Washington State LASER

2005–2006 Program Evaluation Report

Prepared for

Washington State LASER
Pacific Science Center
200 Second Avenue North
Seattle, WA 98109

Prepared by

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January 2007

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Acknowledgements

RMC Research thanks the many people who contributed to the evaluation of Washington State LASER, particularly the directors of the 9 LASER Alliance sites and their staff who so diligently administered the LASER Professional Development Survey for the past 5 years and maintained accurate and up-to-date professional development logs in the database. Special thanks to the Leadership Team of Dennis Schatz, Jeff Estes, Anne Kennedy, and Eric Wuersten for their continued support and guidance.

Executive Summary

Washington State LASER Alliance staff has maintained a database of professional development participation since 1999 and administered the LASER Professional Development Survey (see the Appendix) since 2001. The survey was administered at the beginning of the workshop when Alliance staff first began working with the participating teachers at a workshop and again near the end of the school year each year thereafter. More than 6000 surveys were collected between September 1, 2000, and June 30, 2006. This section presents the highlights from the analysis of the professional development participation and the survey data. More detailed information about the analysis process and the results appears in the later sections of this report.

Key Findings

- More than 3,000 professional development events were carried out between July 1, 1999, and June 30, 2006, accounting for more than 250,000 contact hours of professional development (see Exhibit 2).
- Nearly half of the contact hours provided focused on training teachers how to use the instructional modules; about a fifth of the hours focused specifically on science content (see Exhibit 3).
- Slightly over 5,100 teachers (71% of the teachers targeted) received 18 hours of professional development and 1,011 received the 54 hours of professional development desired for teachers to have over three years (see Exhibit 5).
- Seventy-three percent of the teachers who completed the survey during the 2005–2006 project year reported that they had not taken a college-level science course during the past 3 years (see Exhibit 8). If the teachers who had taught 5 years or less are not considered, the percentage of teachers who had not taken a college-level science class in the past 3 years increases to 84%.
- Nearly half (49%) of the teachers surveyed reported that they had been teaching for 10 years or less, and nearly a third (29%) had been teaching for 5 years or

less (see Exhibit 9). More than 2 out of every 5 teachers had been teaching science for 5 years or less.

- Half of the Grade K–5 teachers reported they teach science 50 minutes or less each week, although the amount of time teaching science each week was nearly evenly distributed across the categories on the survey (see Exhibit 10). Of those teachers, 16% reported teaching science 10 minutes or less a week and 19% reported teaching more than 90 minutes of science each week.
- Teachers reported a significant increase in their preparedness to teach the content addressed in the instructional materials. This increase was most pronounced among the teachers who had 1 year between the first and latest time they completed the survey (see Exhibit 14).
- Teachers reported being better prepared to recognize and respond to student diversity; use strategies that specifically encourage the participation of females and minorities in science; take students' prior understanding into account when planning curriculum and instruction; have students work in collaborative learning groups; help students take responsibility for their own learning; use performance-based assessment; use portfolios; use informal questioning to assess student understanding; and involve parents in the science education of their children (see Exhibit 16).
- Teachers reported a significant increase science pedagogical preparedness between the first and latest survey completion across all teachers in the paired sample and for the teachers who had 1, 2, 3, and 4 years between completed surveys (see Exhibit 18). Furthermore, the increase in science pedagogical preparedness was greatest among those teachers with 4 years between the first and latest completed surveys.
- Teachers reported being better prepared to encourage students' interest in science; engage students in inquiry-oriented activities; develop students' conceptual understanding of science; make connections between science and other disciplines; engage students in applications of science in a variety of contexts; select hands-on activities that appropriately match the learning

objectives; lead a class of students using investigative strategies; and manage a class of students engaged in hands-on/project-based work (see Exhibit 18).

- Three out of every 4 respondents indicated that the workshops had just the right amount of hands-on practice with the modules (see Exhibit 19) and explanation of the use of the modules (see Exhibit 20).
- Of those teachers who completed the survey in 2005–2006, nearly 2 out of every 5 (39%) indicated a need for more professional development that addressed the connections between Washington's Essential Academic Learning Requirements (EALRs) and the modules (see Exhibit 19) and 35% indicated a need for more practice with inquiry-based methods (see Exhibit 23). Approximately 1 out of every 3 indicated a need for more instruction in science content (see Exhibit 21) and more explanation of inquiry-based methods (see Exhibit 22).
- Nearly 4 out of 5 respondents agreed or strongly agreed that they had received adequate notice about upcoming training sessions (see Exhibit 26) and that they understood the purpose of the various trainings and which ones they should attend (see Exhibit 32).
- Fewer respondents agreed or strongly agreed that a site team was available to answer questions outside of the training time (see Exhibit 30).

Introduction

Washington State's LASER Alliances

The Leadership and Assistance for Science Education Reform (LASER) initiative, launched by the National Science Resources Center in 1998, has the overarching goal of promoting a sustainable, inquiry-based model for kindergarten through Grade 8 science education reform. Key elements of the LASER approach are the implementation of inquiry-based curricula, ongoing professional development, effective program and student assessment, curriculum materials supplied to teachers in ready-to-use condition, and the development of strong administrative and community support. The use of hands-on science modules (kits) and inquiry-based pedagogy are hallmarks of the LASER approach.

The Washington State Legislature launched LASER statewide in 1999. Washington State LASER supports annual strategic planning institutes and curriculum showcases and a network of LASER Alliances that provide the ongoing professional development, materials support, and technical assistance needed to implement inquiry-based science instruction in the participating schools. A combination of state, private, and school district sources fund the regional LASER Alliances. Washington's Office of Superintendent of Public Instruction (OSPI), Battelle (the world's largest non-profit R&D organization), and the Pacific Science Center (a science education center for children located in Seattle) provide the leadership for Washington State LASER.

Each Alliance is a coalition of school districts, educational service districts (ESDs), universities, and/or private companies. At the time of this report, 9 LASER Alliances had been established to serve different regions of Washington State:

- Southwest coordinated through ESD 112 in Vancouver.
- South Central coordinated through ESD 105 in Yakima.
- Southeast coordinated through Pacific Northwest National Laboratory and Kennewick, Richland, Pasco, and Walla Walla School Districts.

- North Sound coordinated through the Institute for Systems Biology in Seattle.
- South Sound coordinated through Evergreen State College and Tacoma Public Schools.
- Northwest coordinated by the Northwest ESD 189 in Anacortes.
- Olympic Peninsula coordinated by the Olympic ESD in Bremerton.
- North Central coordinated through ESD 171 in Wenatchee.
- Northeast coordinated through ESD 101 in Spokane.

This report provides a summary of the participation in LASER professional development offered through the LASER Alliances as of June 30, 2006, and a summary of the findings of an analysis of the professional development survey data collected since the beginning of the project.

LASER Professional Development Participation

RMC Research developed an online database for LASER Alliance staff to use to track individual teachers' participation in LASER professional development events. The database contains each participating teacher's contact information, school, and grade level taught; an indication of whether the teacher is a teacher leader; and documentation of participation in professional development. The information about each professional development event includes the date, location, facilitator, focus, and duration. Exhibit 1 identifies the number of unique participants served by each of the 9 LASER Alliances for each project year and overall since the beginning of the initiative through June 30, 2006. A project year is defined as the period from July 1 through June 30 of the designated year.

Exhibit 1
Educators Served by Site and Year

	Number of Professional Development Participants						
Site	**1999–2001**	**2001–2002**	**2002–2003**	**2003–2004**	**2004–2005**	**2005–2006**	**Total**
Southwest	1,322	1,432	1,207	963	988	719	2,849
South Central		104	122	419	717	761	1,206
Southeast			114	109	331	345	634
North Sound			629	725	1,152	1,372	2,904
Northwest			95	103	117	463	495
South Sound			118	245	872	1,533	1,946
Olympic					120	154	175
North Central						94	94
Northeast						78	78
Total	1,322	1,536	2,285	2,564	4,297	5,519	10,381

Note. The figures indicate the number of participants who attended at least one event. The total column does not equal the sum of the each year because many participants attend professional development in more than 1 project year. Counts include all participants regardless of role or teaching assignment.

Since the inception of the project the number of teachers served (nonduplicated count) increased steadily, impacting more than 10,000 educators across Washington State. The original 4 LASER Alliances account for nearly three quarters of the teachers

served. Exhibit 2 shows the number of events, the total participation in those events, and the total contact hours of professional development for each LASER Alliance for each project year.

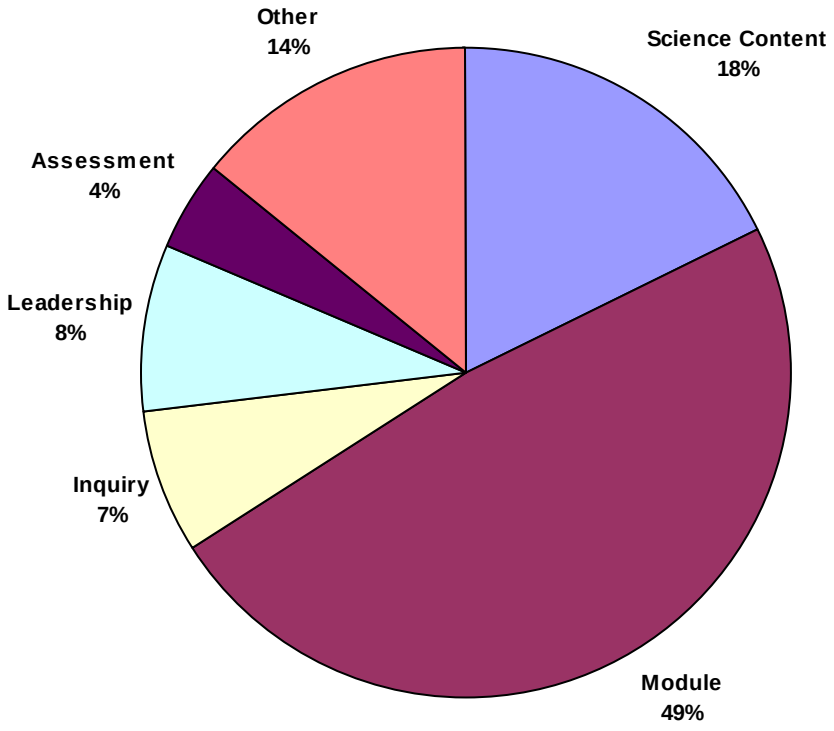
Exhibit 2
LASER Professional Development by Year and Alliance

Alliance		1999–2001	2001–2002	2002–2003	2003–2004	2004–2005	2005–2006	Total
Southwest	Events	425	250	249	221	192	205	1,542
	Participants	5,755	3,868	3,316	2,377	2,172	1,531	19,019
	Contact Hours	29,377	20,315	16,359	12,585	13,761	12,683	105,079
South Central	Events		12	24	36	61	85	218
	Participants		179	374	737	1,358	1,635	4,283
	Contact Hours		1,650	3,521	7,083	12,783	15,267	40,303
Southeast	Events			9	23	48	59	139
	Participants			166	321	774	732	1,993
	Contact Hours			2,390	2,940	4,365	6,111	15,806
North Sound	Events			132	119	99	194	544
	Participants			1,822	1,814	2,220	3,050	8,906
	Contact Hours			8,257	7,839	14,414	15,842	46,352
Northwest	Events			2	4	9	40	55
	Participants			124	151	124	757	1,156
	Contact Hours			870	889	666	9,246	11,671
South Sound	Events			35	62	138	220	455
	Participants			512	922	3,054	3,178	7,666
	Contact Hours			1,568	3,651	9,155	13,870	28,244
Olympic	Events					29	43	72
	Participants					335	458	793
	Contact Hours					1,92	2,465	4,457
North Central	Events						18	18
	Participants						228	228
	Contact Hours						1,368	1,368
Northeast	Events						23	23
	Participants						202	202
	Contact Hours						1,241	1,241
Total	Events	425	262	451	465	576	887	3,066
	Participants	5,755	4,047	6,314	6,322	10,037	11,771	44,246
	Contact Hours	29,377	21,965	32,964	34,986	57,135	78,092	254,518

Note. The participant data represents a duplicated count because an individual may participate in more than one professional development event during the same year. In this case that individual is counted for each event attended. Counts include all participants regardless of role or teaching assignment.

More than 3,000 professional development events occurred between July 1, 1999, and June 30, 2006. These events account for more than 250,000 contact hours of professional development. Exhibit 3 shows the distribution of total contact hours of professional development by type. Exhibit 4 provides details for Exhibit 3 and is based on the data in Exhibit 2 grouped by the professional development type rather than LASER Alliance.

Exhibit 3
Distribution of Contact Total Hours by Type



Nearly half of the contact hours focused on training teachers how to use the instructional modules, whereas a fifth focused specifically on science content. Alliance directors indicated, however, that science content was almost always embedded in the module training. The Other category includes professional development focused on such topics as integrating science with literacy, technology, and direct technical assistance.

Exhibit 4
LASER Professional Development by Year and Type

Type		1999–2001	2001–2002	2002–2003	2003–2004	2004–2005	2005–2006	Total
Content Training: Earth/Space Science	Events	16	20	13	33	19	32	133
	Participants	207	328	150	405	292	471	1,853
	Contact Hours	1,839	2,420	1,044	2,282	1,843	3,009	12,437
Content Training: Life Science	Events	8	31	19	10	27	26	121
	Participants	78	429	239	78	403	384	1,611
	Contact Hours	856	3,265	2,541	650	2,617	2,498	12,427
Content Training: Physical Science	Events	57	15	53	28	30	52	235
	Participants	550	254	646	438	490	662	3,040
	Contact Hours	3,470	1,797	4,447	2,711	4,463	3,208	20,096
Kit Training: Earth/Space Science	Events	35	37	56	92	70	171	461
	Participants	516	477	639	1,108	986	2,285	6,011
	Contact Hours	1,594	1,599	3,661	7,440	7,679	14,612	36,584
Kit Training: Life Science	Events	49	37	57	66	102	133	444
	Participants	406	521	664	880	1,515	1,387	5,373
	Contact Hours	1,359	2,213	3,146	4,789	10,232	11,116	32,854
Kit Training: Physical Science	Events	102	37	99	98	165	204	705
	Participants	1,132	458	1,197	1,241	3,284	2,165	9,477
	Contact Hours	3,468	2,457	7,950	8,532	15,482	14,977	52,866
Inquiry Training	Events	25	18	10	17	31	36	137
	Participants	726	463	430	304	811	680	3,414
	Contact Hours	5,353	2,576	2,139	1,366	4,068	3,158	18,659
Leadership Training	Events	21	16	13	12	38	45	145
	Participants	532	172	260	132	462	676	2,234
	Contact Hours	3,822	1,043	1,596	1,548	4,204	9,282	21,494
Assessment	Events	6	0	21	36	27	84	174
	Participants	22	0	245	556	610	1,314	2,747
	Contact Hours	206	0	803	2,242	2,713	5,161	11,124
Other	Events	106	51	110	73	67	104	511
	Participants	1,586	945	1,844	1,180	1,184	1,747	8,486
	Contact Hours	7,412	4,596	5,638	3,427	3,834	11,071	35,978
Total	Events	425	262	451	465	576	887	3,066
	Participants	5,755	4,047	6,314	6,322	10,037	11,771	44,246
	Contact Hours	29,377	21,965	32,964	34,986	57,135	78,092	254,518

Note. The participant data represents a duplicated count because teachers could participate in more than one professional development event during the same year. In this case that teacher is counted for each event attended. Counts include all participants regardless of role or teaching assignment.

For each module the goal of the LASER professional development is to provide 18 hours of training on the use of the instructional materials, the relevant content, and inquiry-based instructional practices. Because most schools implemented 1 module each year for 3 years, the target is for each teacher to receive 18 hours of professional development each year for a total of 54 hours across the 3-year implementation cycle. Based on this model, LASER has established targets for the number of teachers who participate in at least 18 hours of professional development each year beginning with the 2001–02 project year. Exhibit 5 shows the number of eligible teachers who met this target each year and the number who have participated in at least 54 hours across multiple years.

Exhibit 5
Number of Teachers Participating in at Least 18 & 54 Hours

Project Year	Less than 18 Hours	18 or More Hours	Target	Percent of Target	Average Hours
2001-2002	856	429	921	47%	14.1
2002-2003	1271	685	1382	50%	14.9
2003-2004	1609	681	1382	49%	14.0
2004-2005	2730	1259	1382	91%	13.6
2005-2006	3860	1535	1382	111%	14.0
Total:	10,326	4589	6449	71%	
	Less than 54 Hours	**54 of More Hours**			
Multiple Years	8437	1011	N/A	N/A	N/A

Note. The participant data represents an unduplicated count (unique) of teacher in each year. Counts include only core teachers and not administrators, non core teachers, visitors, consultants, etc.

During the past 2 project years, Washington State LASER has made great strides toward achieving its target of providing at least 18 hours of professional development to 1,382 core teacher each year. Furthermore, during the period between July 1, 1999, and June 30, 2006, 1,011 core teachers have participated in at least 54 hours of professional development.

Although 71% of the target number of teacher received the 18 hours of professional development over the past 5 years, there were still more people who need serving. The

average participation hours across all of the core teachers served has consistently been approximately 14 hours per year for the past 5 years. There are several reasons that probably explain why not all teachers have not received 18 hours/per year.

- Some school districts had been using inquiry-based instructional materials for a long time prior to the LASER project and were in a maintenance mode whereby only new teachers or teachers changing grade levels participated in the professional development.
- In some school districts, many participating teachers received a portion of their 18 hours before becoming part of an Alliance, thus needed less than 18 hours of professional development provided through LASER Alliance to complete their 18 hours.
- In a few cases teachers attended professional development offered by more than one LASER Alliance. In such cases the professional development for those teachers was split across the LASER Alliances.
- Some school districts have the capacity to conduct their own professional development on inquiry-based instructional materials and methods. For the most part, this school- or district-based professional development was not included in the database.
- Teachers in districts served by LASER Alliances have the opportunity to attend professional development supported through other initiatives that is not recorded in the database. For example, several districts in northwestern Washington participate in both the LASER project and the North Cascades and Olympic Science Partnership. Teachers who receive professional development in inquiry-based instructional materials and methods through other sources might be less motivated to meet the LASER professional development target.
- Participating school districts are responsible for implementing the use of inquiry-based instructional materials and methods. Washington State LASER provides support and encouragement but has little authority to require that teachers attend the targeted 18 hours of professional development per module.

- For the most part, the professional development provided by the LASER Alliances is offered in the form of open-enrollment workshops. How teachers identify which professional development to attend varies by LASER Alliance and to a greater extent by school district.
- Although the project aims to train each participating teacher on the use of each module before the teacher uses the materials with students, few of the schools and LASER Alliances have an efficient means of identifying teachers using the modules without the appropriate training. Even if identified, targeting professional development to those in need of training is also challenging.
- Although we attempt to make sure that all professional development is recorded in the database, there may be some professional development that is omitted from the database due to limited resources and administrative oversight at the LASER Alliances.

LASER Professional Development Survey Results

The LASER Professional Development Survey

Washington State LASER Alliance staff have administered the LASER Professional Development Survey (see the Appendix) since 2001. In theory, LASER Alliance staff administer the survey when they begin working with the participating teachers at the beginning of a workshop and again near the end of the school year each year thereafter. In reality each Alliance operates differently and the degree to which this goal is possible varies. For the most part, however, the LASER Alliances strive to survey each teacher they train each year. Exhibit 6 shows the number of surveys administered each year through June 30, 2006. During the 2005–2006 project year the Alliances submitted surveys for project participants served by the Eastern, North Central, Northwest, South Central, Southeast, and Southwest Washington LASER Alliances.

Exhibit 6
Professional Development Surveys Administered by Year

School Year	Professional Development Surveys Administered
2001—2002	518
2002–2003	622
2003–2004	1,111
2004–2005	2,182
2005–2006	1,710

Analysis Methods

RMC Research conducted 2 types of analysis of the survey data. To the extent appropriate, an independent sample analysis was used to compare the results from all teachers within a given project year. Comparison of independent sampling results from year to year must take into account the fact that a portion of the teachers surveyed is different each year.

The other form of analysis conducted by RMC Research is a paired sampling analysis, which involves looking for significant differences between the first time and the most recent time a teacher completes the survey. This approach depends upon the ability to link the responses of individual teachers from one year to the next using the school and the 5-digit number recorded on the survey. The survey recommends that the teacher record the last 5 digits of his or her Social Security number because this number is easily remembered from one year to the next. However, some teachers objected to writing down any portion of their Social Security number. Some LASER Alliances recommended that teachers instead record any number they could remember from one year to the next. In other cases teachers left the number field blank, making it impossible to analyze their survey results over time. For this report RMC Research successfully linked pairs of surveys for 772 teachers (one survey was the first and the other the latest survey completed by the teacher and the first and latest surveys occurred at least 1 year apart). The number of years between the first and latest surveys completed by the 772 teachers ranged from 1 to 4 years.

Definition of Composite Indexes

RMC Research used a combination of factor analysis and logical clustering of survey items to develop composite indexes of groups of items. All indexes range from 0 to 100, whereby 100 represents the maximum score on all items for the respective index. Index calculations also involved setting a threshold for the minimum number of items a respondent must have completed for an index to be calculated. The lowest threshold was 62% for indexes made up of a small number of items. After the composite indexes were calculated, RMC Research tested the composite indexes for reliability using the combined data from surveys administered since 2001 (more than 6,200 surveys). This section describes each index in greater detail.

Content Knowledge Index—The content knowledge index provides a measure of the degree to which teachers reported being knowledgeable on the topics of science in general, the human body, ecology, rocks and soils, astronomy, processes of change over time (e.g., evolution), mixtures and solutions, electricity, sound, forces and motion,

machines, and engineering and design principles (e.g., structures, models). This index uses data from 12 survey items and is considered valid if the respondent completed 8 of the 12 items. The reliability of this index was determined to have a Cronbach's Alpha score of 0.920.

Content Preparedness Index—The content preparedness index provides a measure of the degree to which teachers reported being prepared to teach the topics of science in general, the human body, ecology, rocks and soils, astronomy, processes of change over time (e.g., evolution), mixtures and solutions, electricity, sound, forces and motion, machines, and engineering and design principles (e.g., structures, models). This index uses data from 12 survey items and is considered valid if the respondent completed 8 of the 12 items. The reliability of this index was determined to have a Cronbach's Alpha score of 0.929.

General Pedagogical Preparedness Index—The general pedagogical preparedness index provides a measure of the degree to which teachers reported a preparedness to:

- Recognize and respond to student diversity.
- Use strategies that specifically encourage the participation of females and minorities in science.
- Take students' prior understanding into account when planning curriculum and instruction.
- Have students work in collaborative learning groups.
- Help students take responsibility for their own learning.
- Use performance-based assessment.
- Use portfolios.
- Use informal questioning to assess student understanding.
- Involve parents in the science education of their students.

The general pedagogical preparedness index uses data from 9 survey items and is considered valid if the respondent completed 6 of the 9 items. The reliability of this index was determined to have a Cronbach's Alpha score of 0.897.

Science Pedagogical Preparedness Index—The science pedagogical preparedness index provides a measure of the degree to which teachers reported a preparedness to:

- Encourage students' interest in science.
- Engage students in inquiry-oriented activities.
- Develop students' conceptual understanding of science.
- Make connections between science and other disciplines.
- Engage students in applications of science in a variety of contexts.
- Select hands-on activities that are an appropriate match for the learning objectives.
- Lead a class of students using investigative strategies.
- Manage a class of students engaged in hands-on/project-based work.

The science pedagogical preparedness index uses data from 8 survey items and is considered valid if the respondent completed 5 of the 8 items. The reliability of this index was determined to have a Cronbach's Alpha score of 0.935.

Findings

This section describes each section of the survey and the composite indexes and summarizes the results of the analysis of each. The analysis results tables display the comparisons that are statistically significant ($p <= 0.03$) in boldface. The remainder of this section summarizes the findings in narrative form and, where appropriate, provides the relevant *t*-test results.

Participant Profile

Seventy-six percent of the teachers who completed a survey during the 2005–2006 project year taught at Grades K–5, and 18% of the teachers taught at Grades 6–8 (see Exhibit 7).

Exhibit 7
Distribution of Teachers by Grade Level

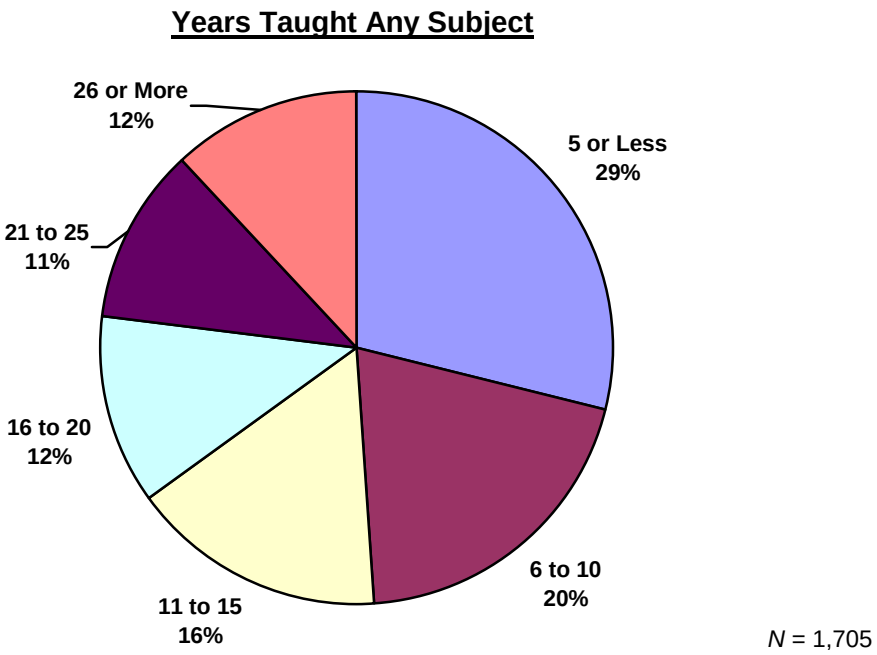
	Grades K–2		Grades 3–5		Grades 6–8		Grades 9–12		
Project Year	***n***	**%**	***n***	**%**	***n***	**%**	***n***	**%**	**Total**
2001–2002	165	32%	203	39%	185	35%	9	2%	523
2002–2003	274	44%	274	44%	98	16%	14	2%	625
2003–2004	455	39%	534	45%	182	15%	7	1%	1,175
2004–2005	887	40%	991	44%	342	15%	29	1%	2,245
2005–2006	641	37%	681	39%	321	18%	31	2%	1,742
	2,422	38%	2,683	43%	1,128	18%	90	1%	6,310

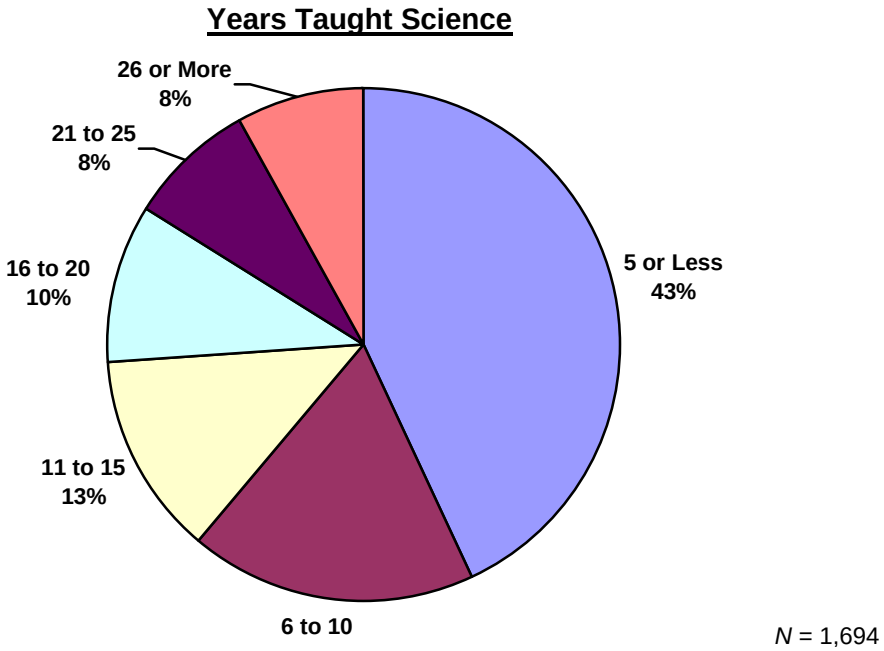
Seventy-three percent of those who completed the survey during the 2005–2006 project year reported that they had not taken a college-level science course during the past 3 years (see Exhibit 8). If the teachers who had taught 5 years or less are not considered, then the percentage of teachers who had not taken a college-level science class in the past 3 years increases to 84% of the respondents. This education pattern is similar to that of previous years' survey respondents.

Exhibit 8
Time Since Last College Course in Science

	Number/Percent of Teacher Respondents										
	< 3 Months		3–6 Months		6–12 Months		1–3 Years		> 3 Years		
Project Year	***n***	**%**	***n***	**%**	***n***	**%**	***n***	**%**	***n***	**%**	**Total**
All Teachers Who Submitted a Survey											
2005–2006	49	3%	36	2%	73	4%	291	17%	1,221	73%	1,670
2001–2005	187	4%	149	3%	154	4%	773	18%	3,131	71%	4,394
Teachers With More Than 5 Years Teaching Experience											
2005–2006	29	2%	22	2%	41	3%	93	8%	987	84%	1,172
2001–2005	128	4%	83	3%	78	3%	331	11%	2,414	80%	3,034

Exhibit 9
Years of Teaching and Teaching Science: 2005–2006 Project Year



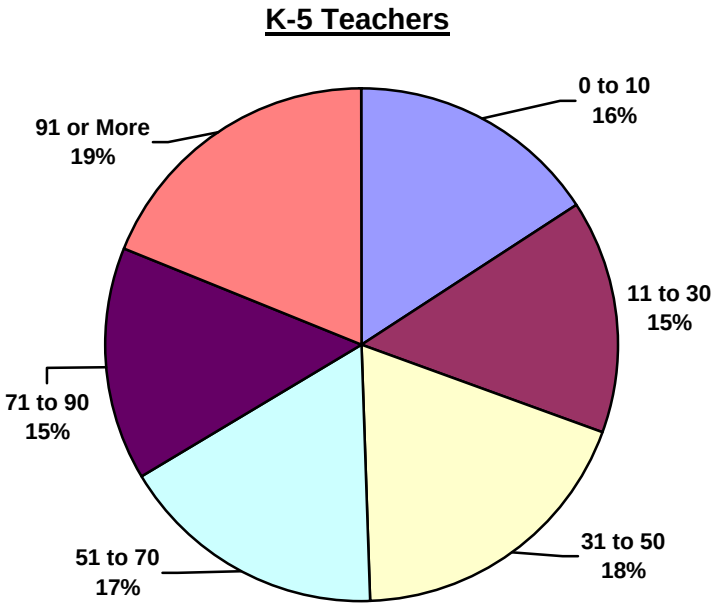


Nearly half (49%) of the teachers surveyed reported that they had been teaching for 10 years or less and nearly a third (29%) had been teaching for 5 years or less. More than 2 out of every 5 teachers had been teaching science for 5 years or less. The project

also involves many veteran teachers. Twelve percent of the teachers surveyed reported that they had been teaching for 26 years or more and 8% reported that they had taught science for 26 years or more (see Exhibit 9).

The amount of time Grade K–5 teachers reported teaching science each week was nearly evenly distributed across the categories on the survey (see Exhibit 10). Half (51%) of the Grade K–5 teachers reported teaching science more than 50 minutes a week and half (49%) reported teaching science 50 minutes or less. Of the latter, 16% reported teaching science 10 minutes or less a week. Conversely, nearly 1 out of every 5 (19%) Grade K–5 teachers reported teaching more than 90 minutes of science each week.

Exhibit 10
Minutes Teaching Science per Week: 2005–2006 Project Year

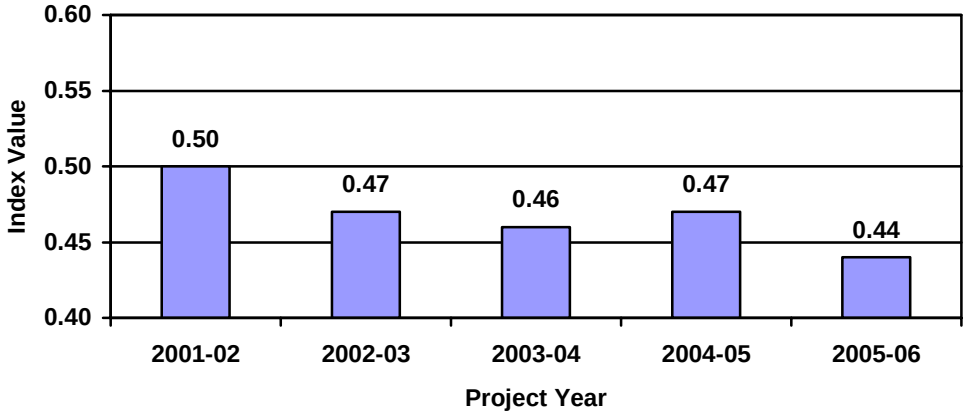


N = 1,276

Content Knowledge

The content knowledge index provides a measure of the degree to which teachers reported being knowledgeable on the topics of science in general, the human body, ecology, rocks and soils, astronomy, processes of change over time (e.g., evolution), mixtures and solutions, electricity, sound, forces and motion, machines, and engineering and design principles (e.g., structures, models).

Exhibit 11
Content Knowledge Index Trend: All Respondents



As Exhibit 11 shows, the mean content knowledge index value decreased over the past 5 survey administration years. Several explanations for the declining content knowledge index values are plausible. One likely explanation is that teachers are not aware of what they do not know until they have some experience using the instructional materials. The inquiry-based science instructional materials require a certain level of content knowledge. Sometimes teachers believe that they understand the content but find themselves unable to adequately answer student questions, which compels them to more realistically asses their content knowledge.

Another possible explanation could be that the survey is showing differences between the 5 cohorts of respondents. Each year, the population of teachers who complete the survey changes as teachers retire, change schools or teaching assignments, and are

replaced by new teachers or teachers from other schools. Over time the cohort changes considerably. In the case of the LASER project, the teachers who completed the survey during the 2001–2002 project year reported a significantly higher knowledge of science content than did the group that completed the survey during the 2005–2006 project year.

Exhibit 12 shows the results of the paired analysis where the results of participants' first completed survey are compared with those of their most recently completed survey. The analysis of the changes in the mean score of the content knowledge index was performed for all teachers in the paired sample and with respect to the number of project years between the first and latest completed survey. There was no significant change (at the .03 level) in the content knowledge index for the overall population or for any of the subgroups.

Exhibit 12
Content Knowledge Index Results: Paired

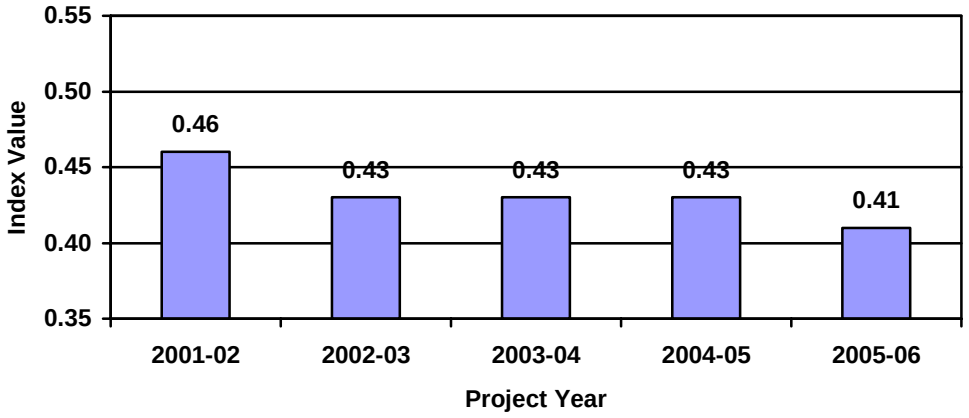
Participant Group	*N*	*M*	*SD*	*M* Diff	*SE*	*p*
All participants who Completed a Survey at Least a Year After They Completed Their Initial Survey						
First Survey	750	0.450	0.007	0.010	0.005	.043
Latest Survey	750	0.461	0.006			
Participants with 1 Year Between First and Latest Survey						
First Survey	367	0.436	0.192	0.008	0.008	.275
Latest Survey	367	0.444	0.173			
Participants with 2 Years Between First and Latest Survey						
First Survey	209	0.449	0.183	0.008	0.010	.456
Latest Survey	209	0.457	0.162			
Participants with 3 Years Between First and Latest Survey						
First Survey	150	0.468	0.180	0.017	0.010	.096
Latest Survey	150	0.485	0.169			
Participants with 4 Years Between First and Latest Survey						
First Survey	24	0.579	0.235	0.026	0.024	.302
Latest Survey	24	0.605	0.226			

Note. For the purpose of this analysis, a change that results in a *t*-test *p*-value of .03 or less is considered significant.

Content Preparedness

The content preparedness index provides a measure of the degree to which teachers reported being prepared to teach the topics of science in general, the human body, ecology, rocks and soils, astronomy, processes of change over time (e.g., evolution), mixtures and solutions, electricity, sound, forces and motion, machines, and engineering and design principles (e.g., structures, models). As Exhibit 13 shows, the content preparedness index shows a similar trend to that of the content knowledge index over the past 5 years. Teachers who completed the survey during the 2005–2006 project year reported a significantly lower content preparedness index score that did the teachers who completed the survey during the 2001–2002 project year.

Exhibit 13
Content Preparedness Index Trend: All Respondents



Possible explanations for the trend parallel those described in the preceding section. That is, as teachers use the instructional materials and become more familiar with the content, they may take a more critical view of how well prepared they are to teach the content addressed in the instructional materials.

Exhibit 14 shows the results of the paired analysis. In this case the comparison of the content preparedness index from the first to the latest survey indicates a small but significant increase. That is, teachers reported a significant increase in their

preparedness to teach the content addressed in the instructional materials. This increase is most pronounced among the teachers who had 1 year between the first and latest time they completed the survey.

Exhibit 14
Content Preparedness Index Results: Paired

Participant Group	*N*	*M*	*SD*	*M* Diff	*SE*	*p*
All participants Who Completed a Survey at Least a Year After They Completed Their Initial Survey						
First Survey	726	0.417	0.200	0.018	0.006	**.004**
Latest Survey	726	0.435	0.188			
Participants with 1 Year Between First and Latest Survey						
First Survey	357	0.396	0.203	0.022	0.009	**.019**
Latest Survey	357	0.418	0.184			
Participants with 2 Years Between First and Latest Survey						
First Survey	202	0.425	0.196	0.006	0.013	.635
Latest Survey	202	0.431	0.184			
Participants with 3 Years Between First and Latest Survey						
First Survey	146	0.434	0.189	0.023	0.013	.065
Latest Survey	146	0.458	0.186			
Participants with 4 Years Between First and Latest Survey						
First Survey	21	0.555	0.210	0.046	0.027	.114
Latest Survey	21	0.600	0.218			

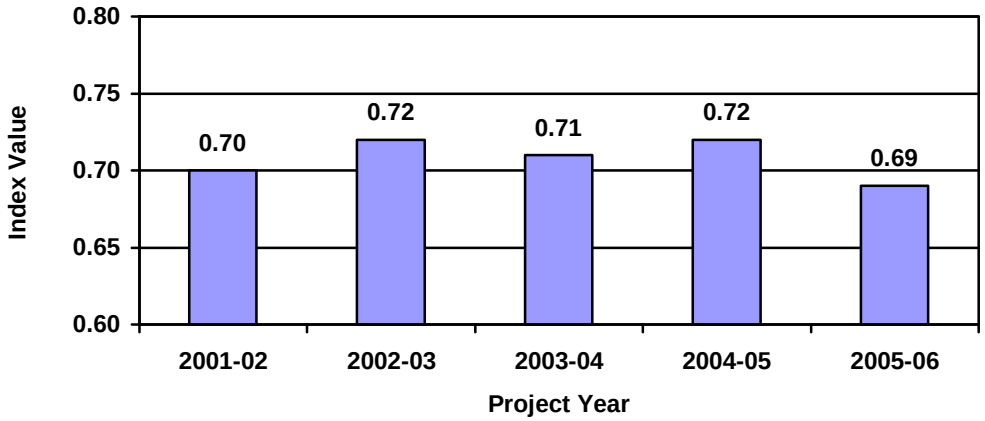
Note. For the purpose of this analysis, a change that results in a *t*-test *p* value of .03 or less is considered significant.

General Pedagogical Preparedness

The general pedagogical preparedness index provides a measure of the degree to which teachers reported a preparedness to recognize and respond to student diversity; use strategies that specifically encourage the participation of females and minorities in science; take students' prior understanding into account when planning curriculum and instruction; have students work in collaborative learning groups; help students take responsibility for their own learning; use performance-based assessment; use portfolios; use informal questioning to assess student understanding; and involve parents in the science education of their students.

The analysis of the general pedagogical preparedness index for each cohort of teachers who completed the survey over the past 5 project years revealed only slight variations in the index value over time (see Exhibit 15).

Exhibit 15
General Pedagogical Preparedness Index Trend: All Respondents



Among the 735 teachers for whom paired analysis was possible was evident a small but significant increase in general pedagogical preparedness from the first to the latest time they completed the survey (see Exhibit 16). This increase was also significant for the teachers who had 1, 3, and 4 years between the first and the latest survey completion. Why those who had 2 years between the first and latest surveys showed no significant increase is unknown.

Exhibit 16
General Pedagogical Preparedness Index Results: Paired

Participant Group	*N*	*M*	*SD*	*M* Diff	*SE*	*p*
All participants Who Completed a Survey at Least a Year After They Completed Their Initial Survey						
First Survey	735	0.682	0.167	0.028	0.006	**<.001**
Latest Survey	735	0.709	0.149			
Participants with 1 Year Between First and Latest Survey						
First Survey	357	0.683	0.165	0.020	0.008	**.016**
Latest Survey	357	0.702	0.150			
Participants with 2 Years Between First and Latest Survey						
First Survey	209	0.678	0.171	0.019	0.012	.117
Latest Survey	209	0.696	0.156			
Participants with 3 Years Between First and Latest Survey						
First Survey	145	0.692	0.164	0.044	0.013	**.001**
Latest Survey	145	0.736	0.133			
Participants with 4 Years Between First and Latest Survey						
First Survey	24	0.637	0.182	0.126	0.024	**<. 001**
Latest Survey	24	0.762	0.148			

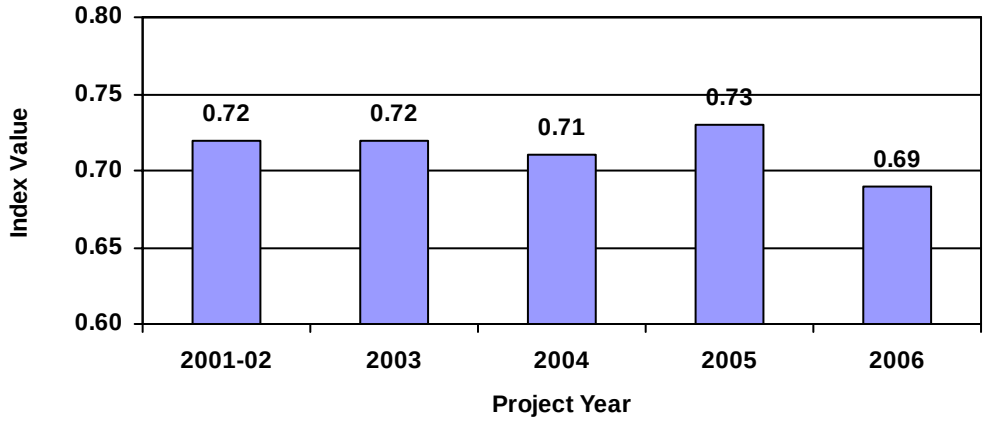
Note. For the purpose of this analysis, a change that results in a *t*-test *p*-value of .03 or less is considered significant.

Science Pedagogical Preparedness

The science pedagogical preparedness index provides a measure of the degree to which teachers reported a preparedness to encourage students' interest in science; engage students in inquiry-oriented activities; develop students' conceptual understanding of science; make connections between science and other disciplines; engage students in applications of science in a variety of contexts; select hands-on activities that appropriately match the learning objectives; lead a class of students using investigative strategies; and manage a class of students engaged in hands-on/project-based work.

The data trend for the science pedagogical preparedness index for each cohort of teachers is very consistent over the past 5 years though a slight decrease occurred among the teachers who completed the survey in the 2005–2006 project year (see Exhibit 17).

Exhibit 17
Science Pedagogical Preparedness Index Trend: All Respondents



Of the 4 indexes measured by the survey, the science pedagogical preparedness showed the greatest increase among the 738 teachers where paired analysis was possible. Significant increases are evident between the first and latest survey completion across all teachers in the paired sample and for the teachers who had 1, 2, 3, and 4 years between completed surveys (see Exhibit 18). Furthermore, the increase in science pedagogical preparedness was greatest among those teachers with 4 years between the first and latest completed surveys.

Exhibit 18
Science Pedagogical Preparedness Index Results: Paired

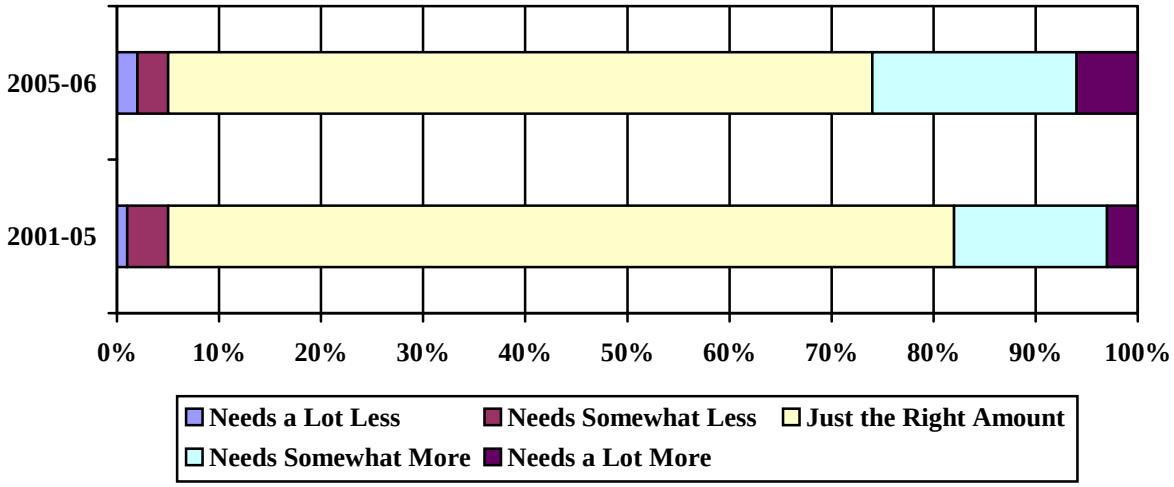
Participant Group	*N*	*M*	*SD*	*M* Diff	*SE*	*p*
All Participants Who Completed a Survey at Least a Year After They Completed Their Initial Survey						
First Survey	738	0.681	0.193	0.051	0.007	**< .001**
Latest Survey	738	0.732	0.159			
Participants with 1 Year Between First and Latest Survey						
First Survey	360	0.675	0.193	0.041	0.009	**< .001**
Latest Survey	360	0.716	0.166			
Participants with 2 Years Between First and Latest Survey						
First Survey	209	0.673	0.200	0.049	0.013	**< .001**
Latest Survey	209	0.722	0.157			
Participants with 3 Years Between First and Latest Survey						
First Survey	145	0.697	0.186	0.070	0.015	**< .001**
Latest Survey	145	0.767	0.361			
Participants with 4 Years Between First and Latest Survey						
First Survey	24	0.737	0.190	0.095	0.030	**.004**
Latest Survey	24	0.832	0.142			

Note. For the purpose of this analysis, a change that results in a *t*-test *p* value of .03 or less is considered significant.

Professional Development Needs

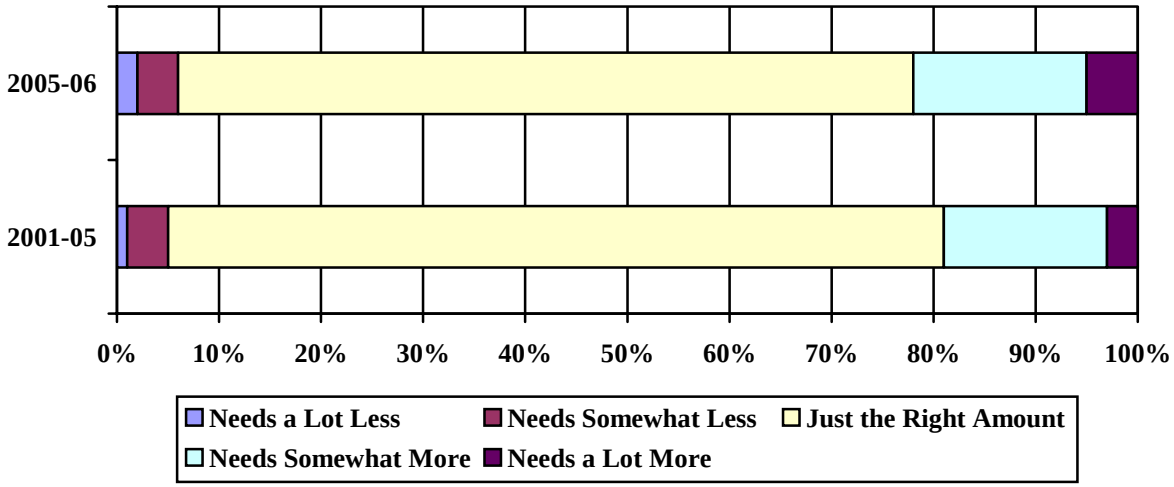
In the professional development needs section of the survey, participants were asked how the effectiveness of the professional development provided through Washington State LASER could be improved. For each component of the professional development participants indicated whether the level of attention should increase a lot, should increase somewhat, was just the right amount, should decrease somewhat, or should decrease a lot. Exhibits 19 through 26 show the frequency distribution of the results from the surveys completed during the 2005–2006 school year compared to the frequency of responses for all previous years (2001 through 2005).

Exhibit 19
Hands-On Practice With the Kits/Modules



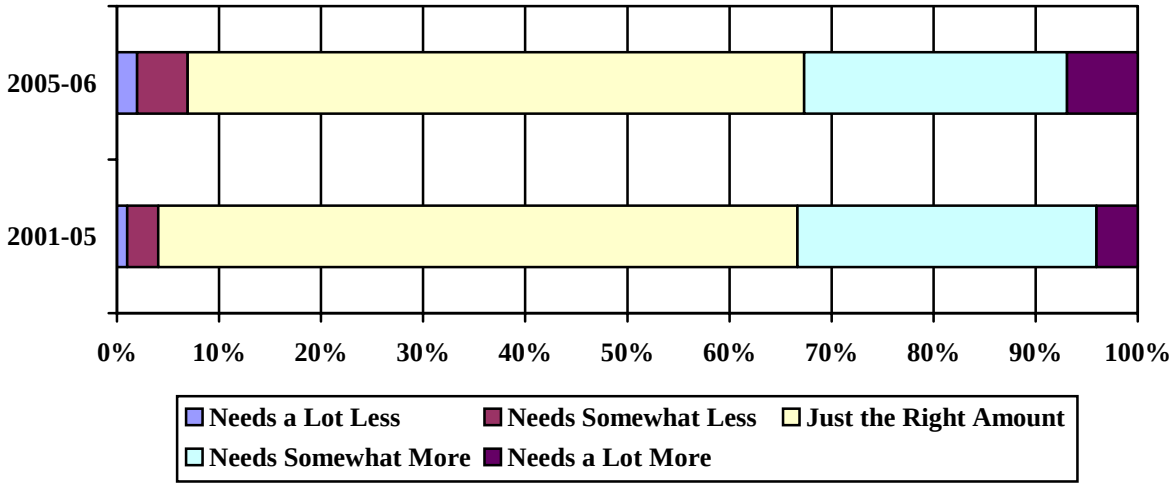
2005–2006: *N* = 1,314 2001–2005: *N* = 1,939

Exhibit 20
Explanation About the Use of the Kits/Modules



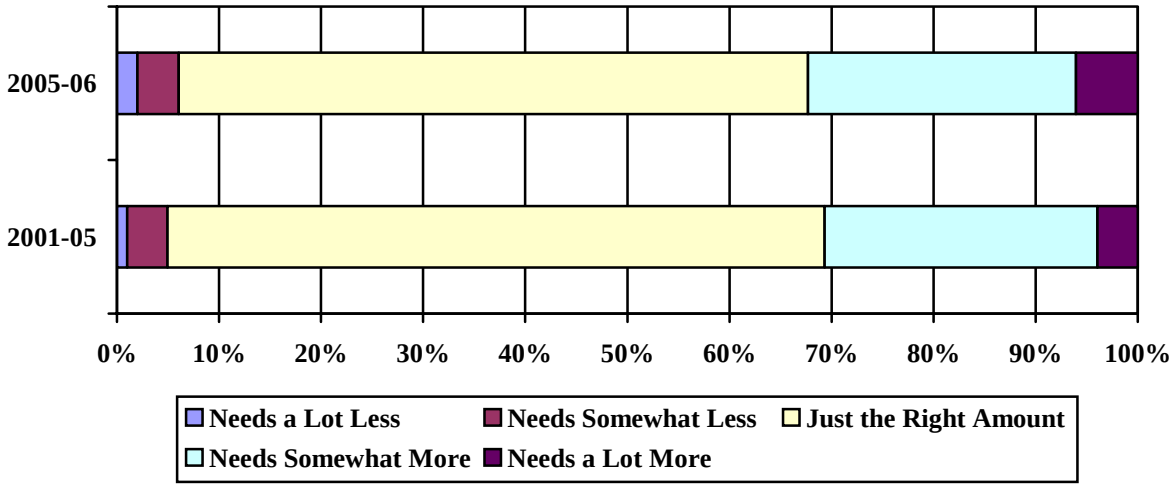
2005–2006: *N* = 1,312 2001–2005: *N* = 1,930

Exhibit 21
Instruction in Science Content



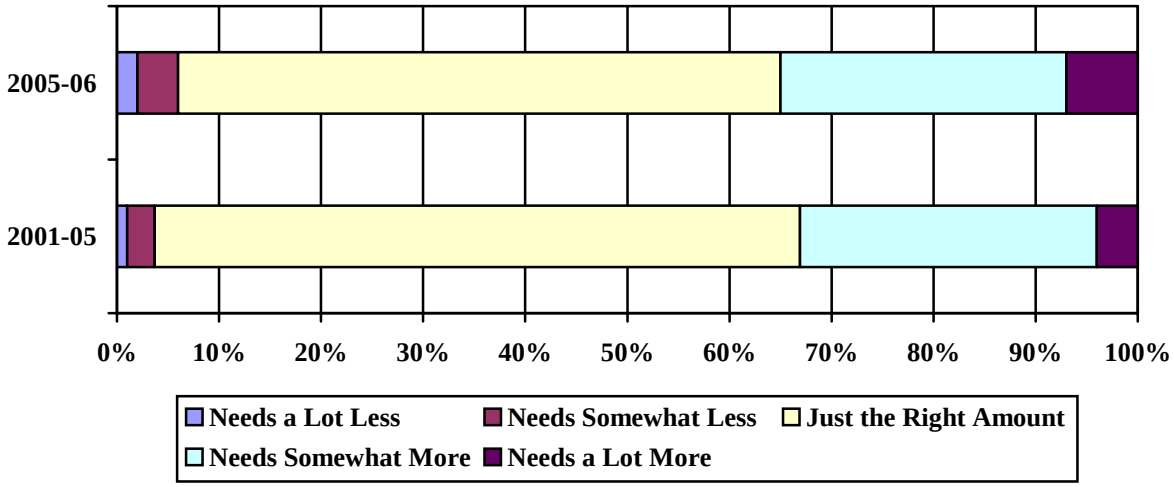
2005–2006: *N* = 1,308 2001–2005: *N* = 1,938

Exhibit 22
Explanation of Inquiry-Based Methods



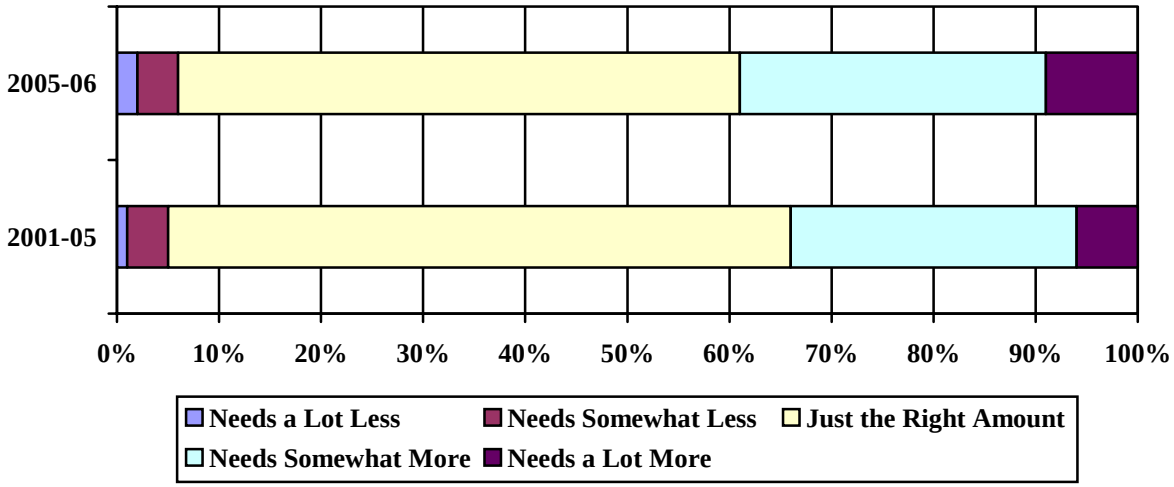
2005–2006: *N* = 1,316 2001–2005: *N* = 1,939

Exhibit 23
Practice With Inquiry-Based Methods



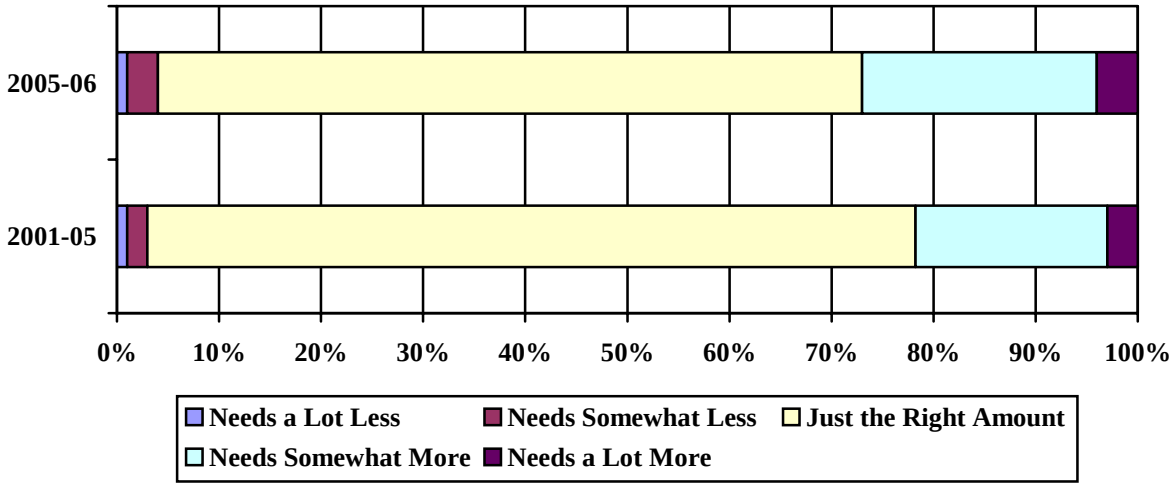
2005–2006: *N* = 1,314 2001–2005: *N* = 1,944

Exhibit 24
Connection of EALRs to Kits/Modules



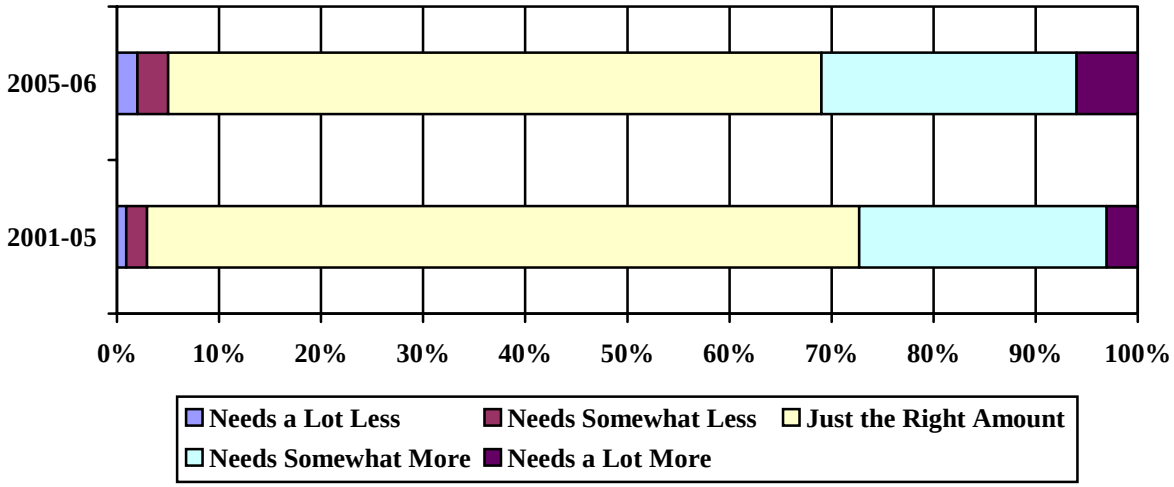
2005–2006: *N* = 1,309 2001–2005: *N* = 1,938

Exhibit 25
Connection of Science Content to Kits/Modules



2005–2006: *N* = 1,307 2001–2005: *N* = 1,940

Exhibit 26
Integration of Inquiry-Based Methods With My Personal Experience



2005–2006: *N* = 1,287 2001–2005: *N* = 1,922

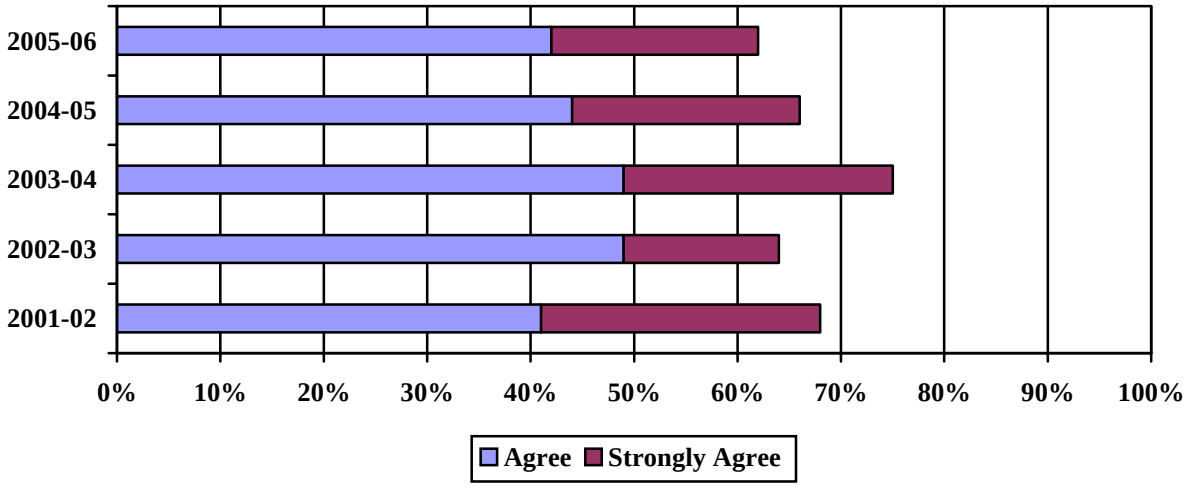
Overall, 2 out of every 3 (67%) of the responses in this section indicated that the professional development had just about the right amount of emphasis on the respective component. Three out of every 4 respondents indicated that the professional development had just the right amount of hands-on experience with the modules and explanation about the use of the modules.

Overall only about 4% of the responses indicated that the workshops should emphasize any component less, whereas nearly 3 out of every 10 (29%) responses indicated a need for more of the workshop components. Of the 2005–2006 survey respondents, nearly 2 out of every 5 (39%) indicated a need for more professional development that addressed the connections between Washington's Essential Academic Learning Requirements (EALRs) and the modules (see Exhibit 24) and 35% indicated needing more practice with inquiry-based methods (see Exhibit 23). Approximately 1 out of every 3 indicated needing more instruction in science content (see Exhibit 21) and more explanation of inquiry-based methods (see Exhibit 22).

Materials Support

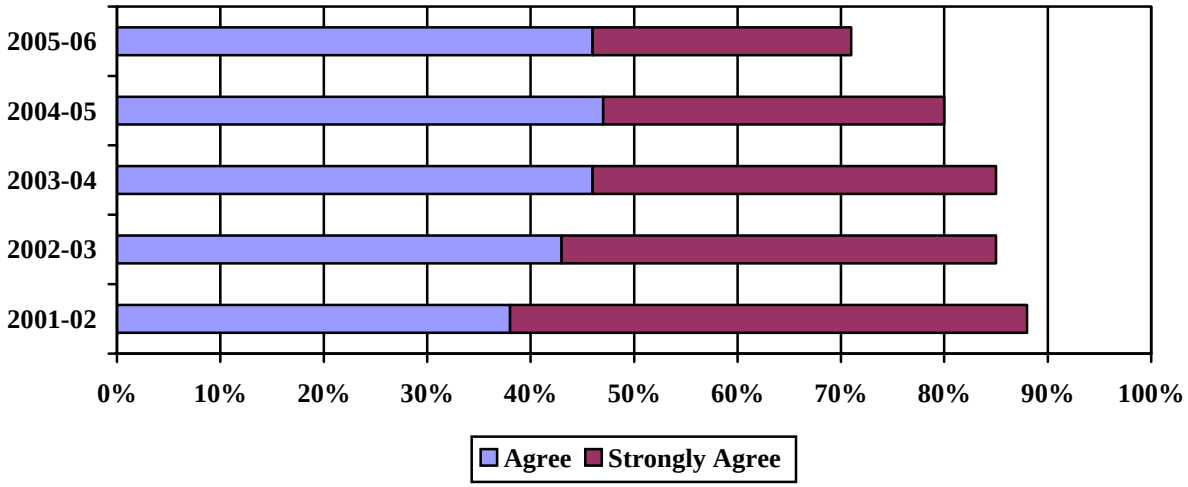
The survey also contains a series of items about the LASER Alliance technical assistance and materials support services. Respondents indicated whether they strongly agreed, agreed, disagreed, strongly disagreed, or were uncertain about statements describing Alliance services. Exhibits 27 through 33 provide the frequency distribution of those who agreed and strongly agreed for the past 5 years of survey administration.

Exhibit 27
Modules (Kits) are available when I need them



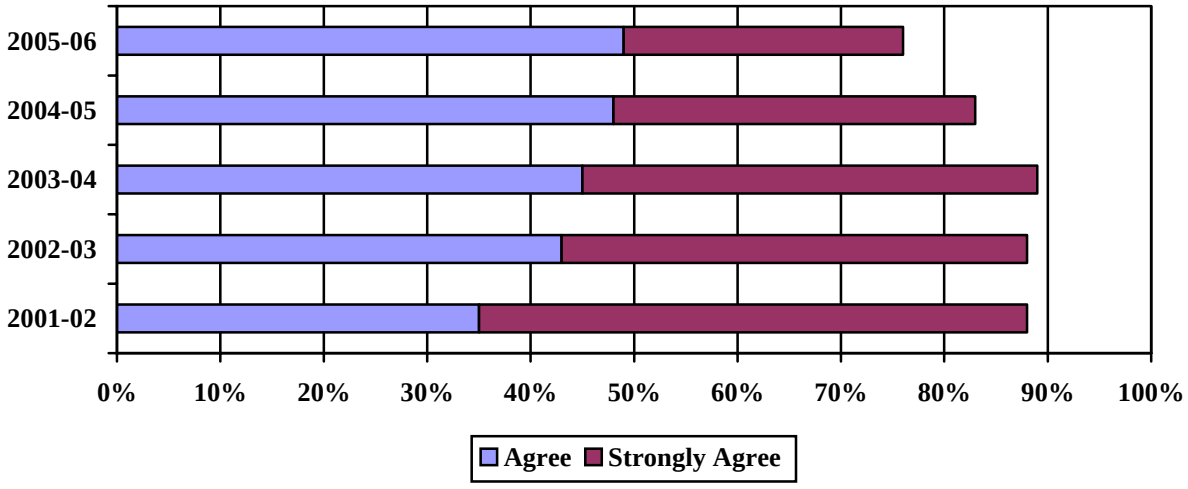
2001–02: *N* = 116 2002–03: *N* = 259 2003–04: *N* = 469 2004–05: *N* = 1,073 2005–06: *N* = 1,348

Exhibit 28
Modules (Kits) are complete when I receive them



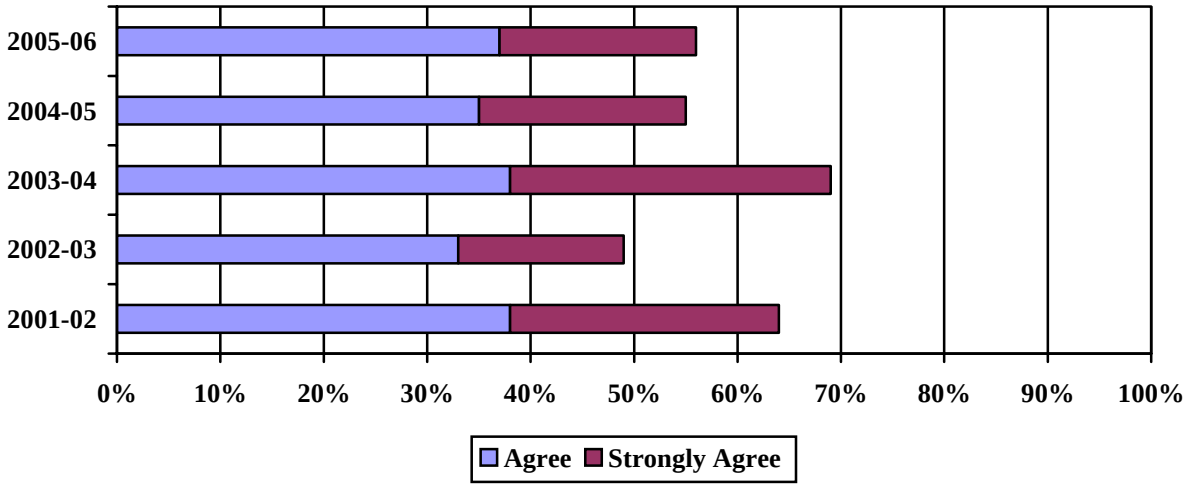
2001–02: *N* = 119 2002–03: *N* = 261 2003–04: *N* = 474 2004–05: *N* = 1,077 2005–06: *N* = 1,337

Exhibit 29
Modules (Kits) are in good condition when I receive them



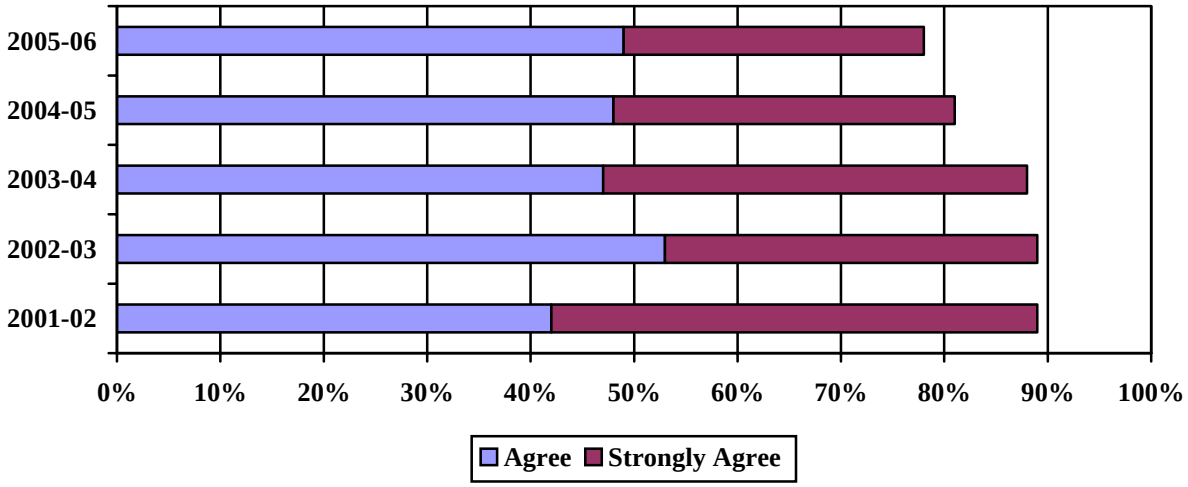
2001–02: *N* = 119 2002–03: *N* = 261 2003–04: *N* = 478 2004–05: *N* = 1,078 2005–06: *N* = 1,334

Exhibit 30
The site team is available to answer my questions outside of training time



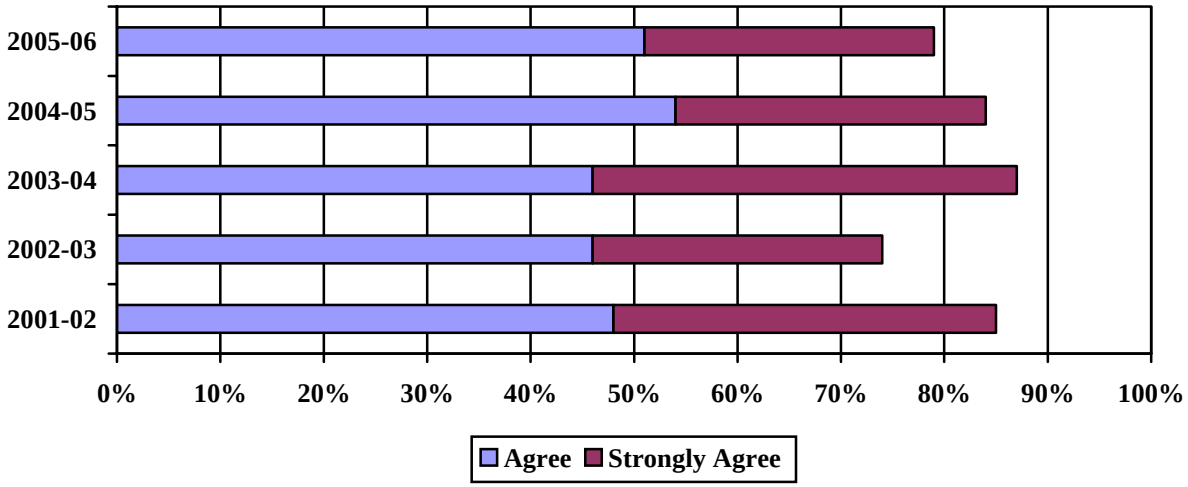
2001–02: *N* = 112 2002–03: *N* = 251 2003–04: *N* = 465 2004–05: *N* = 1,046 2005–06: *N* = 1,330

Exhibit 31
I receive adequate notice about upcoming training sessions



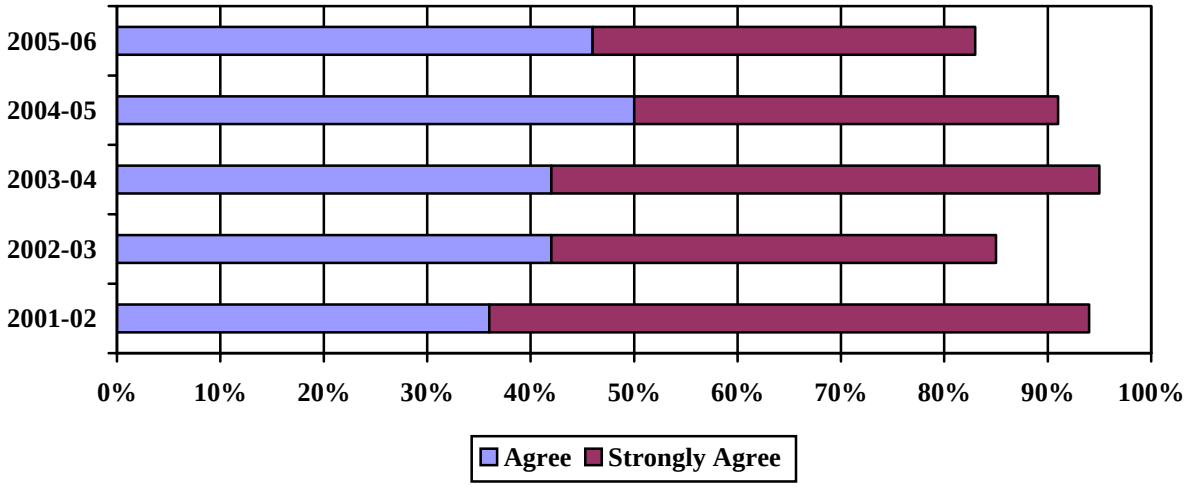
2001–02: *N* = 118 2002–03: *N* = 261 2003–04: *N* = 483 2004–05: *N* = 1,088 2005–06: *N* = 1,364

Exhibit 32
I understand what the various trainings are for and which ones I should attend



2001–02: *N* = 117 2002–03: *N* = 262 2003–04: *N* = 481 2004–05: *N* = 1,089 2005–06: *N* = 1,364

Exhibit 33
The trainings have contributed positively to my professional development



2001–02: *N* = 118 2002–03: *N* = 256 2003–04: *N* = 482 2004–05: *N* = 1,088 2005–06: *N* = 1,357

Overall, the percentages of respondents who agreed or strongly agreed with the positive statements about Alliance services far outnumber the percentages of respondents who disagreed or strongly disagreed. For most of the statements slightly fewer respondents agreed or strongly agreed in the 2005–2006 than in previous years.

Of the 2005–2006 survey respondents, more than 5 out of every 6 (83%) reported agreeing or strongly agreeing that the training had contributed positively to their professional development (see Exhibit 33). Nearly 4 out of 5 agreed or strongly agreed that they had received adequate notice about upcoming training sessions (see Exhibit 31) and that they understood the purpose of the various trainings and which ones they should attend (see Exhibit 32). More that 3 out of 4 (77%) reported that the modules were in good condition when they received them (see Exhibit 29).

Fewer agreed or strongly agreed that a site team was available to answer questions outside of the training time (see Exhibit 30) and that the kits were available when they needed them (see Exhibit 27).

Conclusion

Washington State LASER has accomplished a great deal since its conception in 1999. Many elementary schools that taught little or no science now have in place a coherent science program that includes the use of hands-on, inquiry-based science instructional materials. LASER has provided more than 250,000 contact hours of professional development on the use of the instructional modules, science content, inquiry-based instructional methods, leadership, and related topics. The analysis of participation in the professional development indicates that the LASER Alliances have, for the first time in 2005–60 project year, exceeded the desired number of teachers with at least 18 hours of professional development per year. This effort has significantly and positively impacted the degree to which teachers have reported feeling better prepared to teach the content addressed in the instructional materials and to implement inquiry-based science instructional practices.

Appendix
LASER Professional Development Survey

LASER Professional Development Survey

2005–2006 Program Year

Today's date: _____/_____/_____ Month / Day / Year

District: _____ **School:** _____

Last 5 digits of your Social Security Number: ____ - ____ ____ ____ ____

(Numbers used only to link your responses on this survey to your responses on previous surveys)

Thank you for completing this survey. ***We are interested in your experiences and views about the professional development activities in which you have participated***. The results will help us to understand how well the LASER professional development program is working and how to improve it in the future. **The results of your survey will be kept confidential. Only group data will be reported.**

1. Which LASER Alliance serves your school district? (check only **one**)

❒ Southwest Washington LASER Alliance (ESD 112)
❒ South Central Washington LASER Alliance (ESD 105)
❒ Southeast Washington LASER Alliance (Tri Cities)
❒ North Sound LASER Alliance (ISB)
❒ Northwest Washington LASER Alliance (ESD 189)
❒ Olympic Peninsula LASER Alliance (Olympic ESD 114)
❒ South Sound LASER Alliance (Tacoma/Evergreen)
❒ North Central Washington LASER Allinace
❒ Eastern Washington LASER Alliance

2. Are you currently a lead teacher or in training to be a lead teacher? ❒Yes ❒No

NOTE: A lead teacher is one who has additional responsibility to train and assist other teachers in his or her school.

3. What grade(s) do you teach (during 2005–2006)?

❒ K, 1, or 2 ❒ 3, 4, or 5 ❒ 6, 7, or 8 ❒ 9, 10, 11, or 12

4. Approximately how many semesters of college coursework in each of the following areas have you completed? If you did not complete any semesters, enter "0" and skip to Question 6.

Life science: _____ semesters Physical science: _____ semesters
Earth or space science: _____ semesters

5. How long has it been since you last took a college course in science?

❒ Less than 3 months ago ❒ 3 to 6 months ago ❒ More than 6 months, but less than 1 year ago ❒1 to 3 years ago ❒ More than 3 years ago

6. How many years have you taught **any subject**?

❒ 0–2 ❒ 3–5 ❒ 6–10 ❒ 11–15 ❒ 16–20 ❒ 21–25 ❒ 26 or more

7. How many years have you taught **science**?

❒ 0–2 ❒ 3–5 ❒ 6–10 ❒ 11–15 ❒ 16–20 ❒ 21–25 ❒ 26 or more

8. During the 2005–2006 school year, approximately how many minutes do you spend teaching **science** each week?

❒ 0–10 ❒ 11–30 ❒ 31–50 ❒ 51–70 ❒ 71–90 ❒ 91 or more

9. How many different science kits/modules have you previously taught?

❒ 0 ❒ 1 ❒ 2 ❒ 3 ❒ 4 or more

Being **knowledgeable** in a subject and being **prepared to teach** that subject are not always the same thing. In this section of the survey, you are asked to rate how knowledgeable you are about various subjects and how prepared you feel to teach these subjects.

10. How knowledgeable are you and how well prepared do you feel to teach each of the following subjects at the grade levels you teach, whether or not you are currently teaching these subjects?

Subject	**Knowledge**					**Preparedness**				
	Very high level of knowledge	**High** level of knowledge	**Moderate** level of knowledge	**Low** level of knowledge	**Very low** level or no knowledge	**Very well prepared** to teach	**Well prepared** to teach	**Adequately prepared** to teach	**Less than adequately prepared** to teach	**Completely unprepared** to teach
a. Science	⑤	④	③	②	①	⑤	④	③	②	①
b. Mathematics	⑤	④	③	②	①	⑤	④	③	②	①
c. Reading/language arts	⑤	④	③	②	①	⑤	④	③	②	①
d. Social studies	⑤	④	③	②	①	⑤	④	③	②	①

11. How knowledgeable are you and how well prepared do you feel to teach each of the following science topics/concepts at the grade levels you teach, whether or not the topics are currently included in your curriculum?

Topic	**Knowledge**					**Preparedness**				
	Very high level of knowledge	**High** level of knowledge	**Moderate** level of knowledge	**Low** level of knowledge	**Very low** level or no knowledge	**Very well prepared** to teach	**Well prepared** to teach	**Adequately prepared** to teach	**Less than adequately prepared** to teach	**Completely unprepared** to teach
a. The human body	⑤	④	③	②	①	⑤	④	③	②	①
b. Ecology	⑤	④	③	②	①	⑤	④	③	②	①
c. Rocks and soils	⑤	④	③	②	①	⑤	④	③	②	①
d. Astronomy	⑤	④	③	②	①	⑤	④	③	②	①
e. Processes of change over time (e.g., evolution)	⑤	④	③	②	①	⑤	④	③	②	①
f. Mixtures and solutions	⑤	④	③	②	①	⑤	④	③	②	①
g. Electricity	⑤	④	③	②	①	⑤	④	③	②	①
h. Sound	⑤	④	③	②	①	⑤	④	③	②	①
i. Forces and motion	⑤	④	③	②	①	⑤	④	③	②	①
j. Machines	⑤	④	③	②	①	⑤	④	③	②	①
k. Engineering and design principles (e.g., structures, models)	⑤	④	③	②	①	⑤	④	③	②	①

12. Several educational practices are listed below. How well prepared do you feel to use each practice in your science classroom? (Please respond to each item whether or not you are currently using the practice.)

Practice	**Preparedness**				
	Very well prepared to teach	**Well prepared** to teach	**Adequately prepared** to teach	**Less than adequately prepared** to teach	**Completely unprepared** to teach
1. Recognize and respond to student diversity	⑤	④	③	②	①
2. Use strategies that specifically encourage the participation of females and minorities in science	⑤	④	③	②	①
3. Encourage students' interest in science	⑤	④	③	②	①
4. Take students' prior understanding into account when planning curriculum and instruction	⑤	④	③	②	①
5. Engage students in inquiry-oriented activities	⑤	④	③	②	①
6. Develop students' conceptual understanding of science	⑤	④	③	②	①
7. Make connections between science and other disciplines	⑤	④	③	②	①
8. Engage students in applications of science in a variety of contexts	⑤	④	③	②	①
9. Select hands-on activities that are an appropriate match for learning objectives	⑤	④	③	②	①
10. Lead a class of students using investigative strategies	⑤	④	③	②	①
11. Manage a class of students engaged in hands-on/project-based work	⑤	④	③	②	①
12. Have students work in collaborative learning groups	⑤	④	③	②	①
13. Help students take responsibility for their own learning	⑤	④	③	②	①
14. Use performance-based assessment	⑤	④	③	②	①
15. Use portfolios	⑤	④	③	②	①
16. Use informal questioning to assess student understanding	⑤	④	③	②	①
17. Involve parents in the science education of their students	⑤	④	③	②	①

13. If you could make one change to improve science education *in your school*, what would it be?

14. Consider the professional development you have received through LASER so far and how it might be made more effective in helping teachers use kits/modules to implement inquiry-based science instruction. Use the scale provided to indicate your views on each of the training components described below.	Needs a lot more	Needs somewhat more	Has just the right amount	Needs some-what less	Needs a lot less	N/A
a. Hands-on practice with the kits/modules	⑤	④	③	②	①	⓪
b. Explanation about the use of the kits/modules	⑤	④	③	②	①	⓪
c. Instruction in science content	⑤	④	③	②	①	⓪
d. Explanation of inquiry-based methods	⑤	④	③	②	①	⓪
e. Practice with inquiry-based methods	⑤	④	③	②	①	⓪
f. Connection of EALRs to kits/modules	⑤	④	③	②	①	⓪
g. Connection of science content to kits/modules	⑤	④	③	②	①	⓪
h. Integration of inquiry-based methods with my personal experience	⑤	④	③	②	①	⓪
i. _____	⑤	④	③	②	①	⓪

KEY:
5 = The LASER training ***needs a lot more*** of this characteristic.
4 = The LASER training ***needs somewhat more*** of this characteristic.
3 = The LASER training ***has just the right amount*** of this characteristic.
2 = The LASER training ***needs somewhat less*** of this characteristic.
1 = The LASER training ***needs a lot less*** of this characteristic.
0 = Not applicable to my experience so far.

15. These questions involve the functioning of your LASER regional site in the areas of ongoing technical assistance and materials distribution. Please indicate your level of agreement with each of the following statements.	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
a. Kits are available when I need them	⑤	④	③	②	①
b. Kits are complete when I receive them (i.e., nothing is missing).	⑤	④	③	②	①
c. Kits are in good condition when I receive them (i.e., nothing broken or improperly stored or poorly packed).	⑤	④	③	②	①
d. The site team is available to answer my questions outside of training time.	⑤	④	③	②	①
e. I receive adequate notice about upcoming training sessions.	⑤	④	③	②	①
f. I understand what the various trainings are for and which ones I should attend.	⑤	④	③	②	①
g. The trainings have contributed positively to my professional development.	⑤	④	③	②	①

Thank you for completing this survey!