responsibilities of the Rural Regional Coordinators, learning from their first attempts at implementing the rural model. In addition, RRCs relieve the PTRAs from the burden of institute logistics, giving them more time to plan and prepare for workshop delivery.

The project's decision to focus each rural institute on a coherent scope and sequence (e.g., kinematics and dynamics) allows for more time to be spent working with outreach participants on issues of content and pedagogy. This focus is even more important given the target audience of under-prepared or cross-over physics/physical science teachers.

Still, as is the case with most projects in their early stages, a substantial amount of work remains to be done. In the spirit of a critical friend, HRI offers the following recommendations to the project.

- **As the PTRAs are the key to the project's success, the project may want to build opportunities into the PTRA summer institute for the PTRAs to learn and practice the leadership skills necessary for them to become more than sharers of activities.**

  Although high-quality classroom activities are an important part of PTRA workshops, they should be viewed not as ends in-and-of-themselves but as the means for helping outreach participants:

  - Master the physics concepts;
  - Become familiar with the wealth of research on misconceptions and how students learn physics; and
  - Examine various teaching strategies, and consider when and why to use different pedagogical approaches.

  In the past, the PTRAs have been more receptive to dealing with pedagogy and leadership issues when they are built into the various workshops. The selection of workshop topics and leaders is a critical component for the project's success. Establishing a workshop review process that would begin several weeks before the summer institute would help the project ensure that the summer institute workshops dealt with more than just sharing activities. It would also help the PTRAs become more than sharers of activities by providing them with opportunities to learn and practice the skills necessary to successfully lead workshops that are likely to have positive impacts on physics/physical science teaching and learning.

  Moreover, interviews with PTRAs and outreach participants as well as HRI's observations during a rural institute indicate that the PTRAs need support in planning and implementing professional development for an audience with diverse needs. The middle school teachers reported feeling that the workshop tended to be over their heads, while the high school teachers thought the workshops were being taught at too low a level for them. The project may want to facilitate a discussion at the summer institute to give the PTRAs an opportunity to explore the issue and the pros and cons of various solutions.

- **The project should consider including a greater focus on the findings of the physics education community in its workshop manuals and summer institute.**

  Given that physics, more so than any other subject, has a large body of research about misconceptions and effective teaching practices, the RPTRA project is perfectly positioned to help bridge the gap between the physics education research community and the classroom teacher. Having this information built into the workshop manuals would make it easier, and thus more likely, for the PTRAs to include relevant pieces in their outreach workshops, again helping them move beyond the role of sharers of activities.

- **Even though the project is just getting into high gear, the project should consider ways to boost attendance at the rural institute follow-up sessions.**

  Offering consistently high-quality professional development is important to sustaining participation, but additional measures may be needed as well. It will be important to make sure the participants are told the dates and times of the follow-up sessions when they are signing up for an institute. In addition, the project's recruitment literature could stress the importance of attending these sessions. Another option is for the project to offer a material incentive (e.g., equipment as door prizes) to participants who attend the follow-up sessions.

- **Given that relatively few rural teachers have access to graphing calculators and interfacing devices, the project should reconsider the balance of high-tech and low-tech activities during the rural institutes.**

  Although the project has a number of cost-sharing agreements with companies that produce these technologies, spending valuable professional development time training teachers how to use specific brands of equipment they do not have or are unlikely to be able to acquire puts the PTRAs in the position of appearing to be sales representatives for these companies. The project way want to consider surveying outreach participants prior to the rural institute to assess their need and interest in receiving training on these technologies as well as what brand(s), if any, they have access to in their schools. If participants have competing brands of equipment, the project may want to ask them to bring a set with them to the rural institute so the focus of the institute can be on using the technology effectively in the classroom rather than on learning how to use a specific brand of technology.

Appendix A
Outreach Participant Questionnaires

PTRA 2002 Rural Institute Participant Survey

Instructions: Please use a #2 pencil or a blue or black pen to complete this questionnaire. Darken circles completely, but do not stray into adjacent circles. Be sure to erase completely or white out any stray marks. Please remove the label before you return the completed questionnaire to the workshop leader.

A. Teacher Demographic Information

1. Are you: ◯ Male ◯ Female

2. Race - Are you: (Darken one or more.)

- ◯ American Indian or Alaskan Native
- ◯ Asian
- ◯ Black or African-American
- ◯ Hispanic or Latino
- ◯ Native Hawaiian or Other Pacific Islander
- ◯ White

3. For how many days did you participate in last summer's PTRA rural institute?

◯ 0 ◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5

4. For each of the following subjects, please indicate (a) the number of semesters of college coursework you have completed, and (b) whether you are certified to teach it at the secondary level. (Darken one circle in each section on each line.)

	Number of semesters college coursework				Certified?	
	0	1-3	4-7	8 or more	Yes	No
a. Life Science/Biology	◯	◯	◯	◯	◯	◯
b. Earth/Space Science	◯	◯	◯	◯	◯	◯
c. Chemistry	◯	◯	◯	◯	◯	◯
d. Physics/Physical Science	◯	◯	◯	◯	◯	◯
e. Engineering/Technology	◯	◯	◯	◯	◯	◯
f. Mathematics	◯	◯	◯	◯	◯	◯

5. How many years have you taught prior to this school year? (Darken one circle.)

0-2	3-5	6-10	11-15	16-20	21-25	26 or more
◯	◯	◯	◯	◯	◯	◯

6. Which of the following did you teach this past school year? (Darken each circle that applies.)

- ◯ Middle school science
- ◯ High school science

7. How many sections of each of the following courses did you teach this past school year? (Darken one circle on each line.)

	0	1	2	3	4	5	6	7 or more
Physics/Advanced Physics/AP Physics	◯	◯	◯	◯	◯	◯	◯	◯
Physical Science	◯	◯	◯	◯	◯	◯	◯	◯
Other Science	◯	◯	◯	◯	◯	◯	◯	◯
Other Non-Science	◯	◯	◯	◯	◯	◯	◯	◯

B. Teacher Opinions and Preparedness

8. In the left section, please rate each of the following in terms of its **importance** for effective science instruction in the grades you teach. In the right section, please indicate how **prepared** you feel to do each one. (Darken one circle in each section on each line.)

	Importance: Not important	Importance: Somewhat important	Importance: Fairly important	Importance: Very important	Preparation: Not adequately prepared	Preparation: Somewhat prepared	Preparation: Fairly well prepared	Preparation: Very well prepared
a. Provide concrete experience before abstract concepts.	○	○	○	○	○	○	○	○
b. Develop students' conceptual understanding of science.	○	○	○	○	○	○	○	○
c. Take students' prior understanding into account when planning curriculum and instruction.	○	○	○	○	○	○	○	○
d. Make connections between science and other disciplines.	○	○	○	○	○	○	○	○
e. Have students work in cooperative learning groups.	○	○	○	○	○	○	○	○
f. Have students participate in appropriate hands-on activities.	○	○	○	○	○	○	○	○
g. Engage students in inquiry-oriented activities.	○	○	○	○	○	○	○	○
h. Have students prepare project/laboratory/research reports.	○	○	○	○	○	○	○	○
i. Use calculators.	○	○	○	○	○	○	○	○
j. Use computers.	○	○	○	○	○	○	○	○
k. Engage students in applications of science in a variety of contexts.	○	○	○	○	○	○	○	○
l. Use performance-based assessment.	○	○	○	○	○	○	○	○
m. Use portfolios.	○	○	○	○	○	○	○	○
n. Use informal questioning to assess student understanding.	○	○	○	○	○	○	○	○
o. Use calculator/computer-based labs.	○	○	○	○	○	○	○	○
p. Use graphing calculators.	○	○	○	○	○	○	○	○

9. Please indicate how well prepared you feel to do each of the following. (Darken one circle on each line.)

	Not adequately prepared	Somewhat prepared	Fairly well prepared	Very well prepared
a. Lead a class of students using investigative strategies.	○	○	○	○
b. Manage a class of students engaged in hands-on/project-based work.	○	○	○	○
c. Help students take responsibility for their own learning.	○	○	○	○
d. Recognize and respond to student diversity.	○	○	○	○
e. Encourage students' interest in science.	○	○	○	○
f. Use strategies that specifically encourage participation of females and minorities in science.	○	○	○	○
g. Involve parents in the science education of their students.	○	○	○	○

PLEASE DO NOT WRITE IN THIS AREA

[FORMID]

10. Within science, many teachers feel better prepared to teach some topics than others. How well prepared do you feel to teach each of the following topics at the grade levels you teach, whether or not they are currently included in your curriculum? (Darken one circle on each line.)

	Not adequately prepared	Somewhat prepared	Fairly well prepared	Very well prepared
a. Physics				
1. Forces and motion	○	○	○	○
2. Energy	○	○	○	○
3. Light and sound	○	○	○	○
4. Electricity and magnetism	○	○	○	○
5. Modern physics (e.g., special relativity)	○	○	○	○
b. Scientific methods and inquiry skills				
1. Formulating hypotheses, drawing conclusions, making generalizations	○	○	○	○
2. Experimental design	○	○	○	○
3. Describing, graphing, and interpreting data	○	○	○	○

Questions 11-14 ask about your science teaching. Please answer for your first physics or physical science class of the day during this past school year. <u>If you did not teach physics or physical science</u>, please answer for your first science class of the day.

11. What was the subject of this class? (Darken one circle.)

- ○ Life science/Biology
- ○ Earth/Space science
- ○ Environmental science
- ○ Chemistry
- ○ Physics
- ○ Physical science
- ○ Integrated science

12. What grade level was it? (Darken one circle.) ○ Middle school science ○ High school science

13. About how often did **you** do each of the following in your science instruction in this class? (Darken one circle on each line.)

	Never	Rarely (e.g., a few times a year)	Sometimes (e.g., once or twice a month)	Often (e.g., once or twice a week)	All or almost all science lessons
a. Introduce content through formal presentations.	○	○	○	○	○
b. Demonstrate a science-related principle or phenomenon.	○	○	○	○	○
c. Teach science using real-world contexts.	○	○	○	○	○
d. Arrange seating to facilitate student discussion.	○	○	○	○	○
e. Use open-ended questions.	○	○	○	○	○
f. Require students to supply evidence to support their claims.	○	○	○	○	○
g. Encourage students to explain concepts to one another.	○	○	○	○	○
h. Encourage students to consider alternative explanations.	○	○	○	○	○
i. Allow students to work at their own pace.	○	○	○	○	○
j. Help students see connections between science and other disciplines.	○	○	○	○	○
k. Use assessment to find out what students know before or during a unit.	○	○	○	○	○
l. Embed assessment in regular class activities.	○	○	○	○	○
m. Assign science homework.	○	○	○	○	○
n. Read and comment on the reflections students have written in their notebooks or journals.	○	○	○	○	○

14. About how often did **students** in this class take part in each of the following types of activities as part of their science instruction? (Darken one circle on each line.)

	Never	Rarely (e.g., a few times a year)	Sometimes (e.g., once or twice a month)	Often (e.g., once or twice a week)	All or almost all science lessons
a. Participate in student-led discussions.	○	○	○	○	○
b. Participate in discussions with the teacher to further science understanding.	○	○	○	○	○
c. Work in cooperative learning groups.	○	○	○	○	○
d. Make formal presentations to the class.	○	○	○	○	○
e. Read from a science textbook in class.	○	○	○	○	○
f. Read other (non-textbook) science-related materials in class.	○	○	○	○	○
g. Answer textbook/worksheet questions.	○	○	○	○	○
h. Review homework/worksheet assignments.	○	○	○	○	○
i. Work on solving a real-world problem.	○	○	○	○	○
j. Share ideas or solve problems with each other in small groups.	○	○	○	○	○
k. Engage in hands-on science activities.	○	○	○	○	○
l. Follow specific instructions in an activity or investigation.	○	○	○	○	○
m. Design or implement their *own* investigation.	○	○	○	○	○
n. Design objects within constraints (e.g., egg drop, toothpick bridge, aluminum boats).	○	○	○	○	○
o. Work on models or simulations.	○	○	○	○	○
p. Work on extended science investigations or projects (a week or more in duration).	○	○	○	○	○
q. Participate in field work.	○	○	○	○	○
r. Record, represent, and/or analyze data.	○	○	○	○	○
s. Write reflections in a notebook or journal.	○	○	○	○	○
t. Prepare written science reports.	○	○	○	○	○
u. Use mathematics as a tool in problem-solving.	○	○	○	○	○
v. Use calculators.	○	○	○	○	○
w. Use computers.	○	○	○	○	○
x. Work on portfolios.	○	○	○	○	○
y. Take short-answer tests (e.g., multiple choice, true/false, fill-in-the-blank).	○	○	○	○	○
z. Take tests requiring open-ended responses (e.g., descriptions, explanations).	○	○	○	○	○
aa. Engage in performance tasks for assessment purposes.	○	○	○	○	○

THANK YOU!!

●●●●●

PLEASE DO NOT WRITE IN THIS AREA

[FORMID]

Sample Page from the
Activity-Usage Questionnaire

Activity 1. Making a One Second Timer (pg. 9)

Description: In this activity students attempt to construct a pendulum that takes one second to make a complete cycle.

No, I did not use this activity at all

Please indicate why you *did not use* this activity: (select all that apply)

- ☐ I **don't teach the concept** addressed by the activity
- ☐ I have not yet covered this topic in my class, but I **plan on using this activity** later this year
- ☐ I am not confident in **my own understanding of the concept**
- ☐ The activity is **too difficult (conceptually)** for my students
- ☐ The activity is **too easy (conceptually)** for my students
- ☐ I have a **different activity** covering the same concept that I prefer using
- ☐ I don't have the **necessary equipment**/materials
- ☐ The activity is **too long** to complete in one class period
- ☐ The activity **does not work reliably**
- ☐ There is **not enough time** in the school year to use the activity
- ☐ There are **safety** issues with the activity
- ☐ **Other** (please specify): ______

Continue to next activity. . .

Yes, I used this activity

○ **I used this activity *exactly* as written**

○ **I *modified* this activity in the following ways:** (select all that apply)

- ☐ I **used it as a demonstration** rather than as a student activity
- ☐ I **integrated pieces** of this activity into another one that I did
- ☐ I changed **how students were grouped** (e.g., pairs rather than individuals)
- ☐ I **cut part of the activity** so it would fit in one class period
- ☐ I **simplified** or made the activity more structured to make it appropriate for my students
- ☐ I made the activity **less structured** to make it appropriate for my students
- ☐ I **substituted equipment**/materials
- ☐ I made it **more "high-tech"** to take advantage of equipment I have
- ☐ I made it **more "low-tech"** due to lack of equipment
- ☐ **Other** (please specify): ______

Appendix B
Analysis and Reporting of Questionnaire Data

To facilitate the reporting of large amounts of survey data, and because individual questionnaire items are potentially unreliable, HRI used factor analysis to identify survey questions that could be combined into "composites."[10] Each composite represents an important construct related to mathematics teaching.

Each composite is calculated by summing the responses to the items associated with that composite and then dividing by the total points possible. In order for the composites to be on a 100-point scale, the lowest response option on each scale was set to 0 and the others were adjusted accordingly; so for instance, an item with a scale ranging from 1 to 5 was re-coded to have a scale of 0 to 4. By doing this, someone who marks the lowest point on every item in a composite receives a composite score of 0 rather than some positive number. It also assures that 50 is the true mid-point. The denominator for each composite is determined by computing the maximum possible sum of responses for a series of items and dividing by 100; e.g., a 9-item composite where each item is on a scale of 0–4 would have a denominator of 0.36.

Attitudes Towards *Standards*-Based Teaching	**Item**
Provide concrete experience before abstract concepts.	Q8ai
Develop students' conceptual understanding of science.	Q8bi
Make connections between science and other disciplines.	Q8di
Have students work in cooperative learning groups.	Q8ei
Have students participate in appropriate hands-on activities.	Q8fi
Engage students in inquiry-oriented activities.	Q8gi
Use computers.	Q8ji
Engage students in applications of science in a variety of contexts.	Q8ki
Use portfolios.	Q8mi
Use informal questioning to assess student understanding.	Q8ni
Number of Items in Construct	**10**
Reliability (Cronbach's Coefficient Alpha)	**.77**

[10] See "Technical Report: Analysis of the Psychometric Structure of the LSC Surveys" (12/07/98) by David B. Flora and A.T. Panter, L.L. Thurstone Psychometric Lab, University of North Carolina at Chapel Hill, NC for a detailed description of the factor analysis process.

Pedagogical Preparedness	Item
Provide concrete experience before abstract concepts.	Q8ap
Develop students' conceptual understanding of science.	Q8bp
Take students' prior understanding into account when planning curriculum and instruction.	Q8cp
Make connections between science and other discipline	Q8dp
Have students work in cooperative learning groups.	Q8ep
Have students participate in appropriate hands-on activities.	Q8fp
Engage students in inquiry-oriented activities.	Q8gp
Engage students in applications of science in a variety of contexts.	Q8kp
Use performance-based assessment.	Q8lp
Use portfolios.	Q8mp
Use informal questioning to assess student understanding.	Q8np
Lead a class of students using investigative strategies.	Q9a
Manage a class of students engaged in hands-on/project-based work.	Q9b
Help students take responsibility for their own learning.	Q9c
Recognize and respond to student diversity.	Q9d
Encourage students' interest in science.	Q9e
Use strategies that specifically encourage participation of females and minorities in science.	Q9f
Involve parents in the science education of their students.	Q9g
Number of Items in Construct	**18**
Reliability (Cronbach's Coefficient Alpha)	**.91**

Physics Content Preparedness	Item
Forces and motion	Q10a1
Energy	Q10a2
Light and sound	Q10a3
Electricity and magnetism	Q10a4
Modern physics (e.g., special relativity)	Q10a5
Formulating hypotheses, drawing conclusions, making generalizations	Q10b1
Experimental design	Q10b2
Describing, graphing, and interpreting data	Q10b3
Number of Items in Construct	**8**
Reliability (Cronbach's Coefficient Alpha)	**.84**

Traditional Teaching Practices	Item
Assign science/mathematics homework.	Q13m
Answer textbook/worksheet questions	Q14g
Practice routine computations/algorithms.	
Review homework/worksheet assignments.	Q14h
Take short-answer tests (e.g., multiple choice, true/false, fill-in-the-blank).	Q14y
Number of Items in Construct	**4**
Reliability (Cronbach's Coefficient Alpha)	**.71**

Investigative Teaching Practices	**Item**
Make formal presentations to the class.	Q13d
Engage in hands-on science activities.	Q13e
Design or implement their own investigation.	Q14m
Work on models or simulations.	Q14o
Work on extended science investigations or projects (a week or more in duration).	Q14p
Participate in field work.	Q14Q
Write reflections in a notebook or journal.	Q14s
Work on portfolios.	Q14x
Number of Items in Construct	**8**
Reliability (Cronbach's Coefficient Alpha)	**.80**

Investigative Culture	**Item**
Arrange seating to facilitate student discussion.	Q13d
Use open-ended questions.	Q13e
Require students to supply evidence to support their claims.	Q13f
Encourage students to explain concepts to one another.	Q13g
Encourage students to consider alternative explanations.	Q13h
Participate in discussions with the teacher to further science understanding.	Q14b
Work in cooperative learning groups.	Q14c
Share ideas or solve problems with each other in small groups.	Q14j
Number of Items in Construct	**8**
Reliability (Cronbach's Coefficient Alpha)	**.80**

Appendix C
Additional Baseline Data on Outreach Participants

Table C-1
Importance for Effective Science Instruction

	Percent of Participants			
	Not Important	Somewhat Important	Fairly Important	Very Important
Have students participate in appropriate hands-on activities	0	0	6	94
Develop students' conceptual understanding of science	0	0	12	88
Engage students in applications of science in a variety of contexts	0	3	35	62
Make connections between science and other disciplines	0	3	35	62
Engage students in inquiry-oriented activities	0	6	32	62
Take students' prior understanding into account when planning curriculum and instruction	0	7	31	62
Provide concrete experience before abstract concepts	0	10	29	60
Use informal questioning to assess student understanding	0	10	35	54
Use computers	0	18	32	50
Have students prepare project/laboratory/research reports	0	9	48	43
Use performance-based assessments	1	15	44	40
Use calculators	0	22	37	40
Have students work in cooperative learning groups	0	13	48	39
Use calculator/computer-based labs	1	24	42	33
Use graphing calculators	6	28	44	22
Use portfolios	14	42	35	9

Table C-2
Preparedness to do the Following

	Percent of Participants			
	Not Adequately Prepared	Somewhat Prepared	Fairly Well Prepared	Very Well Prepared
Encourage students' interest in science	0	9	51	40
Manage a class of students engaged in hands-on/project-based work	0	15	47	38
Use informal questioning to assess student understanding	1	22	44	32
Have students participate in appropriate hands-on activities	0	18	51	31
Have students work in cooperative learning groups	5	17	50	29
Help students take responsibility for their own learning	1	15	56	28
Lead a class of students using investigative strategies?	0	25	48	27
Make connections between science and other disciplines	4	27	42	27
Use strategies that specifically encourage participation of females and minorities in science	7	32	35	25
Have students prepare project/laboratory/research reports	4	19	52	24
Use calculators	7	30	40	22
Engage students in inquiry-oriented activities	3	38	37	22
Develop students' conceptual understanding of science	1	9	71	19
Recognize and respond to student diversity	0	22	59	19
Use performance-based assessment	9	31	44	16
Use computers	12	28	45	15
Provide concrete experience before abstract concepts	1	24	62	13
Take students' prior understanding into account when planning curriculum and instruction	1	28	57	13
Engage students in applications of science in a variety of contexts	1	37	50	12
Use portfolios	23	49	17	11
Use graphing calculators	40	32	18	10
Use calculator/computer-based labs	28	37	25	9
Involve parents in the science education of their students	16	49	31	4

Table C-3
Science Content Preparedness

	Percent of Participants			
	Not Adequately Prepared	Somewhat Prepared	Fairly Well Prepared	Very Well Prepared
Forces and motion	3	12	59	26
Energy	3	18	54	25
Light and Sound	9	28	51	12
Electricity and magnetism	12	44	38	6
Modern physics (e.g., special relativity)	47	37	12	4
Formulating hypotheses, drawing conclusions, making generalizations	1	9	50	40
Describing, graphing, and interpreting data	3	22	35	40
Experimental design	3	29	37	31

Table C-4
Frequency of the Following in Your Science Instruction†

	Percent of Participants				
	Never	Rarely	Sometimes	Often	All or Almost All
Assign science homework	0	5	16	38	42
Teach science using real-world contexts	0	10	16	54	21
Introduce content through formal presentations	2	8	17	64	9
Use open-ended questions	0	3	25	45	27
Demonstrate a science-related principle or phenomenon	0	5	23	60	12
Help students see connections between science and other disciplines	0	8	23	43	26
Encourage students to explain concepts to one another	2	9	26	37	26
Embed assessment in regular class activities	2	9	28	37	25
Require students to supply evidence to support their claims	0	8	34	31	28
Encourage students to consider alternative explanations	2	12	31	38	17
Allow students to work at their own pace	2	17	28	31	23
Arrange seating to facilitate student discussion	8	23	23	18	28
Use assessment to find out what students know before or during a unit	5	18	32	31	14
Read and comment on the reflections students have written in their notebooks or journals	25	34	18	18	5

Table C-5
Frequency of the following in your science instruction†

	Percent of Participants				
	Never	Rarely	Sometimes	Often	All or Almost All
Engage in hands-on science activities	0	0	12	65	23
Review homework/worksheet assignments	0	3	15	57	25
Use mathematics as a tool in problem-solving	2	6	14	45	33
Use calculators	2	5	19	44	31
Participate in discussions with the teacher to further science understanding	0	6	18	48	28
Answer textbook/worksheet questions	0	9	16	63	13
Follow specific instructions in an activity or investigation	0	2	29	54	15
Work in cooperative learning groups	2	3	26	46	23
Record, represent, and/or analyze data	2	6	33	41	17
Share ideas or solve problems with each other in small groups	3	6	34	36	20
Work on solving a real-world problem	8	12	38	32	9
Participate in student-led discussions	5	17	38	29	11
Prepare written science reports	6	30	38	19	6
Use computers	6	25	44	21	3
Take tests requiring open-ended responses (e.g., descriptions, explanations)	3	15	58	20	3
Engage in performance tasks for assessment purposes	12	28	37	20	3
Read from a science textbook in class	16	36	25	20	3
Take short-answer tests (e.g. multiple choice, true/false, fill-in-the-blank)	3	12	63	17	5
Read other (non-textbook) science-related materials in class	15	31	34	20	0
Write reflections in a notebook or journal	45	27	9	13	6
Design or implement their own investigation	8	43	34	12	3
Work on models or simulations	9	38	40	12	0
Work on portfolios	51	32	6	6	5
Design objects within constraints (e.g., egg drop, toothpick bridge, aluminum boats)	12	43	35	9	0
Work on extended science investigations or projects (a week or more in duration)	11	63	18	8	0
Make formal presentations to the class	9	45	41	3	2
Participate in field work	42	41	13	3	2

Appendix D
Additional Data From the Activity Use Survey

Table D-1
Outreach Participants' Modifications to Workshop Activities

	Number of Participants[†]								
	Number Modifying	Used Pieces	Used Demonstration	Changed How Students were Grouped	Simplified the Activity	Made it Less Structured	Substituted Equipment	Made it More High-Tech	Made it More Low-Tech
Traveling Washer in One Dimension	0	0	0	0	0	0	0	0	0
Where Am I?	0	0	0	0	0	0	0	0	0
The Race Track Game	0	0	0	0	0	0	0	0	0
Using a Liquid Level Accelerometer to Classify Motion	1	0	0	0	0	0	1	0	0
Position Versus Time Graphs	2	2	0	1	0	0	1	0	1
Speed and Acceleration on an Inclined Plane	2	0	0	1	0	0	2	0	1
Finding the Speed and Velocity of a Car Traveling in Uniform Circular Motion	3	2	1	0	1	0	0	0	0
Measurement of Speed on an Inclined Plane	3	2	0	0	0	0	2	0	1
Traveling Washer in Two Dimensions	3	2	0	1	0	1	1	0	0
Speed of a Student	2	0	0	0	0	0	0	0	2
Acceleration of a Student	4	2	0	0	2	0	0	0	0
Finding Speed and Acceleration for Stroboscopic Data	4	2	0	1	1	0	2	0	2
Pendulums on Parade	4	4	0	1	0	1	1	0	0
Making a One-Second Timer	6	5	0	3	1	1	2	1	0
Measurement of Speed on a Level Surface	7	1	1	2	0	1	5	0	3

† Participants could indicate more than one modification, so the number of modifications for any given activity may be greater than the number of participants modifying the activity.

Table D-2
Outreach Participants' Reasons for Not Using Workshop Activities in Their Classroom

	Number of Participants†										
	Number not using	Use a Different Activity	Don't Teach the Concept	Plan on Using Later this Year	Not Confident in Own Understanding of Concept	Too Difficult for Students	Too Easy for Students	Don't Have the Equipment	Activity is Too Long	Not Enough Time in School Year to Use	Other
Traveling Washer in One Dimension	9	5	1	0	0	0	1	0	0	2	0
Where Am I?	9	2	3	1	0	1	1	0	1	0	0
The Race Track Game	8	1	0	0	1	1	1	0	0	3	2
Using a Liquid Level Accelerometer to Classify Motion	8	3	1	0	0	1	0	3	0	2	0
Position Versus Time Graphs	8	0	0	0	0	1	1	7	0	0	1
Speed and Acceleration on an Inclined Plane	8	0	1	0	0	1	0	7	0	0	1
Finding the Speed and Velocity of a Car Traveling in Uniform Circular Motion	8	1	3	1	0	0	0	1	1	2	0
Measurement of Speed on an Inclined Plane	8	1	0	0	0	1	0	6	0	1	0
Traveling Washer in Two Dimensions	8	5	2	0	0	0	1	0	0	1	0
Speed of a Student	6	3	2	0	0	1	0	0	1	0	1
Acceleration of a Student	6	3	1	0	0	1	0	1	0	1	1
Finding Speed and Acceleration for Stroboscopic Data	6	1	0	0	0	1	0	3	0	0	1
Pendulums on Parade	5	2	2	0	0	1	0	0	0	1	0
Measurement of Speed on a Level Surface	4	0	1	0	0	0	0	2	0	1	0
Making a One-Second Timer	4	2	1	0	0	1	0	1	1	0	0

† Participants could indicate more than one reason for not using an activity, so the number of reasons may not be greater than the number of participants not using an activity.