

Washington State LASER

2008–2009 Evaluation Report

Prepared for

Washington State LASER

Pacific Science Center
200 Second Avenue North
Seattle, WA 98109

Prepared by

RMC Research Corporation

111 SW Columbia Street, Suite 1200
Portland, OR 97201

January 2010

Washington State LASER

2008–2009 Evaluation Report

Prepared for

Dennis Schatz

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

Prepared by

Dave Weaver
Chandra Lewis
Paméla Raya-Carlton

RMC Research Corporation
111 SW Columbia Street, Suite 1200
Portland, OR 97201

January 2010



Contents

Exhibits.....	v
Acknowledgements	vii
Executive Summary	ix
Summary of Findings	x
Other Findings	xiii
Recommendations	xvi
Participation in Professional Development	1
Analysis of Science WASL Results	3
School-Level Analysis of 2009 Science WASL Results	3
Grade 5 Methodology	5
Grade 8 Methodology	8
Student-Level Analysis of 2008 Science WASL Results	8
Grade 5 Methodology	10
Grade 8 Methodology	12
Longitudinal Study of Science WASL Results	12
Methodology	13
Conclusion	15
Considerations for Interpretation	16
Module-Level Assessment of Student Achievement	17
About the Assessments	17
Recruiting Volunteers.....	17
Item Analysis and Scale Construction.....	19
Analysis of Means.....	20
Professional Development and Student Achievement	21
Conclusion	22
Sentinel Site Visit Results	25
Sentinel Site Selection	25
Data Collection.....	25
Descriptive Analysis.....	26
Analysis of Gains	29
Analysis of Achievement Ranking.....	31
Principal Survey Results	33
Curriculum	34
Professional Development	38
Materials Support.....	42
Classroom Instruction	45
Student Assessment.....	47
Community and Administrative Support.....	47
Overall	48

Regional Alliance Director Survey Results	51
Regional Alliance Membership	51
Curriculum	51
Materials Support.....	53
Professional Development	55
Assessment	57
Administrative and Community Support.....	58
Literacy	60
LASER Professional Development Provider Survey	61
Training Design.....	62
Training Implementation	63
Science Content.....	64
Science Pedagogy	66
Instructional Module Preparation	67
Final Preparedness.....	70
Overall Preparedness	74
References.....	77

Appendix A Module-Level Assessment Recruitment Materials

Appendix B Assessment Instructions and Other Materials

Appendix C Sentinel Site Data Collection Instruments

Appendix D Survey Instruments

Exhibits

Exhibit 1	Teacher Participation in Professional Development: July 1, 2007, Through June, 30 2009	1
Exhibit 2	Professional Development Participation	2
Exhibit 3	Professional Development Provider Training Participation	2
Exhibit 4	Distribution of Grade 5 Study Schools Across Regional Alliances.....	4
Exhibit 5	Distribution of Grade 8 Study Schools Across Regional Alliances.....	5
Exhibit 6	School-Level Regression Analysis Results for Grade 5.....	6
Exhibit 7	3-Year PD Index Categories of Grade 5 Schools	7
Exhibit 8	2009 Grade 5 Science WASL Results by PD Index Category	7
Exhibit 9	School-Level Regression Analysis Results for Grade 8.....	8
Exhibit 10	Student-Level Analysis Data Linkage Map	10
Exhibit 11	Student-Level Regression Analysis Results for Grade 5	11
Exhibit 12	Student-Level Regression Analysis Results for Grade 8	12
Exhibit 13	Longitudinal Analysis Data Linkage Map	13
Exhibit 14	3-Year PD Index Categories of Grade 8 Schools	14
Exhibit 15	Regression Analysis Results for Grade 8 for PD Index Category	14
Exhibit 16	2008 Grade 8 Science WASL Results by PD Index Category	15
Exhibit 17	Distribution of Participating Classes by Module	18
Exhibit 18	Demographic Distribution of Participating Students.....	19
Exhibit 19	Reliability of Instructional Module Assessment Item Scales	20
Exhibit 20	Pre- and Postassessment Mean Scores.....	20
Exhibit 21	Student Assessment Gains as a Function of Professional Development...	22
Exhibit 22	School Summary Ratings and Teacher Survey Descriptive Statistics	27
Exhibit 23	Classroom Observation Rating Descriptive Statistics	28
Exhibit 24	Demographic Differences of Sentinel Site Schools Serving Grade 5.....	29
Exhibit 25	Sentinel Site Differences With Respect to Science WASL Improvement...	30
Exhibit 26	Sentinel Site Differences With Respect to Science WASL State Average .	32
Exhibit 27	Distribution of Respondents by Regional Alliance	33
Exhibit 28	Principal Survey Item Predictors of Student Science Achievement	34
Exhibit 29	First School Year Using Modules.....	36
Exhibit 30	Instructional Modules per School Year	36
Exhibit 31	Decision Regarding Instructional Module Sequence	37
Exhibit 32	Fidelity of Instructional Module Use	37
Exhibit 33	Instructional Module Usage	38

Exhibit 34	Foundational Training Participation	39
Exhibit 35	Advanced Training Participation	40
Exhibit 36	Frequency of School-Based Professional Development.....	40
Exhibit 37	Frequency of Professional Learning Community Meetings.....	41
Exhibit 38	Professional Learning Community Time Devoted to Science	41
Exhibit 39	Instructional Module Storage	42
Exhibit 40	Access to Instructional Modules	43
Exhibit 41	Instructional Module Refurbishment	43
Exhibit 42	Frequency of Problems With Instructional Module Condition.....	44
Exhibit 43	Timeliness of Instructional Module Delivery.....	44
Exhibit 44	Frequency of Principal Observation of Science Classes.....	45
Exhibit 45	Classroom Observation Perceptions of Principals	46
Exhibit 46	Summative and Formative Assessment.....	47
Exhibit 47	Priority of Science	48
Exhibit 48	Overall Rating of Regional Alliance Services.....	49
Exhibit 49	Supported Module Titles From Each Vendor	54
Exhibit 50	How Well the Schools and Districts Ensure that Teachers Have the Required Training	57
Exhibit 51	In-Service Training Hours Earned.....	62
Exhibit 52	Design of Initial Provider Training	63
Exhibit 53	Implementation of Initial Provider Training.....	64
Exhibit 54	Science Content of Initial Provider Training.....	65
Exhibit 55	Science Pedagogy of Initial Training.....	66
Exhibit 56	Focus of Provider Training: Physical Science.....	67
Exhibit 57	Focus of Provider Training: Life Science	68
Exhibit 58	Focus of Provider Training: Earth and Space Science.....	69
Exhibit 59	Focus of Provider Training: Earth and Space Science.....	70
Exhibit 60	Preparedness for Physical Science Instructional Modules.....	71
Exhibit 61	Preparedness for Life Science Instructional Modules	72
Exhibit 62	Preparedness for Earth Science Instructional Modules	73
Exhibit 63	Overall Preparedness to Help Teachers	74
Exhibit 64	Overall Preparedness to Create Effective Classroom Experiences for Students	75
Exhibit 65	How Employment Status Affects Availability to Conduct Foundational Training.....	76

Acknowledgements

RMC Research thanks the many people who contributed to the evaluation of Washington State LASER, particularly the directors of the 10 Regional Alliance sites and their staff who so diligently maintained the Washington State LASER professional development database with accurate, current information. Special thanks to the Leadership Team of Dennis Schatz, Jeff Estes, Mary McClellan, Sonia Siegel Vexler, Lonnie Keown, Peggy Willcuts, and Anne Kennedy for their continued support and guidance. Finally, thanks to Robin Munson, Lisa Ireland, and Andrea Meld for their work that enabled RMC Research to access the data for analysis.

Executive Summary

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. The use of hands-on science modules (kits) and inquiry-based pedagogy are hallmarks of the LASER approach. Other key elements of the LASER approach are 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.

In 1999, a partnership between Battelle/Pacific Northwest National Lab (PNNL) and Pacific Science Center launched a statewide LASER initiative modeled after the national LASER initiative. Support from the Washington State Legislature started in 2001. Washington State LASER supports annual strategic planning institutes, curriculum showcases, and a statewide network of Regional Alliances that provide the ongoing professional development, materials support, and technical assistance needed to implement inquiry-based science instruction in the participating schools. Today, a combination of state, school district, and private sources. Washington's Office of Superintendent of Public Instruction (OSPI), Battelle (the world's largest nonprofit research and development organization), and the Pacific Science Center (a science education center for children located in Seattle) provide the leadership for Washington State LASER.

Each Regional Alliance is a coalition of school districts, educational service districts (ESDs), universities, and/or businesses. At the time of this report 10 Regional Alliances served the different regions of Washington State:

- Mountain to Harbor Alliance, coordinated by ESD 113 in Olympia.
- North Central Alliance, coordinated by North Central ESD in Wenatchee.
- North Sound Alliance, coordinated through Institute for Systems Biology.
- Northeast Alliance, coordinated by ESD 101 in Spokane.
- Northwest Alliance, coordinated by Northwest ESD 189 in Anacortes.
- Olympic Peninsula Alliance, coordinated by Olympic ESD in Bremerton.
- South Central Alliance, coordinated through ESD 105 in Yakima.
- South Sound Alliance, coordinated through Puyallup School District.
- Southeast Alliance, coordinated through Pacific Northwest National Laboratory and Kennewick School District, and ESD 123 in the Tri Cities.
- Southwest Washington Alliance, coordinated by the ESD 112 in Vancouver.

In 2007 the Washington State Legislature greatly expanded the funding and scope of Washington State LASER for the 2007–2009 biennium. This expansion included the

addition of a tenth Regional Alliance, additional funding to increase the number of teachers served by the Alliances, and the implementation of a training program designed to increase the number of professional development providers qualified to deliver foundational training on inquiry-based instructional modules, the establishment of a program to conduct in-depth research on science reform efforts, and broadened program evaluation efforts. This report summarizes the research and evaluation findings with respect to the impact of Washington State LASER from July 1, 2008, through June 30, 2009.

Summary of Findings

During the 2007–2009 biennium the Regional Alliances conducted 2,144 professional development events focused on inquiry-based science instruction for a total of 15,521 hours of professional development. These events had a total attendance of 27,178 and served 10,241 educators (unduplicated count). Together these educators received nearly 198,000 contact hours of professional development (see Exhibit 2).

The Washington State LASER evaluation plan posed the following questions regarding the impact of this professional development.

Question 1: *To what extent did teacher professional development on inquiry-based science instruction contribute to improved student achievement on the Grade 5 and 8 Washington Assessment of Student Learning of science (science WASL)?*

The level of teacher participation in professional development is a small but significant predictor of student achievement on the science WASL. This statement is supported by the results of 3 separate analyses of the relationship between the professional development participation of teachers and student achievement on the science WASL.

- **2009 School-Level Analysis**—RMC Research found that the amount of professional development the science teachers in a school received during the 3-year period prior to the administration of the 2009 science WASL was a small but significant predictor of that school’s student achievement on the Grade 5 and 8 science WASL above and beyond what could be explained by the skill level of the cohort of students (previous grade mathematics achievement) and the socioeconomic characteristics of the students (eligibility for free or reduced-price lunch). For more details see Exhibits 6, 7, 8, and 9.
- **2008 Student-Level Analysis**—This analysis revealed that the amount of professional development a science teacher received during the 3-year period prior to the administration of the 2008 science WASL was a small but significant predictor of that teacher’s students’ achievement on the Grade 5 and 8 science WASL above and beyond what could be explained by the skill level of the students (previous grade mathematics achievement) and the socioeconomic characteristics of the students (eligibility for free or reduced-price lunch). For more information see Exhibits 11 and 12. The cumulative effect of the professional development received by students’ Grade 5 teacher and Grade 4

teacher was not, however, a significant predictor of student achievement on the 2008 Grade 5 science WASL.

- **2005–2008 Longitudinal Analysis**—This analysis revealed that the amount of professional development the science teachers in a middle school received was a small but significant predictor of that school’s student achievement on the Grade 8 science WASL above and beyond what could be explained by student demographics (free or reduced-price lunch, special education, gifted, or minority) or by their skill level in science as demonstrated by their score on the Grade 5 science WASL. For more details see Exhibits 15 and 16.

In addition to the fact that these 3 separate analyses produced similar findings, they echoed the findings of previous studies conducted as part of the evaluation of Washington State LASER.

Question 2: *To what extent did teachers who had received LASER professional development use with fidelity the science modules as the core science curriculum?*

Sixty-four schools with high levels of science teacher participation in professional development were selected for site visits. The results of the teacher surveys administered during the site visits indicate that 94% of the teachers used the science modules as the core science curriculum. However, only 6% reported using the science modules exactly as prescribed, and on average teachers completed only 85% of the activities (see Exhibit 22). Eighty-four percent of the teachers reported that they implemented the science modules mostly as prescribed but did make some modifications.

In terms of use of the science modules the principal survey results were similar: 96% of principals reported that their school used the science modules as the core science curriculum. The principals were, however, overly optimistic with respect to implementation fidelity: 23% percent believed that teachers implemented the modules exactly as prescribed, and 77% believed that teachers generally completed all of the activities in the science modules (see Exhibit 32).

Question 3: *To what extent did participation in LASER increase the amount of time students in participating schools received science instruction?*

Science instruction time at the elementary school level has been inconsistent. Among the elementary sentinel site schools visited, science instruction time ranged from approximately 50 to 260 minutes per week for an average of 150 minutes of science instruction per week. In some cases the instruction time devoted to science varied within a single school, primarily due to competing demands and the freedom of most elementary teachers to allocate instructional time according to their own priorities.

Question 4: *To what extent did the use of the inquiry-based instructional modules improve students' knowledge of science content?*

Over the course of the biennium, teachers had the opportunity to volunteer to administer pre- and postassessments related to any 1 of the 7 inquiry-based instructional modules. The result was the participation of 179 classes in 68 schools for a total of 3,847 students (see Exhibit 17). Students demonstrated significant improvement between the preassessment and the postassessment on all 7 modules. On average, student scale scores increased 15.9 points (on a 100-point scale) from pre- to postassessment. Students demonstrated the greatest gains on the Electric Circuits module (19.05) and the least gains on the Variables module (8.63; see Exhibit 20). These findings parallel that of ASSET, Inc. who used some of the same assessments to measure increases in science content knowledge of students who used inquiry-based instructional modules in Pennsylvania. In this study, student scores gained 10 points on the Rocks and Minerals module, 17 points on the Electric Circuits module, and 12 points on the Levers and Pulleys module (Dear, 2007).

Question 5: *What was the relationship between the science professional development of the teacher and the gains in student content knowledge?*

Analysis of the relationship between the professional development of the teachers who volunteered to administer the pre- and postassessments and the gains made by their students was inconclusive (see Exhibit 21). That is, the correlation between the gains students made and the amount of or type of professional development of their teachers did not appear to be significant.

Question 6: *To what extent did LASER develop a cadre of professional development providers who are well prepared to conduct foundational training?*

Some of the Regional Alliances provided professional development intended to develop a cadre of teachers with the skills and capacity to deliver foundational training on inquiry-based science instruction to other educators. Five Alliances reported this type of professional development (see Exhibit 3) at 68 events (totaling 643 hours) attended by 297 educators (7,602 contact hours). Although the online survey respondents seemed to be very satisfied with the professional development they received (see Exhibits 52, 53, 54, 55, 63, and 64), at the conclusion of the professional development provider training in spring 2009, 17% reported feeling very well prepared to conduct foundational training on the instructional modules (see Exhibits 60, 61, and 62), 21% were fairly well prepared and 41% were somewhat prepared. Twenty-one percent of the providers reported being not at all prepared. The professional development providers rated their preparedness to assist teachers with pedagogy considerably higher than their preparedness to train teachers on specific instructional modules. In most cases the providers agreed or strongly agreed with statement about their preparedness to help teachers with pedagogy (see Exhibits 63 and 64).

Other Findings

The activities conducted as part of the evaluation of Washington State LASER also produced findings that did not directly address the evaluation questions but did provide useful information to inform the future of the project.

Other Finding 1—The sentinel site visitors consistently gave high ratings to certain traits, many of which were a direct outcome of Washington State LASER. These highly rated traits likely describe most of the schools visited (see Exhibit 22):

- **Materials Support System**—The system for maintaining, storing, and refurbishing the instructional modules was effective and well organized.
- **Condition of Modules**—Teachers received modules that were complete and ready for classroom use.
- **Inquiry-Based Materials**—The school was implementing 3 or more modules per grade level as the core science curriculum materials. More than 90% of the teachers used the modules as the core science curriculum.
- **Administrative Support**—School administrators appeared to be very supportive of inquiry-based science instruction.
- **District Support**—District administrators appeared to be very supportive of inquiry-based science instruction.
- **Sequence**—All science teachers used the modules according to a sequence clearly prescribed by the district.
- **Critical Mass**—Most (80% or more) teachers in the school had attended the foundational training for all of the modules they used.

The site visitors gave most schools low on the following traits:

- **Summative District Assessments**—Very few school administered districtwide or schoolwide summative student assessments in science annually.
- **Formative Assessments**—Few teachers (25% or less) had adopted a formative assessment strategy for science.
- **Instructional Time**—Science instructional time varied considerably among teachers at the elementary school level and few schools required a minimum amount of science instructional time.
- **Professional Development Time for Teachers**—Time for school-based professional development in science was rarely scheduled during regular work hours.
- **Business, Informal Science, or Higher Education Partnership**—Few teachers had a science education-focused partnership with a business, an informal science organization, or an institute of higher education.

Other Finding 2—Sentinel site visitors gave the lessons observed high ratings in the following areas (see Exhibit 23):

- **Alignment of Lesson Activities**—Lesson activities addressed the stated learning objectives, but how the lesson activities would lead to deeper student understanding of the learning objectives was unclear.
- **Motivation**—The lesson provided mostly extrinsic and some intrinsic motivation. The intrinsic motivation was truncated by the lesson structure and was relatively short lived.
- **Understanding of Purpose**—Throughout the lesson many students understood why they were doing each activity, but the purpose of activities could have been more explicit.
- **Classroom Discourse**—For the most part students and teachers supported and encouraged respectful and constructive discourse around important science concepts, although only some students appeared to feel comfortable asking questions, backing up their own claims, and critiquing claims made by others.

The site visitors gave the lessons observed low ratings in the following areas:

- **Lesson Closure**—At the conclusion of the lesson the teacher provided a brief review, but students did not have an opportunity to fully examine how the lesson related to science concepts.
- **Application of Science**—A few students applied something they learned in the lesson to a new context.
- **Reflection and Meta-Cognition**—Students had some opportunity to reflect on their thinking but were not asked to identify ways in which their thinking about the science concepts had changed.

Other Finding 3—Schools that demonstrated increased student science achievement were significantly different demographically from those schools that did not. Also evident were significant differences in the instructional practices of the teachers observed by the site visitors (see Exhibit 25). Science lessons that demonstrated increased student achievement in the sentinel site schools were more likely to exhibit the following characteristics:

- **Learning Objectives**—The teacher stated learning objectives focused on the content and very clearly conveyed the important and enduring science concepts (big ideas).
- **Alignment of Lesson Activities**—Lesson activities directly addressed the stated learning objectives, and it was very clear how the lesson activities would lead to a deeper student understanding of the learning objectives.
- **Understanding of Purpose**—Throughout the lesson most students clearly understood why they were doing each activity.
- **Intellectual Engagement**—Students were intellectually engaged with the science content related to the lesson activities. The lesson challenged students to think at higher cognitive levels.
- **Application of Science**—Students applied something they learned in the lesson to a new context.

- **Classroom Discourse**—Students and teachers supported and encouraged respectful and constructive discourse around important science concepts to create a classroom culture in which most students appeared to feel comfortable asking questions, backing up their own claims, and critiquing claims made by others.
- **Motivation**—The lesson provided an appropriate balance of extrinsic and intrinsic motivation. The lesson effectively motivated students to learn by appealing to their interests, addressing a relevant topic, creating a desire to resolve a discrepancy, creating cognitive dissonance, or employing other intrinsic motivators.

Other Finding 4—Schools that demonstrated above state average student achievement in science were significantly different demographically from those schools with below average student achievement in science. The schools also differed significantly in terms of other characteristics (see Exhibit 26). Schools whose students performed at or above average in science were more likely to exhibit the following characteristics:

- **Instructional Time Allocated**—The school designated a specific amount of instructional time for science.
- **Integration of Literacy**—Many teachers integrated science and literacy through the use of supplementary reading materials and science notebooks.
- **Professional Development Time for Teachers**—Time for school-based professional development in science was occasionally scheduled during regular work hours.
- **District Support**—District administrators appeared to be somewhat supportive of inquiry-based science instruction.
- **Parent and Community Support**—Parents and the community appeared to be somewhat supportive of inquiry-based science instruction.

Other Finding 5—Several factors addressed by the principal survey were significant predictors of student performance on the science WASL above and beyond what could be attributed to the socioeconomic characteristics of the students (free or reduced-price lunch). Factors that were significant predictors of student achievement included these:

- Organized efforts to identify instructional materials to fill gaps in the science curriculum.
- Student use of evidence to engage in discourse about science.
- Regular provision of time during the regular work day for teachers to participate in school-based science professional development.
- Support for professional learning communities focused on improving science teaching and learning.

Other Finding 6—Themes that emerged from the findings further confirm and support the recommendations based on the 2007–2008 evaluation and the planned changes to Washington State LASER. School-level factors that contribute to student achievement and should be encouraged through the program include these:

- Professional development time for teachers during the school day.
- Designated science instructional time at the elementary school level.
- Professional learning communities.
- Commitment to filling science curriculum gaps (i.e., grade level expectations not addressed by the instructional modules) through the use of supplementary materials.
- Integration of literacy support into science instruction.
- District, parent, and community support.

Instructional factors shown by this evaluation to contribute to student achievement that should also be encouraged through Washington State LASER by:

- Increasing science discourse that requires students to use evidence to support observations or claims.
- Encouraging teachers to establish clear learning objectives and help students understand why they are doing each activity.
- Engaging students intellectually (i.e., thinking deeply about the scientific concepts) in the science content addressed.
- Appealing to students' intrinsic motivation by ensuring the relevance of lessons and by creating opportunities for students to use scientific investigation to resolve cognitive dissonance.
- Providing opportunities for students to apply the science they learn.

Recommendations

The results of the visits to sentinel site schools with a recent history of staff participation in science professional development indicate that the infrastructure to support the use of a core curriculum of inquiry-based science instructional modules is in place and is functioning adequately in the schools visited (see Exhibit 27). Although these conditions are necessary for the implementation of inquiry-based science instruction, they are not sufficient to significantly raise student achievement as measured by the science WASL. Differences between schools that correlated to increased student achievement on the science WASL related to the use of specific classroom instructional practices or professional development on topics beyond initial use of the modules. As a result, RMC Research continues to stand behind the recommendations made in 2008:

- Ensure that the professional development on research-based instructional practices is consistent and explicit across all of the Regional Alliances. According to a recent report from the Center on Instruction, “Considerable evidence from research shows that instruction is most effective when it elicits students’ initial

ideas, provides them with opportunities to confront those ideas, helps them formulate new ideas based on evidence, and encourages students to reflect upon how their ideas have evolved” (Banilower, Cohen, Pasley, & Weiss, 2008, p. 7). The results of the analysis of the sentinel site visits further supports these findings (see the classroom observation results in Exhibits 23 and 25). These elements of effective science instruction are embodied in the Washington State LASER classroom observation protocol used during the sentinel site visits. The professional development should make every effort to help teachers develop an understanding of the elements of effective science instruction and adopt the practice to use the inquiry-based instructional modules as a means of carrying out the element with their students.

- Increase support for school-based professional development that helps teachers (a) assume accountability for student learning that results from the use of the modules and (b) collaboratively implement the elements of effective science instruction. This objective might be accomplished by establishing professional learning communities that regularly conduct professional development focused on improving student learning in science. The professional learning communities must have sufficient structure and leadership to fulfill their intended purpose and be sufficiently flexible to allow all participants to be vested and realize the benefit.

Participation in Professional Development

RMC Research developed an online database Washington State LASER Alliances used to track individual teachers' participation in professional development. 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 (including the date, location, facilitator, focus, and duration). Exhibits 1 and 2 show the participation in the professional development conducted by the 10 Regional Alliances between July 1, 2007, and June 30, 2009.

Exhibit 1
Teacher Participation in Professional Development:
July 1, 2007, Through June, 30 2009

Alliance	< 18 Hours	18 to 35 Hours	36 to 54 Hours	> 54 Hours	Total
Mountain to Harbor	322	119	105	63	609
North Central	143	301	174	24	642
North Sound	1,158	305	42	29	1,534
Northeast	206	282	166	49	703
Northwest	933	233	87	153	1,406
Olympic	529	102	4	1	636
South Central	256	350	208	82	896
South Sound	1,270	252	77	84	1,683
Southeast	298	292	150	36	776
Southwest	719	436	92	51	1298
Total	5,834	2,672	1,105	572	10,183
	57%	26%	11%	6%	

During the 2007–2009 biennium the 10 Regional Alliances served more than 10,000 teachers. More than half (57%) participated in fewer than 18 hours of professional development during the 2-year period—a finding attributable to the fact that Washington State LASER has been operating since 1999 and many teachers participated in the foundational training prior to July 1, 2007. Therefore, many teachers attended professional development to expand their knowledge or to learn new instructional modules. Analysis of the distribution of professional development participation by Regional Alliance suggests several possible explanations. 1) Some teachers received training on the use of instructional modules through sources such as the district or the vendor (these types of professional development were not included in the Washington State LASER database). 2) Some districts did not ensure teachers participated in the professional development for the instructional modules they use.

Exhibit 2
Professional Development Participation

Alliance	Sessions	Hours Offered	Attendance	Participants^a	Contact Hours
Mountain to Harbor	147	1,068	2,180	609	16,417
North Central	109	1,068	1,799	642	16,936
Northeast	178	1,101	2,868	703	17,901
North Sound	197	1,312	3,247	1,534	21,315
Northwest	310	2,723	3,001	1,406	28,631
Olympic	88	510	1,129	636	5,308
South Central	180	1,620	2,664	961	23,945
Southeast	214	1,618	2,297	776	17,711
South Sound	366	2,243	4,247	1,683	26,365
Southwest	355	2,258	3,746	1,299	23,457
Total	2,144	15,521	27,178	10,241	197,986

Note. Participation period: July 1, 2007, though June 30, 2009.

^aUnduplicated count.

Over the course of the biennium the Regional Alliances conducted 2,144 professional development sessions focused on inquiry-based science instruction for a total of 15,521 hours. These sessions had a total attendance of 27,178 and served 10,241 educators (unduplicated count). Altogether these educators received nearly 198,000 contact hours of professional development. Some of the professional development aimed to develop a cadre of trainers with the capacity to provide foundational training to other teachers. Five Regional Alliances reported delivering 68 sessions of this type of professional development for a total of 643 hours attended by 297 teachers (7,602 contact hours; see Exhibit 3).

Exhibit 3
Professional Development Provider Training Participation

Alliance	Sessions	Hours Offered	Attendance	Participants^a	Contact Hours
Mountain to Harbor	4	82	55	53	1,548
North Central	12	90	336	71	2,292
Northeast	38	309	150	58	1,122
North Sound	4	72	60	54	1,080
South Central	10	90	177	61	1,560
Total	68	643	778	284	7,602

Note. Participation period: July 1, 2007, though June 30, 2009. PD = professional development.

^aUnduplicated count.

Analysis of Science WASL Results

RMC Research used 3 approaches to analyze the science WASL results for evidence of a relationship between the professional development provided to teachers through Washington State LASER and student achievement on the science portion of the WASL: school-level analysis, student-level analysis, and longitudinal analysis. This section describes in detail the method and findings for each analysis approach.

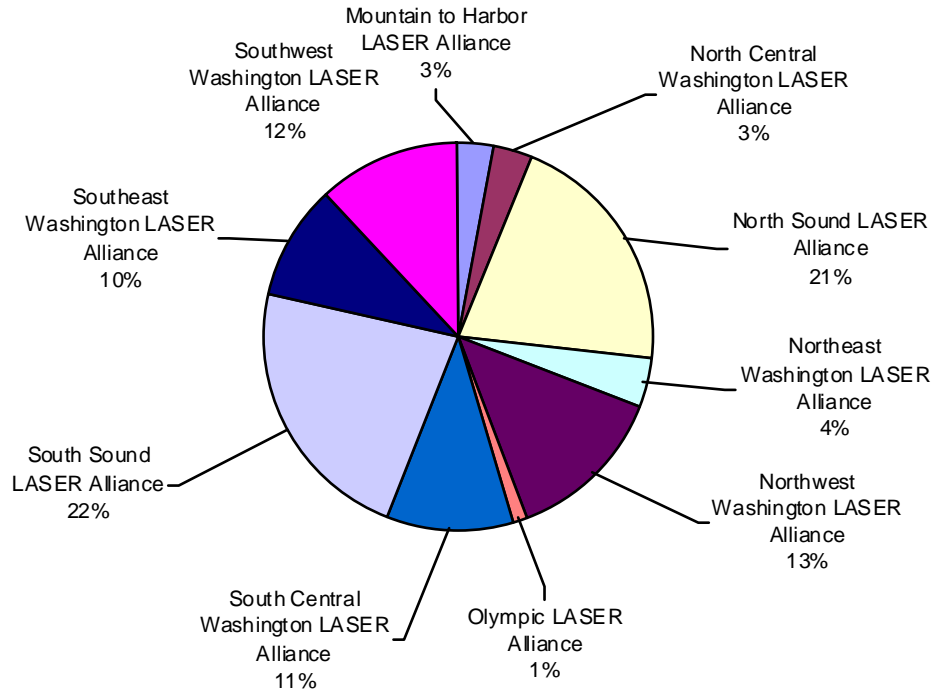
School-Level Analysis of 2009 Science WASL Results

RMC Research downloaded the school-level results of the 2009 science WASL from the website operated by OSPI and prepared Grade 5 and Grade 8 data files for analysis. The Grade 5 data file contained the following information:

- School and district identifying information.
- School demographic information including grade span, enrollment, percentage of students in each ethnic category, full-time equivalent value assigned to the school, percentage of students who qualify for free or reduced-price lunch, percentage of teachers with a Master's degree, and the average number of years experience among the teaching staff.
- The 2009 Grade 5 science WASL results including the number of students assessed, the number and percentage who met the standards, and the number and percentage who at each of the 4 levels of achievement.
- The 2008 Grade 4 mathematics WASL results including the number of students assessed and the number and percentage who met the standards.
- The total number of science professional development hours attended by the school staff in the year prior to the administration of the WASL (from April 1 through March 31) each year from 2000 to 2009.

Rather than include in the database all of the schools whose teachers had participated in professional development provided by the Regional Alliances, RMC Research filtered the data set to include only those schools that (a) assessed 10 or more students on the science WASL, (b) participated in LASER professional development within the past 3 years, and (c) were in districts that were members of a Regional Alliance in 2009. The resulting Grade 5 data file contained information about more than 386 schools representing approximately 27,625 students. Exhibit 4 shows that although the schools Grade 5 students were well distributed across the Regional Alliances, Olympic Peninsula Alliance, Mountain to Harbor Alliance, North Central Alliance, and Northeast Alliance served the fewest schools included in the school-level analysis of the 2009 science WASL results.

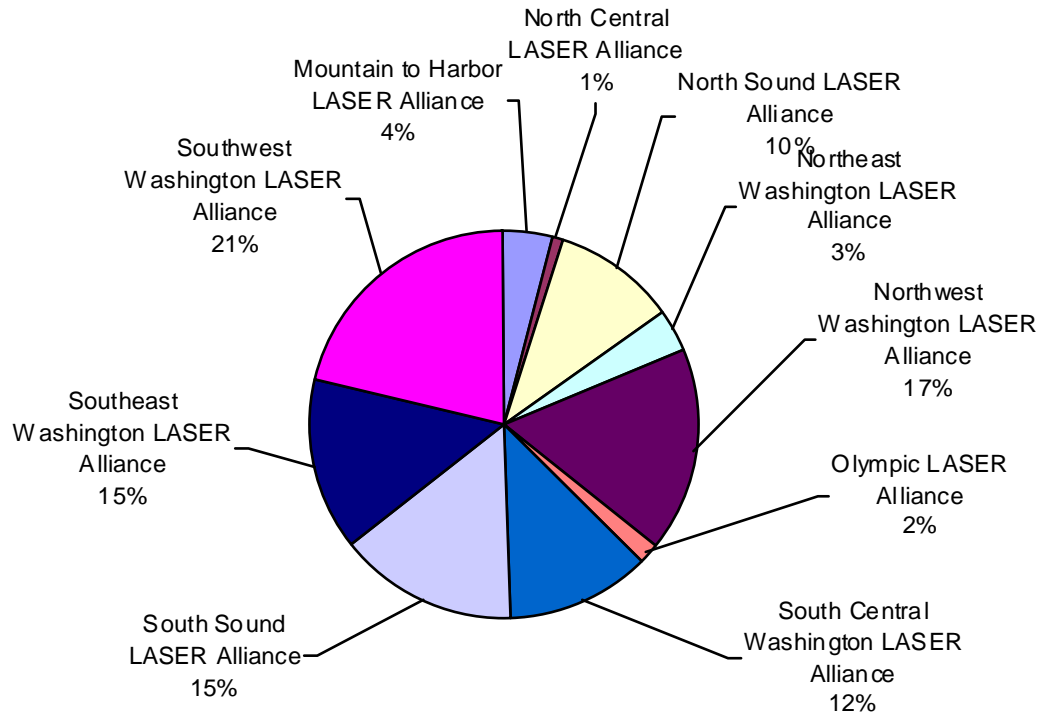
Exhibit 4
Distribution of Grade 5 Study Schools Across Regional Alliances



Note. n = 386.

The Grade 8 data file was similar to the Grade 5 data file except it contained Grade 8 science WASL results and Grade 7 mathematics WASL results for each school. A total of 112 schools representing approximately 21,186 students were included. Exhibit 5 shows the distribution of these 112 schools across the Regional Alliances. The distribution of school with Grade 8 students was similar to that of the schools with Grade 5 students and the same 4 Regional Alliances were under represented.

**Exhibit 5
Distribution of Grade 8 Study Schools Across Regional Alliances**



Note. n = 112.

Grade 5 Methodology

For the purposes of this study the school is considered the unit of analysis and the percentage of each school’s Grade 5 students who met or exceeded the state standards on the 2009 science WASL is the dependent variable. To develop the independent variable for analysis RMC Research used the Washington State LASER professional development database to calculate 5 professional development indexes (PD index) for each school. These indexes did not include administrators or any other noncore teaching staff (e.g., special education teachers, instructional aides) or schools that administered the 2009 science WASL to fewer than 10 students. Each index represents the level of participation of the total science teaching staff in science professional development on the use of the inquiry-based instructional modules per full-time equivalent for the 1, 2, 3, 4, or 5 years prior to the administration of the 2009 WASL.

The PD indexes were calculated from the professional development records submitted by the Regional Alliances and might not reflect professional development provided through other entities, such as the district. The rationale behind the calculation of the PD indexes is the hypothesis that schools with a high PD index had a higher percentage

of teachers participating in science professional development, which would in turn likely impact WASL results. Conversely, among schools with a low PD index and fewer teachers participating, professional development would be a lesser factor in the WASL results. Furthermore, the PD indexes were calculated as rates (per full-time equivalent) to compensate for the relative size of each school, thereby allowing for the comparison of schools of different sizes.

To identify other predictors of WASL that could be used as control variables, RMC Research calculated correlations and developed regression models that examined the demographic factors of gender, ethnicity, eligibility for free or reduced-price lunch, average class size, average years of teaching experience, percentage of teaching staff with a Master’s degree, and percentage of students participating in programs such as special education and bilingual programs. The analysis also included the percentage of Grade 4 students who met the state mathematics standards on the 2008 WASL. The evaluation team considered the Grade 4 mathematics WASL results because they represent a reasonable proxy for the skill level of the cohort of students who entered Grade 5 in the 2008–2009 school year.

This school-level analysis revealed that the combination of Grade 4 mathematics WASL results, the percentage of students who qualified for free or reduced-price lunch, and the 3-year PD index were significant predictors of Grade 5 achievement on the 2009 science WASL. Other factors such as the percentage of minority students and the percentage of bilingual students highly correlated to the free and reduced-price lunch factor and could be omitted from the model with little effect.

Exhibit 6 shows the results of the linear regression analysis controlling for Grade 4 mathematics WASL results and eligibility for free or reduced-price lunch and weighted by the number of students assessed at Grade 5 to compensate for school size. This model accounts for approximately 56% of the variance in the 2009 science WASL results and shows that the 3-year PD index is a small but significant predictor of science WASL results (note Beta value). The 2-year PD index was also a significant, though weaker, predictor of student achievement on the 2009 science WASL.

Exhibit 6
School-Level Regression Analysis Results for Grade 5

Variable	Standardized Beta	t
Percent met WASL mathematics standards in Grade 4	.163	33.999
Percent eligible for free or reduced-price lunch	-.650	-136.537
PD index (3-year)	.075	18.834

Note. $n = 27,625$ Grade 5 students in 386 schools. Adjusted $R^2 = .563$. The change in R^2 produced by adding the PD index was .006. Results weighted by the number of students tested. Each variable are significant at the .001 level.

To portray these findings more clearly, RMC Research divided the 386 schools into 3 groups containing approximately the same numbers of school by identifying cut points in the 3-year PD index values. Exhibit 7 shows the PD index interval and the number of schools and Grade 5 students included in each interval.

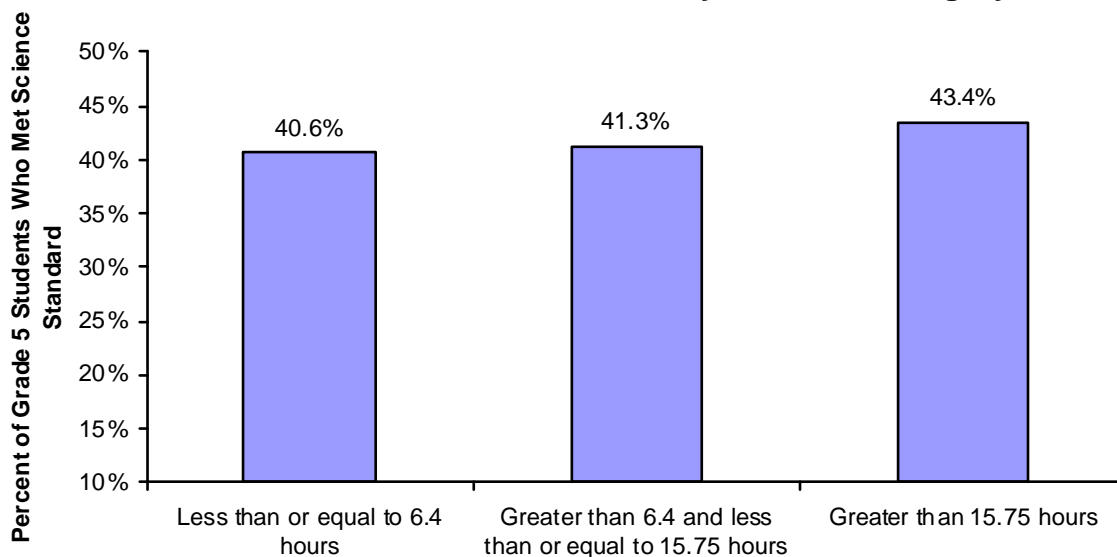
Exhibit 7
3-Year PD Index Categories of Grade 5 Schools

Level of Professional Development (PD Index)	Schools	Students
Less than or equal to 6.4	128	8,923
More than 6.4 but less than or equal to 15.75	130	9,756
More than 15.75	128	8,946

Note. Intervals represent the total professional development hours per full-time equivalent from April 1, 2006, through March 31, 2009 (the 3 years prior to the administration of the 2009 WASL).

For each of the 3 categories of schools identified in Exhibit 7, RMC Research calculated the mean percentage of Grade 5 students who met the state standards on the 2009 science WASL adjusted for the 2 control variables used in the regression analysis (percentage of Grade 4 students who met the 2008 mathematics WASL standards and percentage of students who qualified for free or reduced-price lunch). Exhibit 8 shows the adjusted mean values of the science WASL results for Grade 5 for each PD index category.

Exhibit 8
2009 Grade 5 Science WASL Results by PD Index Category



Note. Intervals represent the total professional development hours per full-time equivalent from April 1, 2006, through March 31, 2009. Covariates evaluated at the following values: Grade 4 mathematics = 50.099; free or reduced-price lunch = 50.484.

Once the mean values were adjusted for the influence of Grade 4 mathematics results and eligibility for free or reduced-price lunch, the pattern more clearly showed an increase in Grade 5 student performance on the 2009 science WASL as the level of teacher in science professional development increased.

Grade 8 Methodology

The analysis of the Grade 8 data followed the same procedures. The percentage of Grade 8 students who met or exceeded the state standards on the 2009 science WASL for each school functioned as the dependent variable and—as in the Grade 5 analysis—the 3-year PD index showed the strongest potential to serve as the independent variable. The same control variables used for the Grade 5 analysis were appropriate for the Grade 8 analysis: the percentage of Grade 7 students who met the mathematics WASL state standards in 2008 and the percentage of students who qualified for free or reduced-price lunch.

Exhibit 9
School-Level Regression Analysis Results for Grade 8

Variable	Standardized Beta	t
Percent met WASL mathematics standard in Grade 7	.202	42.769
Percent eligible for free or reduced-price lunch	-.704	-149.905
PD index (3-year)	.062	16.537

Note. $n = 21,186$ Grade 8 students in 112 schools. Adjusted $R^2 = .716$. The change in R^2 produced by adding the PD index was .004. Results weighted by the number of students tested. Each variable are significant at the .001 level.

Although the model accounts for much of the variance in the 2009 science WASL results, by itself the 3-year PD index accounts for only a small portion of this variance and the strength of the PD index as a predictor of Grade 8 student achievement in science is similar to that of the PD index for Grade 5 (see Beta value in Exhibit 9). Therefore the findings from the Grade 8 school-level analysis of the 2009 science WASL results further support the claim that the level of a school’s teacher participation in science professional development is a small but significant predictor of student achievement on the science WASL above and beyond what could be explained by the skill level of the cohort of students (as indicated by the previous year’s mathematics WASL scores) and socioeconomic factors (eligibility for free or reduced-price lunch).

Student-Level Analysis of 2008 Science WASL Results

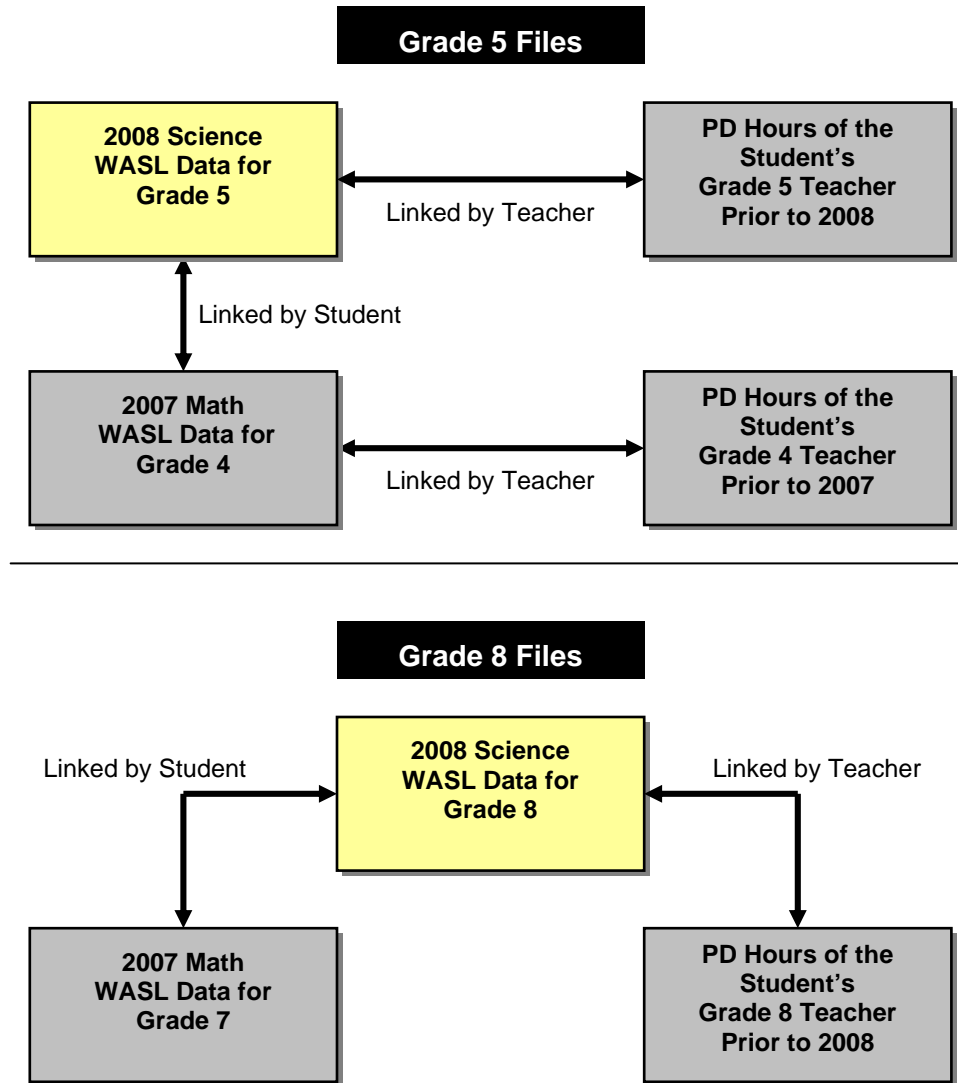
In fall 2008 RMC Research established a data sharing agreement with OSPI for access to WASL data for individual students statewide. The data sets provided by OSPI included the 2008 science WASL results for Grade 5 and Grade 8 students, the 2007 reading and mathematics WASL results for Grade 4 and Grade 7 students, and the 2005 science WASL results for Grade 5 students. Each data set included unique

research identification numbers that RMC Research used to link an individual student's record in one file to the corresponding record in the other files. The WASL data files also contained student demographic information (i.e., gender, ethnicity, age, grade) and enrollment status in programs such as special education and eligibility for free or reduced-price lunch.

The OSPI data sets also contained the names of the teachers who administered each WASL. Because most Grade 5 classes are self-contained classrooms, RMC Research assumed that the same teachers who administered the WASL were the students' science teachers and therefore used teacher and school information to link the WASL data to the professional development records in the Washington State LASER database. Links were established only in cases of reasonable certainty. WASL data that could not be matched to a teacher's LASER professional development records were not included in the analysis. Similarly, RMC Research assumed that the same teachers who administered the Grade 4 mathematics WASL the previous year had been those students' science teachers and matched the professional development records of each student's Grade 4 mathematics teacher to the LASER professional development database records. The ability to include the science professional development of the students' Grade 4 teachers allowed RMC Research to explore the effect of 2 consecutive years of professional development on science achievement at the Grade 5 level. Exhibit 10 shows how the various data files were linked for analysis.

At the Grade 8 level science is generally taught by teachers who teach primarily science rather than self-contained classroom teachers thus the teachers who administered the 2008 science WASL might not have been the students' science teachers. Similarly, the teachers likely had not administered the mathematics WASL the previous year. As a result, the file linking was different for the Grade 8 data. Due to the lack of evidence supporting the assumption that the teachers who administered the Grade 8 science WASL were the student's science teachers, caution must be exercised when considering the validity of the findings of the student-level analysis of the 2008 science WASL results. This limitation on the analysis of data from multiple sets will remain an issue until OSPI implements a data system that links student assessment results to a unique identifier of the teacher of the subject under consideration.

**Exhibit 10
Student-Level Analysis Data Linkage Map**



Grade 5 Methodology

For the purposes of this study the student is considered the unit of analysis, and each student's science scale score on the 2008 science WASL is the dependent variable. To identify control variables for the analysis, RMC Research calculated nonparametric correlations and developed regression models that examined demographic factors such as gender, ethnicity, eligibility for free or reduced-price lunch, and participation in programs such as special education and bilingual programs. The analysis also included each student's 2007 mathematics WASL scale score as a proxy for his or her skill level at the end of Grade 4 in the 2007–2008 school year. The analysis revealed that the

combination of the Grade 4 mathematics WASL scale score and eligibility for free or reduced-price lunch were both significant predictors of the 2008 science WASL score.

To develop the independent variable for analysis RMC Research used the Washington State LASER professional development database to calculate 5 PD indexes for each teacher. Each index represents the number of professional development hours the teacher participated in for the 1, 2, 3, 4, or 5 years prior to the administration of the 2008 WASL. The calculation of the PD indexes was based on the hypothesis that teachers with a high PD index would be more likely to implement the inquiry-based instructional practices that would impact WASL scores. As in the school-level analysis, the PD indexes were calculated from the professional development records in the database (submitted by the Regional Alliances) and might not reflect professional development provided through other entities, such as the district.

RMC Research performed linear regression analysis for each PD index controlling for Grade 4 mathematics WASL scores and eligibility for free or reduced-price lunch. The PD index that most closely correlated with the 2008 science WASL scores included the total number of science professional development hours for the 3 years prior to the administration of the 2008 WASL—that is, all of the hours of professional development the teachers participated in between April 1, 2005, and March 31, 2008. Exhibit 11 shows the results of the linear regression analysis controlling for Grade 4 mathematics WASL results and eligibility for free or reduced-price lunch. This model accounts for approximately 62% of the variance in the 2008 WASL science scores and shows that the 3-year PD index was a small but significant predictor of the 2008 WASL results (note Beta value).

Exhibit 11
Student-Level Regression Analysis Results for Grade 5

Variable	<i>Beta</i>	<i>t</i>	<i>SE</i>
Eligibility for free or reduced-price lunch	-.129	-31.599	.222
Grade 4 mathematics WASL scale score	.731	179.338	.003
PD index (3-year)	.031	8.211	.004

Note. $n = 26,533$ Grade 5 students. Adjusted $R^2 = .619$. The change in R^2 produced by adding the PD index was .001. Each variable are significant at the .001 level.

These findings echo those of previous analyses of student-level science WASL results and the findings of the school-level analysis of the 2009 science WASL results. The cumulative effect of the professional development received by the students' Grade 5 teacher plus the professional development received by the students' Grade 4 teacher was not, however, a significant predictor of student achievement on the Grade 5 science WASL.

Grade 8 Methodology

The linear regression analysis of the Grade 8 data followed the same procedures and produced much the same results (see Exhibit 12). Controlling for Grade 7 WASL mathematics results and eligibility for free or reduced-price lunch accounts for approximately 64% of the variance in the 2008 science WASL scores.

Exhibit 12
Student-Level Regression Analysis Results for Grade 8

Variable	Beta	t	SE
Eligibility for free or reduced-price lunch	-.098	-13.793	.411
Grade 7 mathematics WASL scale score	.763	106.882	.005
PD index (3-year)	.024	3.585	.004

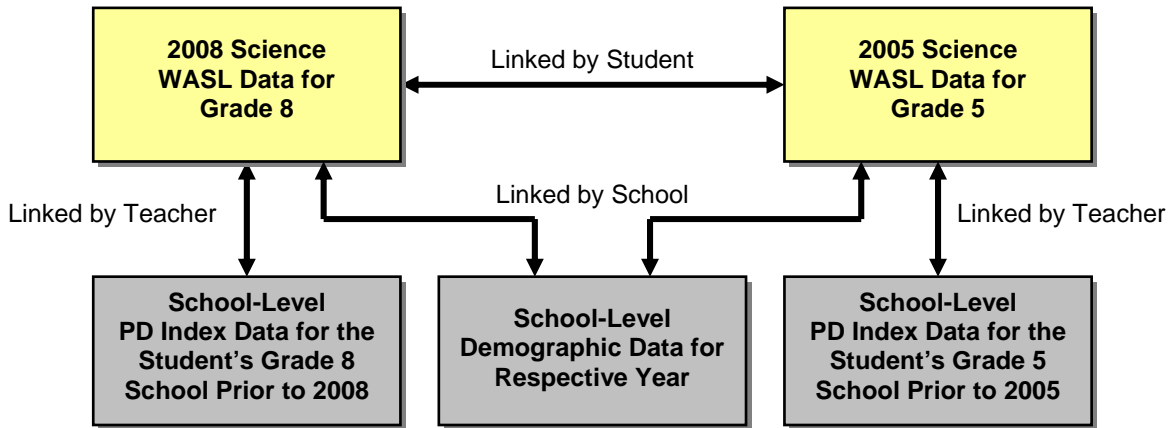
Note. $N = 7,812$ Grade 8 students. Adjusted $R^2 = .639$. The change in R^2 produced by adding the PD index was .001. Each variable are significant at the .001 level.

The 3-year PD index was again a small but significant predictor of the WASL results (note Beta value). The major difference is that eligibility for free or reduced-price lunch was a much smaller factor at the Grade 8 level. Furthermore, in far fewer cases were teacher professional development records and student WASL results matched. As a result, the findings are not nearly as convincing.

Longitudinal Study of Science WASL Results

The administration of the 2008 WASL resulted in the availability of 2 sets of science data for the same cohort of students. That is, the students assessed with the science WASL in Grade 5 in 2005 were the same students assessed with the science WASL in Grade 8 in 2008. To examine the impact of the science professional development on student achievement between the implementation of the 2 assessments, RMC Research reconfigured the data sets used for both the school-level and student-level analyses to conduct a longitudinal analysis of the data. Exhibit 13 describes the contents of each data file and how they were linked.

Exhibit 13 Longitudinal Analysis Data Linkage Map



Methodology

For this longitudinal analysis RMC Research designated the dependent variable to be the student-level 2008 Grade 8 science WASL scale score. Choosing the independent variable proved to be more challenging. Due to the limited amount of professional development data available and the uncertainty of assuming that the teacher who administered the assessment was also the student's Grade 8 science teacher, RMC Research elected to use as the independent variable the school-level PD index developed for the school-level analysis, which represents the level of participation of the total science teaching staff in science professional development on the use of inquiry-based instructional modules per full-time equivalent. The PD index was calculated from the total hours of professional development in the 3 years prior to the administration of the 2008 WASL (2005–2008).

The rationale for the use of the PD index is based on the hypothesis that a higher level of participation in professional development associated with a high PD index would be more likely to have a positive impact on the WASL results. Conversely, in schools with a low PD index participation in professional development would be a lesser factor in the WASL results. For the purpose of the longitudinal analysis RMC Research divided the Grade 8 schools into 4 categories with respect to the 3-year PD index of the school (see Exhibit 14).

Exhibit 14
3-Year PD Index Categories of Grade 8 Schools

Level of Professional Development (PD Index)	Students
Greater than 0 but less than or equal to 1.28	8,742
Greater than 1.28 but less than or equal to 5.14	8,618
Greater than 5.14 but less than or equal to 10.00	8,598
Greater than 10.00	8,948
Total	34,906

Note. Intervals represent the total professional development hours per full-time equivalent from April 1, 2005, through March 31, 2008 (the 3 years prior to the administration of the 2008 WASL).

RMC Research examined the bivariate correlations and performed regression analyses of combinations of Grade 8 demographic variables to identify possible control variables for use in the longitudinal analysis model. The selected control variable included eligibility for free or reduced-price lunch, participation in special education, participation in gifted and talented education, and racial or ethnic minority. In addition, the student-level 2005 Grade 5 science WASL scale score served as a control variable to represent the students' initial science skills. RMC Research analyzed this model to determine the degree to which the 3-year PD index category of the students' Grade 8 and Grade 5 schools was a predictor of student achievement on the science WASL in Grade 8. Exhibit 15 shows the results of this analysis.

Exhibit 15
Regression Analysis Results for Grade 8 for PD Index Category

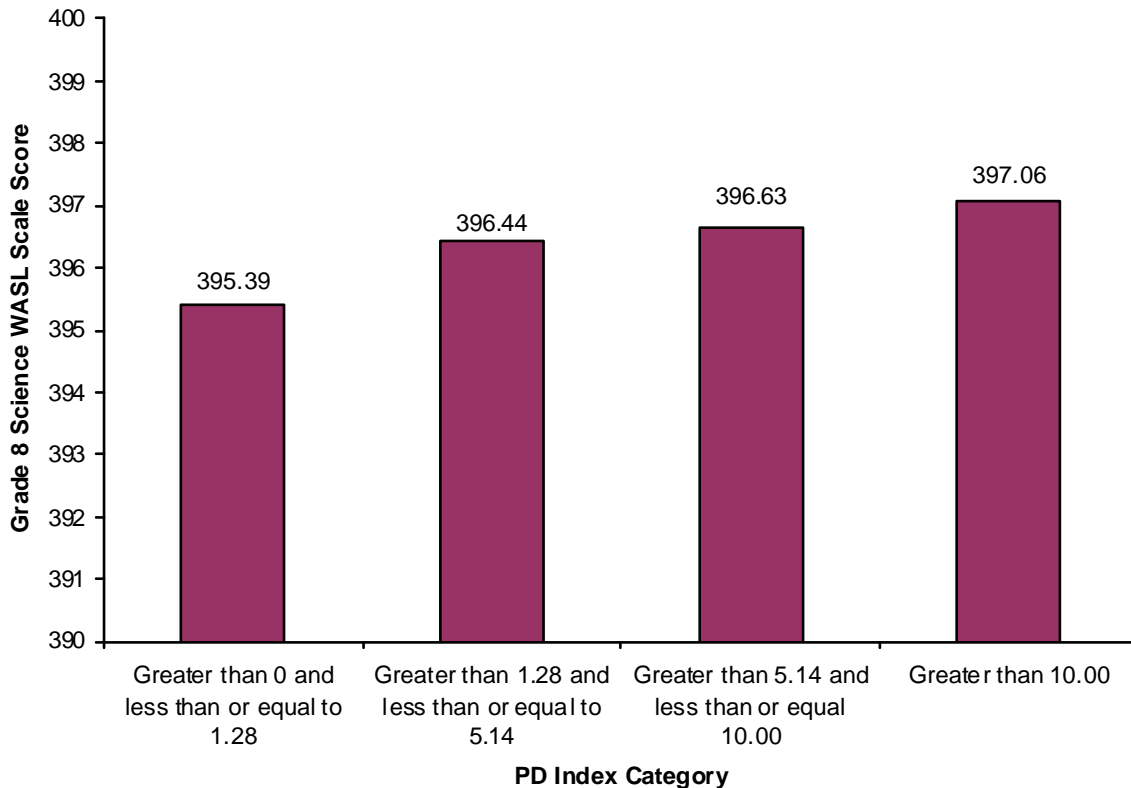
Variable	<i>Beta</i>	<i>T</i>	<i>SE</i>
2005 Grade 5 WASL science scale score	.665	170.882	.005
Eligibility for free or reduced-price lunch	-.089	-24.352	.222
Special education program participation	-.147	-42.075	.344
Gifted and talented education program participation	.068	20.054	.458
Racial or ethnic minority	-.026	-7.222	.224
Grade 8 school PD index category	.020	6.096	.085

Note. $n = 34,906$ Grade 8 students. Adjusted $R^2 = .629$. The contribution of the Grade 8 3-year PD index to the change in R^2 was undetectable. Each variable are significant at the .001 level.

The level of science teacher participation in science professional development in the Grade 8 students' school was a small but significant predictor of student achievement on the Grade 8 science WASL above and beyond what could be explained by student demographics (i.e., eligibility for free or reduced-price lunch, special education participation, gifted education participation, racial or ethnic minority). Although the

results are statistically significant, professional development once again appears to be a small factor compared to other variables such as eligibility for free or reduced-price lunch. To show this relationship more clearly RMC Research used the control variables to calculate adjusted means for the students in each PD index category (see Exhibit 16). The science WASL performance of Grade 8 students increased as the PD index category of the science teachers in the school increased.

Exhibit 16
2008 Grade 8 Science WASL Results by
PD Index Category



Note. Covariates appearing in the model are evaluated at the following values: Grade 5 WASL science scale score = 389.8850, eligibility for free or reduced-price lunch = .3770, special education = .0989, gifted and talented education = .0491, racial or ethnic minority = .3255.

Conclusion

All 3 approaches to the analysis of the science WASL data produced similar results that echo the findings of previous studies conducted as part of the evaluation of Washington State LASER. That is, the number of professional development hours in which a student's science teacher participates is a small but significant predictor of student performance on the science WASL above and beyond what could be explained by socioeconomics (as indicated by eligibility for free or reduced-price lunch) and the

student's skill level (as indicated by the student's performance on the mathematics WASL the previous year or on a previous science WASL; see Exhibits 6, 8, 9, 11, 12, 15, and 16).

Considerations for Interpretation

The reader must consider several factors when interpreting these results because some of the variables used in the analyses are proxies for broader concepts and some assumptions were necessary to link data sets.

- PD index—The PD index served as an indicator of the degree to which a school's science teaching staff implemented inquiry-based science instruction utilizing the adopted instructional modules. The assumption is that the more teachers participate in science professional development the more they will effectively implement inquiry-based instruction. Therefore the PD index is a rough proxy for the level of implementation of the instructional practices promoted by the science professional development.
- Mathematics WASL results—The percentage of students who met or exceeded the state standards on the mathematics WASL the previous year is a rough proxy for the skill level of the students entering the next grade. The reliability of this variable is only slightly diminished by student turnover from one grade to the next because the correlations between the science WASL results for one year are correlated with the mathematics WASL results from the previous year.
- Eligibility for free or reduced-price lunch—The percentage of students eligible for free or reduced-price lunch is a reasonably reliable proxy for the socioeconomic status of the families whose children each school serves.
- Linkage of student achievement results with teacher professional development records—Because most Grade 5 classes are self-contained classrooms, RMC Research assumed that the same teacher who administered the WASL was the students' science teacher and therefore used teacher and school information to link the Grade 5 WASL data to the professional development records in the Washington State LASER database. It is important to note that there remains an element of doubt with respect to the validity of this assumption.

Module-Level Assessment of Student Achievement

Most of the effort to assess the impact of Washington State LASER prior to the 2007–2008 project year was limited to analysis of science WASL results. Another way to gauge the program’s impact is to use measures of student achievement that align closely with the instructional modules.

About the Assessments

Washington State LASER negotiated with Horizon Research, Inc., a science and mathematics education research firm in North Carolina, for permission to administer student assessments developed by the firm that align with some of the inquiry-based instructional modules. Of the 13 assessments developed by Horizon Research, Washington State LASER staff selected 7 that aligned with instructional modules commonly used by schools in Washington State:

- Electric Circuits (STC)
- Environments (FOSS)
- Human Body (FOSS)
- Levers and Pulleys (FOSS)
- Motion & Design (STC)
- Rocks and Minerals (STC)
- Variables (FOSS)

Each assessment comprised 20 multiple choice items on the science content addressed in the respective instructional module and 5 multiple choice items regarding the respondents’ demographics.

Recruiting Volunteers

Beginning in March 2008 Washington State LASER and RMC Research collaborated to recruit volunteer teachers from schools that planned to use the 7 selected instructional modules in spring 2008 or during the 2008–2009 school year (see Appendix A). The desired outcome was to identify for each instructional module 30 teachers, half who had 54 or more hours of professional development on the module and half who had 18 or fewer hours of professional development on the module. The agreement between Horizon Research and Washington State LASER stipulated that the assessment items could be used only for the purposes of this research study and the volunteer teachers were required to sign an agreement to keep the assessment items confidential and to return all materials to RMC Research upon completion of the postassessment.

RMC Research mailed each teacher who volunteered to administer the assessments a complete set of materials at the beginning of each of the terms including spring 2008, fall 2008, winter 2009, and spring 2009. Each set of materials included 35 assessment

booklets, answer sheets for both the preassessment and postassessment, instructions for administering the assessments, and instructions and labels for returning the materials to RMC Research (see Appendix B). Teachers who satisfactorily completed the assessments received a \$75 gift card to Borders bookstore. Only data from students who completed both the preassessment and postassessment were included in the analyses. Exhibit 17 shows the distribution of the participating students, the teachers volunteers, and the schools.

Exhibit 17
Distribution of Participating Classes by Module

Module	Students	Teachers	Schools
Electric Circuits	919	43	24
Environments	352	17	12
Human Body	626	31	20
Levers and Pulleys	256	13	7
Motion and Design	580	28	16
Rocks and Minerals	866	41	26
Variables	248	11	8
Total	3,847	179	68

Note. Only students who completed both the pre- and postassessment are included.

Exhibit 18 shows the demographic distribution of the students in the participating classes compared to that of all elementary school students in Washington State. The students in the participating classes are comparable to the students in all elementary schools with respect to gender but not with respect to race or ethnicity. In addition, among the participating classes Hispanic students were overrepresented and Asian students were underrepresented compared to elementary schools statewide. This finding is due to the high number of participating schools located in the Yakima region, which serves a large Hispanic population.

Exhibit 18
Demographic Distribution of Participating Students

Category	Participating Classes	All Elementary Schools
Gender		
Male	49.3%	51.4%
Female	50.7%	48.6%
Grade		
Grade 3	21.8%	N/A
Grade 4	46.8%	N/A
Grade 5	25.4%	N/A
Grade 6	5.5%	N/A
English Speaking at Home		
Yes	84.9%	N/A
No	15.1%	N/A
Race or Ethnicity		
Asian	3.3%	7.9%
Black	4.6%	5.5%
Hispanic	22.6%	15.2%
White	64.8%	64.8%
Other	4.7%	6.6%

Note. Demographic data from the 2008–2009 school year.

Item Analysis and Scale Construction

The first step in the analysis of the instructional module assessment data was to test the reliability of the assessments themselves. A combination of factor analysis and reliability tests using the students' postassessment scores revealed that the overall reliability of the assessments could be improved slightly by omitting certain items. Exhibit 19 shows the reliability of all items on each assessment and the reliability of the scales with selected items omitted (scale scores were calculated to range from 0 to 100). The scales developed by RMC Research closely matched similar scales used by Horizon Research, the organization that developed the assessments.

Exhibit 19
Reliability of Instructional Module Assessment Item Scales

Module	Reliability of All Items	Items Omitted	Reliability of Scale
Electric Circuits	.764	Items 4, 8, 14	.766
Environments	.765	None	.765
Human Body	.776	None	.776
Levers and Pulleys	.695	Items 11, 20	.719
Motion and Design	.687	Items 8, 18	.713
Rocks and Minerals	.790	Items 8, 9	.819
Variables	.746	Item 20	.764

Note. Reliability expressed terms of Cronbach's Alpha score.

Analysis of Means

RMC Research then performed a paired sample *t* test of the student assessment results using the scales developed for each instructional module. Exhibit 20 shows the mean values for both the preassessment and postassessment for each module.

Exhibit 20
Pre- and Postassessment Mean Scores

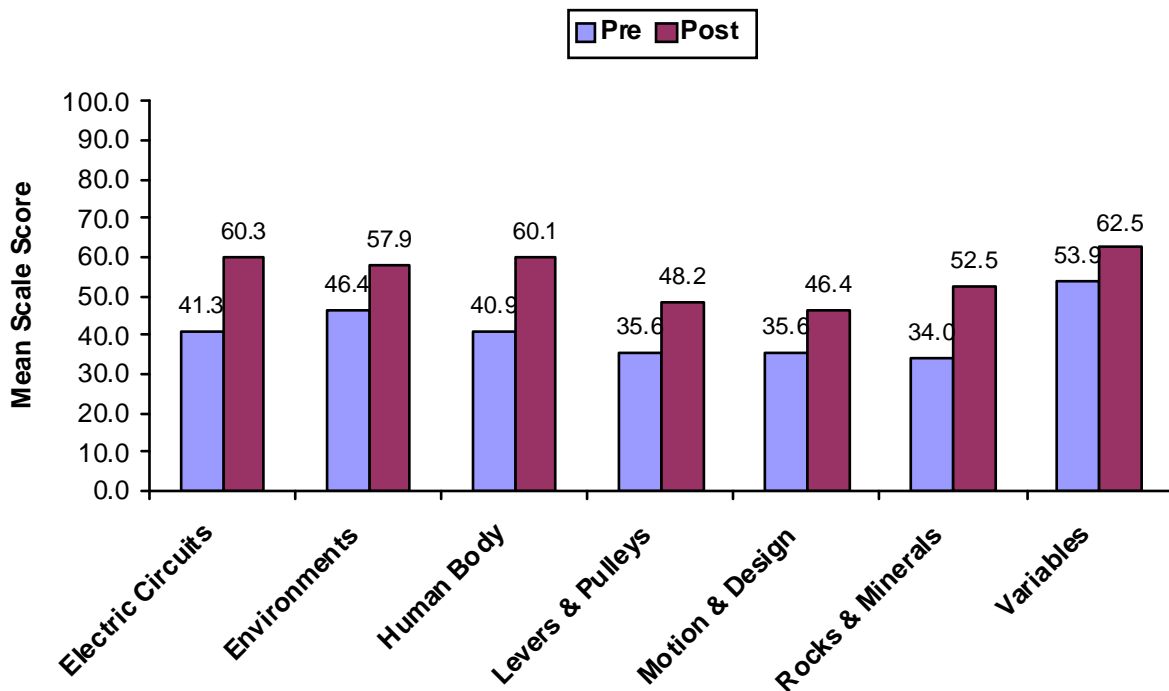


Exhibit 20
Pre- and Postassessment Mean Scores (Continued)

Module/Assessment		N	M	SD	M Diff	SE
Electric Circuits	Pre	919	41.25	15.39	19.05	.582
	Post	919	60.30	18.99		
Environments	Pre	352	46.43	16.58	11.46	.967
	Post	352	57.90	19.89		
Human Body	Pre	626	40.89	15.45	19.15	.720
	Post	626	60.05	20.10		
Levers and Pulleys	Pre	256	35.64	13.56	12.60	1.091
	Post	256	48.24	17.15		
Motion and Design	Pre	580	35.64	14.89	10.72	.684
	Post	580	46.35	17.65		
Rocks and Minerals	Pre	866	33.98	15.58	18.55	.635
	Post	866	52.53	21.08		
Variables	Pre	248	53.89	17.36	8.63	1.024
	Post	248	62.52	18.55		

Note. Scale scores ranged from 0 to 100. Each variable are significant at the .001 level.

Students demonstrated significant improvement between the preassessment and the postassessment on all 7 instructional modules. On average student scale scores increased 15.9 points (on a 100-point scale). Students demonstrated the greatest gains on the Electric Circuits instructional module (19.05) and the least gains on the Variables module (8.63).

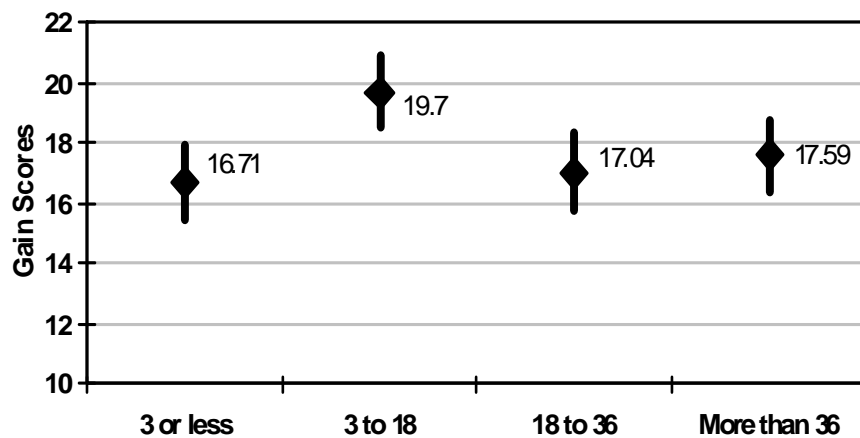
These findings parallel that of ASSET, Inc. who used some of the same assessments to measure increases in science content knowledge of students who used inquiry-based instructional modules in Pennsylvania. In this study, student scores gained 10 points on the Rocks and Minerals module, 17 points on the Electric Circuits module, and 12 points on the Levers and Pulleys module (Dear, 2007).

Professional Development and Student Achievement

Analysis of the relationship between increases in students' assessment scores and the amount of science professional development received by the teachers proved inconclusive. Information about professional development was available through the Washington State LASER database and brief surveys administered to the teachers who volunteered to administer the assessments to their students. Due to the large number of students involved in this analysis, several professional development variables were significant predictors of gains in student achievement after controlling for significant demographic factors. However, the professional development accounted for such a small portion the variance that the overall impact was negligible.

Of the variables analyzed, the number of hours of science professional development on inquiry-based science instruction reported by the teachers on the survey appeared to be the strongest predictor of student achievement. RMC Research explored the relationships between students' gain scores (i.e., the number of points a student's score increased from preassessment to postassessment) and demographic variables such as gender, race, ethnicity, and language spoken at home. Of those variables only Hispanic ethnicity significantly correlated to student gain scores. RMC Research then constructed univariate models that controlled for Hispanic ethnicity to calculate mean gain scores and classified the scores into 4 groups according to the level of science inquiry professional development participation of the students' teachers in the year prior to the assessment. Exhibit 21 shows the results of the analysis.

Exhibit 21
Student Assessment Gains as a Function of Professional Development



Level of Professional Development	Students	<i>M</i>	<i>SD</i>	<i>Adjusted M</i>	<i>SE</i>
3 hours of less	926	16.452	18.354	16.708	.617
More than 3 but less than or equal to 18 hours	966	19.915	19.890	19.699	.604
More than 18 but less than or equal to 36 hours	869	17.176	18.498	17.039	.636
More than 36 hours	926	17.790	18.383	17.586	.616

Note. Vertical bars indicate the 95% confidence interval of the adjusted mean gain scores. Covariates in this model are evaluated with Hispanic ethnicity value of 0.2343. After adjusting for Hispanic ethnicity, teacher professional development is significant at the $p = .002$ level. Adjusted R^2 value of the model is .013. Professional development participation data are from the teacher survey that accompanied the assessment materials.

Conclusion

The relationship between the professional development of the teachers who volunteered to administer the instructional module preassessment and postassessment and the gains achieved by their students is unclear. Only the students of teachers who

attended between 3 and 18 hours of science professional development on inquiry-based science instruction performed better than did students of teachers who participated in more or less professional development. Conversely, students whose teachers participated in more than 18 hours of professional development did not perform significantly different than did students whose teachers participated in 3 or fewer hours of professional development.

Sentinel Site Visit Results

In 2007 the evaluation began conducting in-depth site visits to a sample of schools (sentinel sites) to explore differences in the implementation of inquiry-based science instruction and the relationship between implementation and student performance on the science WASL. Sentinel site visits were conducted during the 2007–2008 and the 2008–2009 school years.

Sentinel Site Selection

To select schools for both rounds of site visits, RMC Research first identified those schools whose science teachers had participated extensively in science professional development in the prior 3 years. The total number of professional development hours of each school's science teachers in the prior 3 years per full-time equivalent was then calculated to produce a PD index score for every school participating in Washington State LASER. RMC Research ranked the schools in descending order with respect to these PD index scores and designated the schools at the top of the list the initial pool of sentinel site candidates.

RMC Research divided the candidate schools into 2 groups according to whether the percentage of students who met the state standards on the science WASL increased or decreased in the interval between the WASL administered 2 years prior to the proposed site visit and the WASL administered 1 year prior to the proposed site visit (i.e., 2006 and 2007 for the 2007–2008 site visits and the 2007 and 2008 for the 2008–2009 site visits). Each group included more than the targeted number of schools in anticipation that some schools would be unwilling to participate. The rationale for using this method to select the sentinel sites is based on the assumption that schools whose staff participated in the most science professional development would be more likely to implement inquiry-based science instruction, and comparison between the 2 achievement groups would illuminate the differences in implementation that result in increased (and decreased) student performance on the science WASL. Sentinel site visits were conducted at 34 schools during the 2007–2008 school year and 30 schools during the 2008–2009 school year.

Data Collection

Either an RMC Research staff member or a science education consultant hired by RMC Research conducted each sentinel site visit, which involved an interview with the principal, interviews with as many teachers as time would allow, the administration of a 1-page survey to all science teachers in the school, and at least 3 classroom observations (whenever possible). Appendix C contains copies of the interview protocols, the teacher survey, the classroom observation protocols, and the site scoring rubric. In 2007–2008 the sentinel site visitors used (with permission, as appropriate) the classroom observation protocol developed by the North Cascades and Olympic Science Partnership at Western Washington University. This protocol included an 11-trait

scoring rubric that ranged from 1 (lowest possible score) to 5 (highest possible score). In 2008–2009 the sentinel site visitors used a classroom observation protocol and developed by RMC Research that reflected current research about how students learn science. This protocol consisted of a 12-trait scoring rubric that ranged from 0 (lowest possible score) to 6 (highest possible score). Five traits were common to both classroom observation protocols. After collecting all of the interview and observation data the site visitors rated each school using a site scoring rubric, developed specifically for the sentinel site visits, that measured 23 traits related to the implementation of inquiry-based science instruction on a scale from 1 to 5.

Descriptive Analysis

As Exhibit 22 shows, the sentinel site visitors consistently rated schools high in several areas indicating that they were evident at most of the schools visited: The traits receiving a mean score of 4.00 or higher (on a 1 to 5 scale) were the following.

- **Materials Support System**—The system for maintaining, storing, and refurbishing the instructional modules was effective and well organized.
- **Condition of Modules**—Teachers received instructional modules that were complete and ready for classroom use.
- **Inquiry-Based Materials**—The school was implementing 3 or more instructional modules per grade level as the core science curriculum. More than 90% of the teachers used the instructional modules as the core science curriculum.
- **Administrative Support**—School administrators appeared to be very supportive of inquiry-based science instruction.
- **District Support**—District administrators appeared to be very supportive of inquiry-based science instruction.
- **Sequence**—All science teachers used the instructional modules according to a sequence clearly prescribed by the district.
- **Critical Mass**—Most (80% or more) teachers in the school had participated in foundational training on all of the instructional modules they used.

There were also areas where the site visitors consistently rated the schools low indicating that those traits were not evident at most of the schools visited: The 5 areas that were rated the lowest are the following (see Exhibit 22).

- **Summative District Assessments**—Very few schools administered districtwide or schoolwide summative student assessments in science annually.
- **Formative Assessments**—Few teachers (25% or less) had adopted a standard formative assessment strategy for science.
- **Instructional Time**—Science instructional time varied considerably at the elementary level and few schools required a minimum amount of science instructional time.

- **Professional Development Time for Teachers**—Teachers rarely had scheduled time during regular work hours to participate in school-based professional development in science. Schools that had designated time for professional development often devoted that time to other subject areas that were higher priority such as reading or mathematics.
- **Business, Informal Science, or Higher Education Partnership**—Few teachers had a science education-focused partnership with a business, an informal science organization, or an institute of higher education.

Exhibit 22
School Summary Ratings and Teacher Survey Descriptive Statistics

Trait	N	Min	Max	M	SD
Materials support system	68	0	5	4.65	.958
Condition of modules	68	1	5	4.53	.855
Inquiry-based materials	68	2	5	4.50	.855
Administrative support	68	3	5	4.44	.608
District support	68	2	5	4.43	.719
Sequence	68	0	5	4.32	1.309
Critical mass	68	0	5	4.13	1.403
Professional development opportunities	68	2	5	3.87	.667
Fidelity	67	1	5	3.81	.821
Parent/community support	68	2	5	3.71	.714
WASL preparation	68	1	5	3.65	1.130
Science advocate	68	1	5	3.63	1.525
Integration of literacy	68	2	5	3.51	.906
Required professional development	68	1	5	3.49	1.275
Instructional time allocated	67	0	5	3.22	1.277
Scope	68	0	5	3.13	1.050
Professional learning community	68	0	5	2.84	1.311
Priority of science	68	0	5	2.82	.976
Partnerships	68	1	5	2.71	1.467
Prof. development time for teachers	68	1	5	2.51	1.355
Instructional time used	67	0	5	2.49	1.965
Science instructional time (elementary)	49	51.4	255.0	152.60	34.803
Formative assessment	68	1	5	2.43	1.418
District assessment	68	1	5	1.59	1.200
Teacher Survey					
Inquiry as core	557			94%	
Percent of module completed	244			86%	
With fidelity	251			6%	
Participation in prof. learning community	555			56%	

Note. Sentinel site scoring rubric scale: 1 (low) to 5 (high).

As Exhibit 23 shows, the sentinel site visitors rated the lessons observed high (4.0 or higher on the 0 to 6 scale) in the following areas:

- **Alignment of Lesson Activities**—Lesson activities addressed the stated learning objectives, but how the lesson activities would lead to deeper student understanding of the learning objectives was unclear.
- **Motivation**—The lesson provided mostly extrinsic and some intrinsic motivation. The intrinsic motivation was truncated by the lesson structure and was relatively short lived.
- **Understanding of Purpose**—Throughout the lesson many students understood why they were doing each activity, but the purpose of activities could have been more explicit.
- **Classroom Discourse**—For the most part students and teachers supported and encouraged respectful and constructive discourse around important science concepts, although only some students appeared to feel comfortable asking questions, backing up their own claims, and/or critiquing claims made by others.

Exhibit 23
Classroom Observation Rating Descriptive Statistics

Trait	<i>N</i>	Min	Max	<i>M</i>	<i>SD</i>
Alignment of lesson activities	79	0	6	4.76	1.398
Motivation	79	0	6	4.65	1.468
Understanding of purpose	79	0	6	4.48	1.648
Classroom discourse	79	0	6	4.23	1.679
Intellectual engagement	79	0	6	3.99	1.728
Learning objectives	79	0	6	3.66	1.775
Use of evidence	144	0	6	3.14	2.032
Formative assessment	144	0	6	3.09	1.869
Elicitation of prior understanding	144	0	6	3.06	1.909
Lesson closure	144	0	6	2.83	2.070
Application of science	144	0	6	2.77	2.122
Reflection and meta-cognition	144	0	6	2.21	1.942

Note. Sentinel site scoring rubric scale: 1 (low) to 5 (high).

The site visitors rated the lessons observed low (less than 3.0 on the 0 to 6 scale) in the following areas:

- **Lesson Closure**—At the conclusion of the lesson the teacher provided a brief review, but students did not have an opportunity to fully examine of how the lesson related to science concepts.

- **Application of Science**—A few students applied something they learned in the lesson to a new context.
- **Reflection and Meta-cognition**—Students had some opportunity to reflect on their thinking but were not asked to identify ways in which their thinking about the science concepts had changed.

Analysis of Gains

RMC Research analyzed the site rubric scores, the classroom observation scores, and the teacher survey data for each school for evidence of significant differences between the schools that experienced an increase in the percentage of students who met the science WASL standard and the that did not between 2006 and 2008 for those schools visited during the 2007–2008 school year and between 2007 and 2009 for those schools visited during the 2008–2009 school year.

Exhibit 24 shows that there were, however, significant demographic differences between the schools in these 2 categories. The schools that demonstrated an increase in the percentage of students who met the science WASL standard between the year of the site visit and 2 years prior to the site visit had significantly fewer students who qualified for free or reduced-price lunch and a slightly higher percentage of Asian students.

Exhibit 24
Demographic Differences of Sentinel Site Schools Serving Grade 5

Demographic Characteristic	<i>n</i>	<i>M</i>	<i>SD</i>	<i>p</i>	<i>M Diff</i>	<i>SE</i>
Percent of students who . . .						
Qualify for free/reduced-price lunch						
Increase	40	39.27	16.67	.025	10.495	4.552
No change or decrease	29	49.76	19.99			
Are Asian						
Increase	40	5.49	5.32	.041	2.135	1.023
No change or decrease	28	3.36	3.09			

Although demographics can account for the overall differences in student achievement, analyses of the sentinel site visit data collected also revealed significant disparities between in groups' science programs. Exhibit 25 shows that the science lessons observed in the sentinel site schools that demonstrated increased student achievement were more likely to exhibit the following traits:

- **Learning Objectives**—The teacher stated learning objectives focused on the content and very clearly conveyed the important and enduring science concepts (big ideas).

- **Alignment of Lesson Activities**—Lesson activities directly addressed the stated learning objectives, and it was very clear how the lesson activities would lead to a deeper student understanding of the learning objectives.
- **Understanding of Purpose**—Throughout the lesson most students clearly understood why they were doing each activity.
- **Intellectual Engagement**—Students were intellectually engaged with the science content related to the lesson activities. The lesson challenged students to think at higher cognitive levels.
- **Application of Science**—Students applied something they learned in the lesson to a new context.
- **Classroom Discourse**—Students and teachers support and encourage respectful and constructive discourse around important science concepts to create a classroom culture in which most students appeared to feel comfortable asking questions, backing up their own claims, and critiquing claims made by others.
- **Motivation**—The lesson provided an appropriate balance of extrinsic and intrinsic motivation. The lesson effectively motivated students to learn by appealing to their interests, addressing a relevant topic, creating a desire to resolve a discrepancy, creating cognitive dissonance, or employing other intrinsic motivators.

Exhibit 25
Sentinel Site Differences With Respect to Science WASL Improvement

Trait		<i>n</i>	<i>M</i>	<i>SD</i>	<i>p</i>	<i>M Diff</i>	<i>SE</i>
Learning objectives	Increased	43	4.16	1.542	.006	1.107	.390
	No change	36	3.06	1.866			
Alignment of lesson activities	Increased	43	5.14	1.104	.010	.834	.313
	No change	36	4.31	1.582			
Understanding of purpose	Increased	43	4.88	1.276	.021	.884	.373
	No change	36	4.00	1.912			
Intellectual engagement	Increased	43	4.40	1.498	.024	.895	.387
	No change	36	3.50	1.875			
Application of science	Increased	83	3.24	2.103	.001	1.118	.344
	No change	61	2.12	1.989			
Classroom discourse	Increased	43	4.58	1.418	.046	.776	.381
	No change	36	3.81	1.880			
Motivation	Increased	43	4.95	1.290	.045	.676	.331
	No change	36	4.28	1.597			

Note. Classroom observation rubric scores scale: 0 (low) to 6 (high). *t* test with equal variances not assumed.

The initial selection of sentinel site schools and their assignment to achievement groups (those that showed an increase and those that did not) was based on the percentage of students who met the state science WASL standard in the 2-year period prior to the selection, whereas the analysis of the results calculated gains for the 2-year period that included the site visit. For example, the schools selected for a sentinel site visit during the 2008–2009 school year were selected and assigned to an achievement group based on achievement patterns between 2006 and 2008 administrations of the WASL, but the data analysis calculated gains for the period from 2007 to 2009. As a result, some school changed from one achievement group to the other after they were selected for a sentinel site visit. Overall, more schools increased enough to change their classification from little or no change to increasing than there were schools that were reclassified downward. These reclassification of the schools into achievement groups resulted in a slight imbalance in the number of schools in each group.

Analysis of Achievement Ranking

RMC Research also analyzed the sentinel site data with respect to overall student performance. In this case, it was determined whether the percentage of students who met the science standard in each school was at or above the state average or below the state average. Exhibit 26 shows the areas in which the sentinel site school summary ratings revealed significant differences between schools at or above the state average compared to schools below the state average:

- **Instructional Time Allocated**—The school designated a specific amount of instructional time for science.
- **Integration of Literacy**—Teachers integrated science and literacy through the use of supplementary reading materials and science notebooks.
- **Professional Development Time for Teachers**—Time for school-based professional development in science was occasionally scheduled during regular work hours.
- **District Support**—District administrators appeared to be somewhat supportive of inquiry-based science instruction.
- **Parent and Community Support**—Parents and the community appeared to be somewhat supportive of inquiry-based science instruction.

Exhibit 26
Sentinel Site Differences With Respect to Science WASL State Average

Trait		<i>n</i>	<i>M</i>	<i>SD</i>	<i>p</i>	<i>M Diff</i>	<i>SE</i>
Grade 5 Schools							
Instructional time allocated	At or above average	32	3.09	.818	.007	.816	.280
	Below average	18	2.28	1.018			
Integration of literacy	At or above average	33	3.73	.911	.009	.616	.225
	Below average	18	3.11	.676			
Professional development time for teachers	At or above average	33	2.61	1.273	.007	.828	.292
	Below average	18	1.78	.808			
District support	At or above average	33	4.61	.556	.045	.439	.209
	Below average	18	4.17	.786			
Grade 8 Schools							
Parent and community support	At or above average	9	3.56	.527	.048	.556	.258
	Below average	8	3.00	.535			

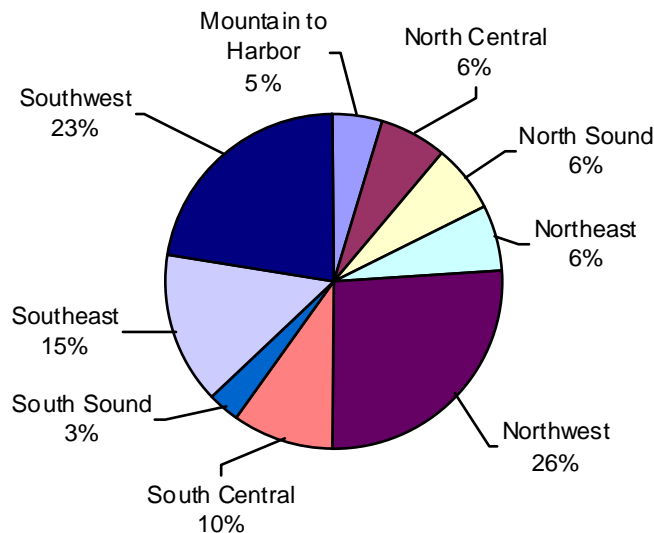
Note. Traits represent those from the school summary ratings that had a significant difference between schools that scored above the state average and those that scored below. Site rubric score scale: 1 (low) to 5 (high).

Principal Survey Results

In spring 2009 RMC Research developed an online survey that closely corresponded to the data collected through interviews, surveys, and classroom observations (see Appendix D for survey items). RMC Research used the data in the Washington State LASER professional development database to identify those schools whose teachers participated in the greatest amount of professional development provided through the Regional Alliances. For each school served by an Alliance within the past 5 years, RMC Research calculated the professional development hours per teacher by dividing the total number of hours of professional development of all teachers in a school over the past 5 years by the teachers' FTE (full time equivalent). This value was used to rank the schools from highest to lowest professional development participation. RMC Research selected all of the schools with 15 or more hours of professional development per FTE to participate in the survey. A total of 319 schools were included in the original sampling frame.

RMC Research sent the principal of each selected school a letter and an email urging him or her to complete the online principal survey. The letter explained why the school was selected and emphasized the relationship between the services the school received through the Regional Alliance and the need for the survey data. RMC Research launched the principal survey on May 22, 2009, and kept it open until the end of July 2009. A total of 62 principals completed the survey for a return rate of 19.4%. Exhibit 27 shows the distribution of the respondents by regional alliance. All Alliances are represented except Olympic Regional Alliance.

Exhibit 27
Distribution of Respondents by Regional Alliance



RMC Research conducted a series of regression analyses to identify survey variables that might be significant predictors of the percentage of students meeting the science WASL standards above and beyond what could be explained by demographic control variables. The analysis revealed that the percentage of students who qualified for free or reduced-price lunch was the one demographic variable available as a control variable in the analysis. Exhibit 28 shows the principal survey items that correspond to the nondemographic school variables that were significant predictors of student science achievement above. These variables included:

- Organized efforts to identify instructional materials to fill gaps in the science curriculum.
- Student use of evidence to engage in discourse about science.
- Regular provision of time during the regular work day for teachers to participate in school-based science professional development.
- Support for professional learning communities focused on improving science teaching and learning.

Exhibit 28
Principal Survey Item Predictors of Student Science Achievement

Survey Item	Grade Tested	Adjusted R ²	Change in R ²	Beta
Has your school or district made an organized effort to identify instructional materials to fill the gaps?	5	.459	.114	.352
Principal observation of classes: Students had opportunities to make claims, and/or use evidence to back up their claims or critique claims made by others. The lesson reinforced the notion that science is a process by which knowledge is constructed.	5	.563	.122	.350
Is time scheduled during regular work hours for teachers in this school to participate in organized, school-based professional development specifically for science?	5	.338	.002	.048
How often do teachers participate in school-based professional development specifically for science?	5	.213	.017	.153
Has any of the professional learning community activities focused on improving science teaching and learning?	5	.476	.031	.211
Approximately what percentage of the professional learning community is devoted to science teaching and learning?	5	.434	.002	.047

Note. Analysis conducted using Grade 5 WASL data.

Curriculum

The principal survey contained a series of items about the schools use of the inquiry-based instructional modules. The table and series graphs that follow (Exhibits 29–33)

show the frequency distribution of the responses to the curriculum items. The key findings from the survey include these:

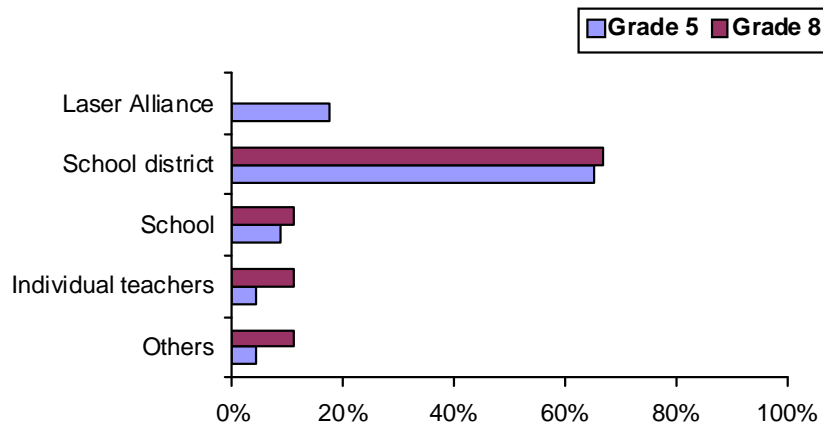
- Principal survey respondents represented schools with a wide range of experience using the instructional modules (see Exhibit 29).
- In nearly 3 out of every 5 elementary schools (58%), teachers typically used 3 instructional modules per year; in 37% of the schools teachers typically used 2 modules per year (see Exhibit 30).
- Ninety-six percent of the principals reported that their school used the inquiry-based instructional modules as the core science curriculum and followed a set sequence that determined which modules were used at each grade level.
- Twenty-three percent of the principals believed that teachers used the instructional modules exactly as prescribed (see Exhibit 32).
- According to 2 out of every 3 respondents, the decision regarding the sequence of instructional modules was made at the district level (see Exhibit 31).
- Seventy-seven percent of the principals believed that teachers generally completed all of the activities in the instructional modules. However, this self-reported opinion of the principals does not agree with the data teachers reported during the sentinel sites visits.
- Approximately half (48%) of the principals reported that teachers made an organized effort to identify instructional materials to fill the science curriculum gaps not addressed by the instructional modules (see Exhibit 33).
- Eighty-four percent of the principal survey respondents represented elementary schools with self-contained classrooms. Of those principals less than half (46%) reported that teachers were expected to devote a set amount of time to science instruction. The designated times ranged from 35 to 300 minutes per week for an average of approximately 140 minutes a week (see Exhibit 33).
- Twenty-eight percent of the principals represented secondary schools or K–8 schools in which science teachers were primarily responsible for science instruction. In 81% of these schools, students studied science for a full year (see Exhibit 33).

Exhibit 29
First School Year Using Modules

First School Year	<i>n</i>	Percent
1999–2000	12	19.4
2000–2001	8	12.9
2001–2002	5	8.1
2002–2003	4	6.5
2003–2004	3	4.8
2004–2005	8	12.9
2005–2006	7	11.3
2006–2007	6	9.7
2007–2008	6	9.7
2008–2009	3	4.8

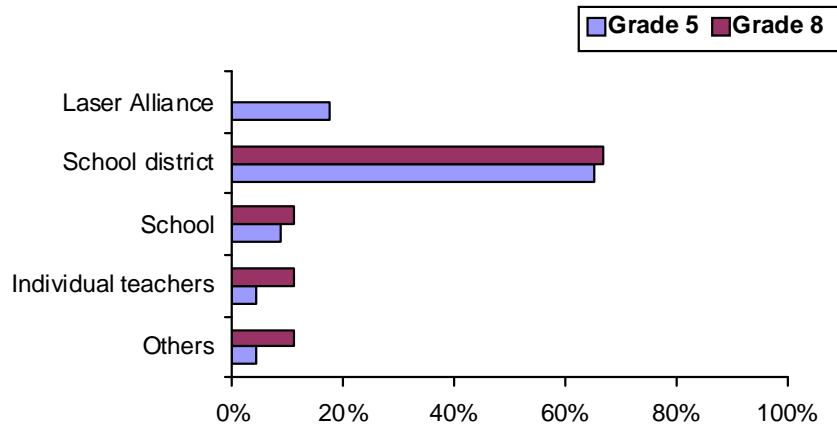
Note. Survey item: “During which school year did your school first begin using the inquiry-based instructional modules (kits) for science?” *n* = 62.

Exhibit 30
Instructional Modules per School Year



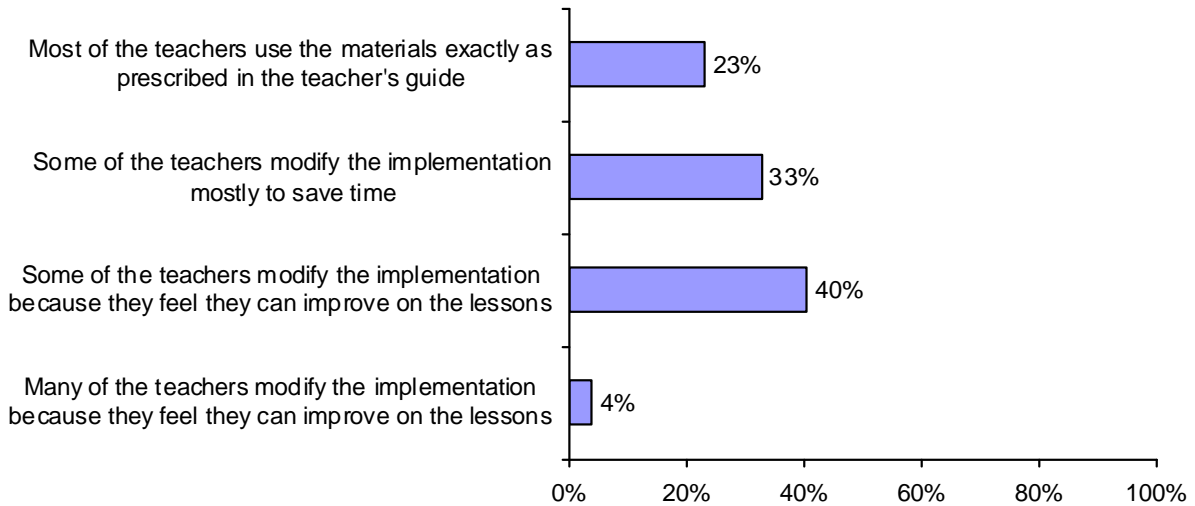
Note. Survey item: “How many instructional modules (kits) did the typical teacher who teaches science in your school use over the course of the current school year?” *n* = 59.

Exhibit 31 Decision Regarding Instructional Module Sequence



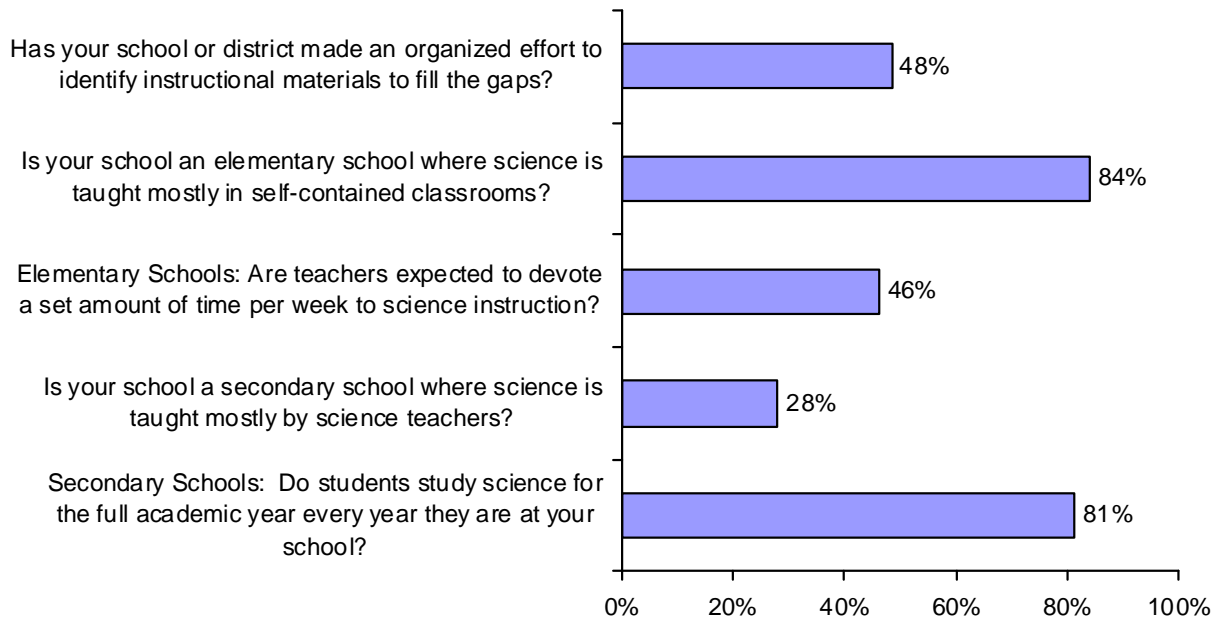
Note. Survey item: "At what level is the decision ultimately made about the sequence of instructional modules (kits) that are used at each grade level?" *n* = 46 at Grade 5, *n* = 9 at Grade 8.

Exhibit 32 Fidelity of Instructional Module Use



Note. Which of the following best describes the degree to which you believe that teachers implement the modules as prescribed in the teachers guide? *n* = 52.

Exhibit 33 Instructional Module Usage



Professional Development

Another section of the principal survey contained items about the professional development the Regional Alliance provided to prepare teachers to effectively use the inquiry-based instructional modules. The series of graphs that follow (Exhibits 34–38) show the frequency distribution of the responses to the professional development items. The key findings from the survey include these:

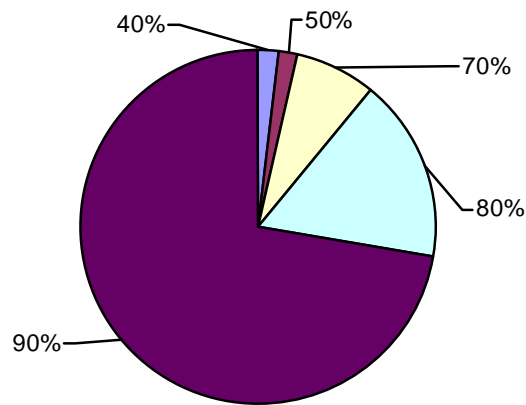
- Two out of every 3 principals (68%) reported that their school or district had a policy that required teachers to participate in professional development prior to their use of each instructional module with students.
- Nearly 3 out of every 4 principals reported that approximately 90% of the teachers in their school had participated in the foundational training on all of the instructional modules they used with students (see Exhibit 34).
- Ninety-one percent of the principals reported that teachers had ample opportunity to participate in the foundational training on the instructional modules they used, and 62% reported that teachers had ample opportunity to participate in additional professional development focused on advanced use of the instructional modules. The reported percentage of teachers who participated in advanced training varied considerably (see Exhibit 35).
- Forty-two percent of the principals reported that time was scheduled during regular work hours for teachers to participate in organized, school-based

professional development in science. The frequency varied considerably from weekly to annually (see Exhibit 36) and the number of hours ranged from 2 to 15.

- Nearly 2 out of every 3 principals (64%) reported that teachers participated in professional learning communities that met regularly to conduct professional development, and 66% of those principals reported that approximately 90% of their school's staff were active participants. Most (58%) of these professional learning communities met weekly (see Exhibit 37), but approximately 2 out of every 3 devoted 30% or less of their meeting time to improving science instruction (see Exhibit 38).
- Nearly 3 out of every 5 principals (57%) reported that the professional learning community sessions involved teams of teachers collaboratively examining samples of student work to gain insight into how students learn science.

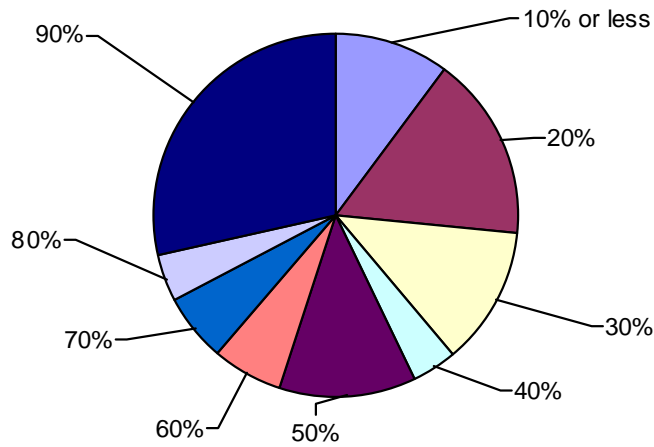
Please note that results that appear in Exhibit 36 and 37 must be interpreted with caution. The survey used the terms school-based professional development and professional learning communities. Inconsistencies between the results of the 2 items indicate that some principals understood the 2 concepts to have the same meaning while others saw the two as different.

Exhibit 34
Foundational Training Participation



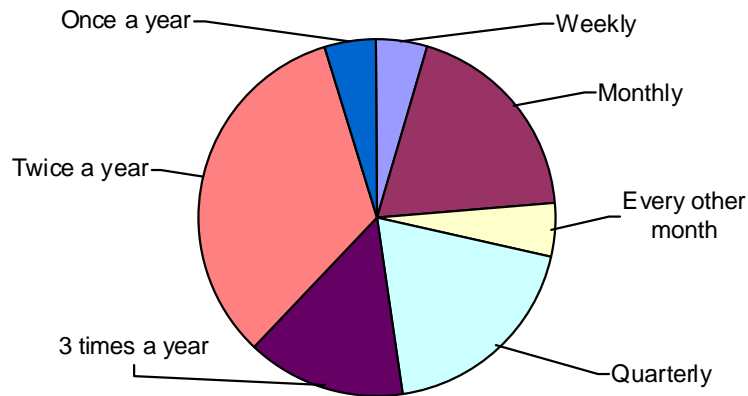
Note. Survey item: "Approximately what percentage of the teachers in this school have participated in the foundational training on all of the instructional modules they are using with students?" $n = 54$.

Exhibit 35 Advanced Training Participation



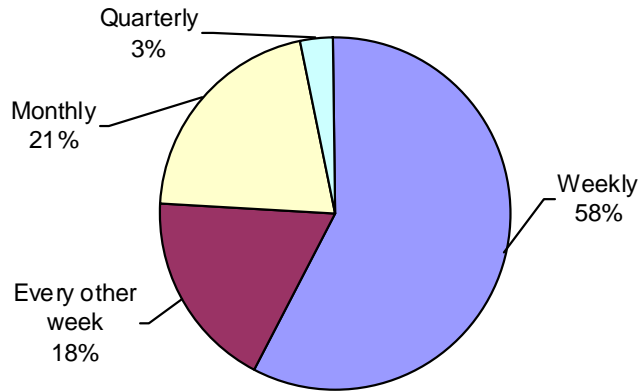
Note. Survey item: “Approximately what percentage of the teachers in this school have participated in professional development that goes beyond foundational and further develops their expertise in the use of the instructional modules?” $n = 49$.

Exhibit 36 Frequency of School-Based Professional Development



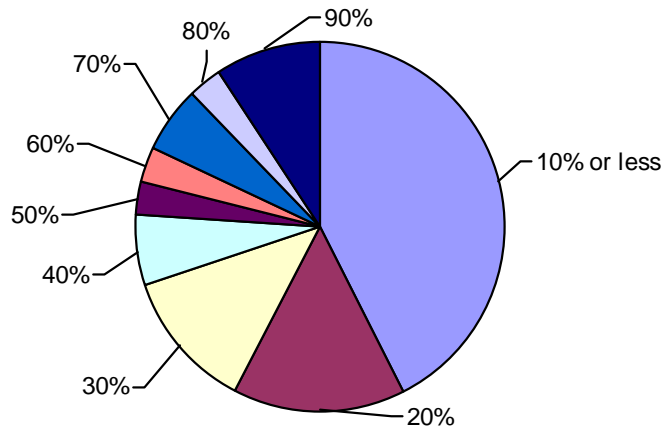
Note. Survey item: “How often do teachers participate in school-based professional development specifically for science?” $n = 21$.

Exhibit 37
Frequency of Professional Learning Community Meetings



Note. Survey item: "How often do professional learning communities meet?"
n = 33.

Exhibit 38
Professional Learning Community Time Devoted to Science



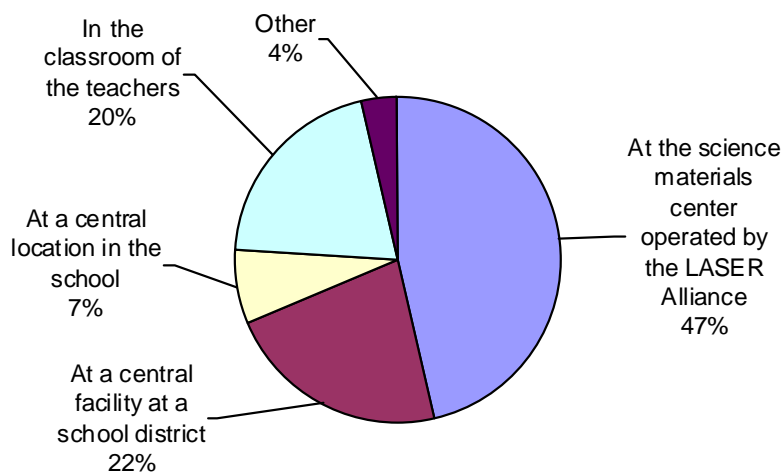
Note. Survey item: "Approximately what percentage of the professional learning community time is devoted to science teaching and learning?"
n = 33.

Materials Support

The principal survey also addressed how the science instructional modules were stored, delivered, and maintained. The series of graphs that follow (Exhibits 39–43) show the frequency distribution of the responses to the professional development items. The key findings include these:

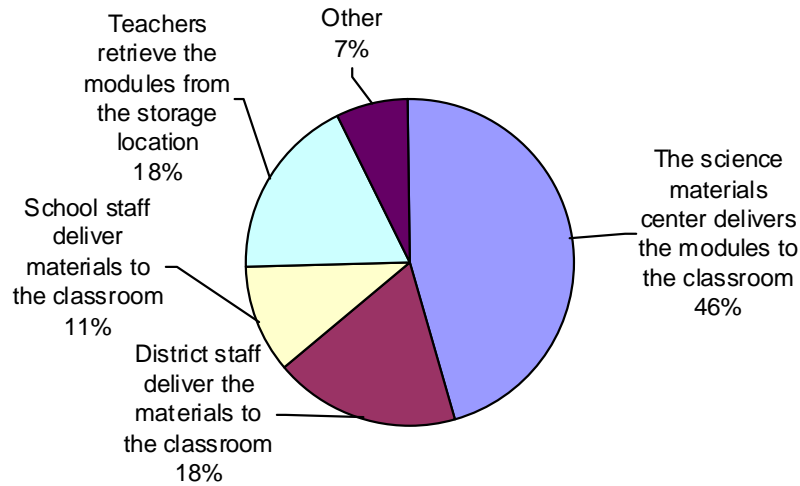
- Nearly half (47%) of the principals reported that the instructional modules were stored at a science materials center, which delivered the modules to the classrooms (see Exhibits 39 and 40).
- Seven out of every 10 principals reported that the instructional modules were refurbished at a science materials center (see Exhibit 41).
- Most (81%) of the principals reported that teachers never or seldom experienced problems with the condition of the instructional modules (see Exhibit 42).
- Ninety-two percent of the principals reported that the modules were always or almost always delivered on time (see Exhibit 43).

**Exhibit 39
Instructional Module Storage**



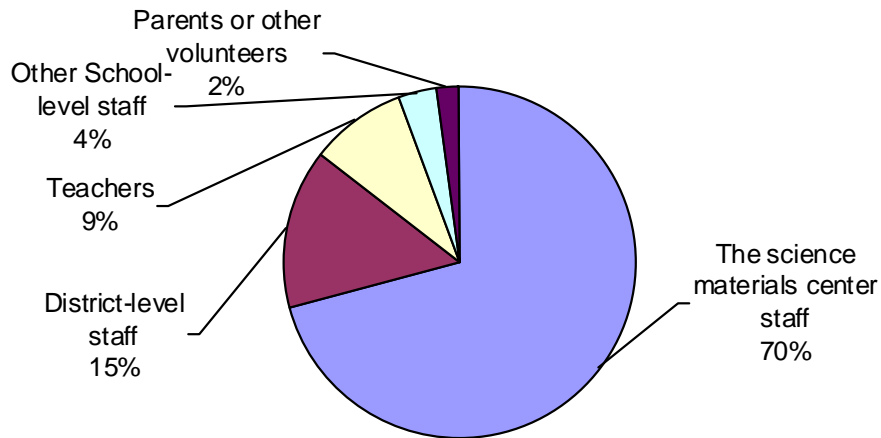
Note. Survey item: "Where are the instructional modules stored when they are not being used?" $n = 54$.

Exhibit 40 Access to Instructional Modules



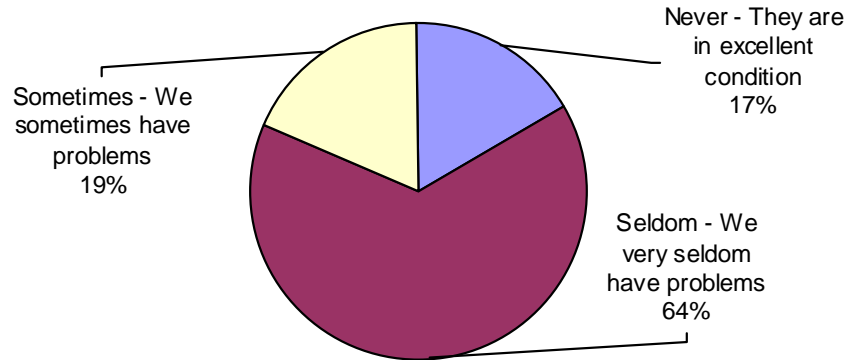
Note. Survey item: “How do teachers obtain the instructional modules when they are ready to use them with students?” *n* = 55.

Exhibit 41 Instructional Module Refurbishment



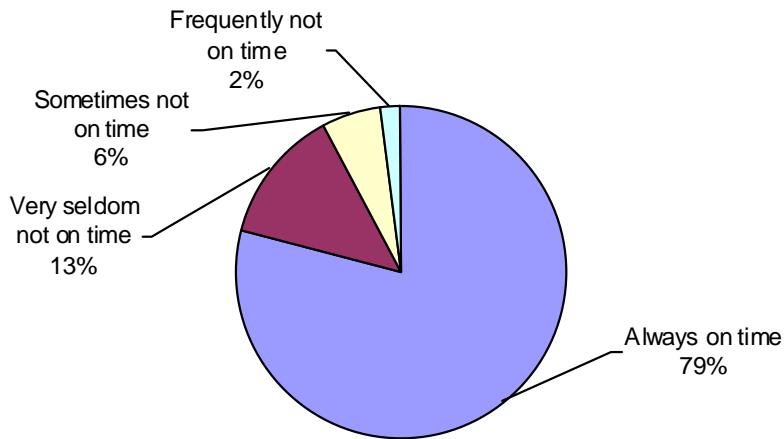
Note. Survey item: “How are the instructional modules refurbished after use?” *n* = 55.

Exhibit 42
Frequency of Problems With Instructional Module Condition



Note. Survey item: "How frequently do your teachers have problems with the condition of the modules?" $n = 54$.

Exhibit 43
Timeliness of Instructional Module Delivery



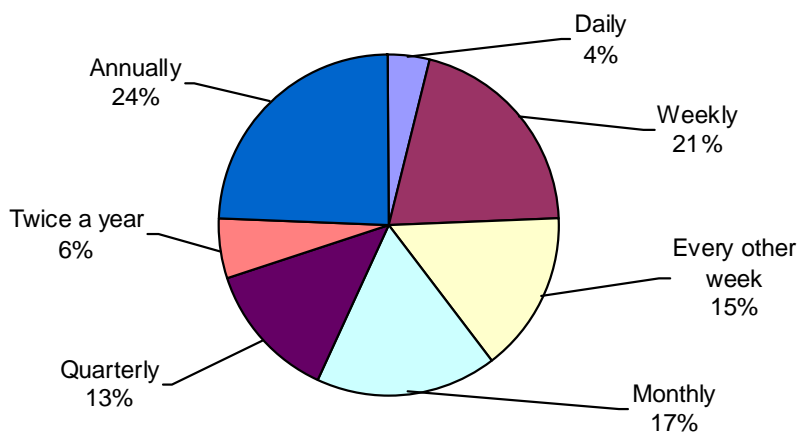
Note. Survey item: "How timely do the modules arrive?" $n = 52$.

Classroom Instruction

The survey solicited the principals' perspective on science instruction based on the classroom observations they had conducted (see Exhibits 44 and 45). The key findings include these:

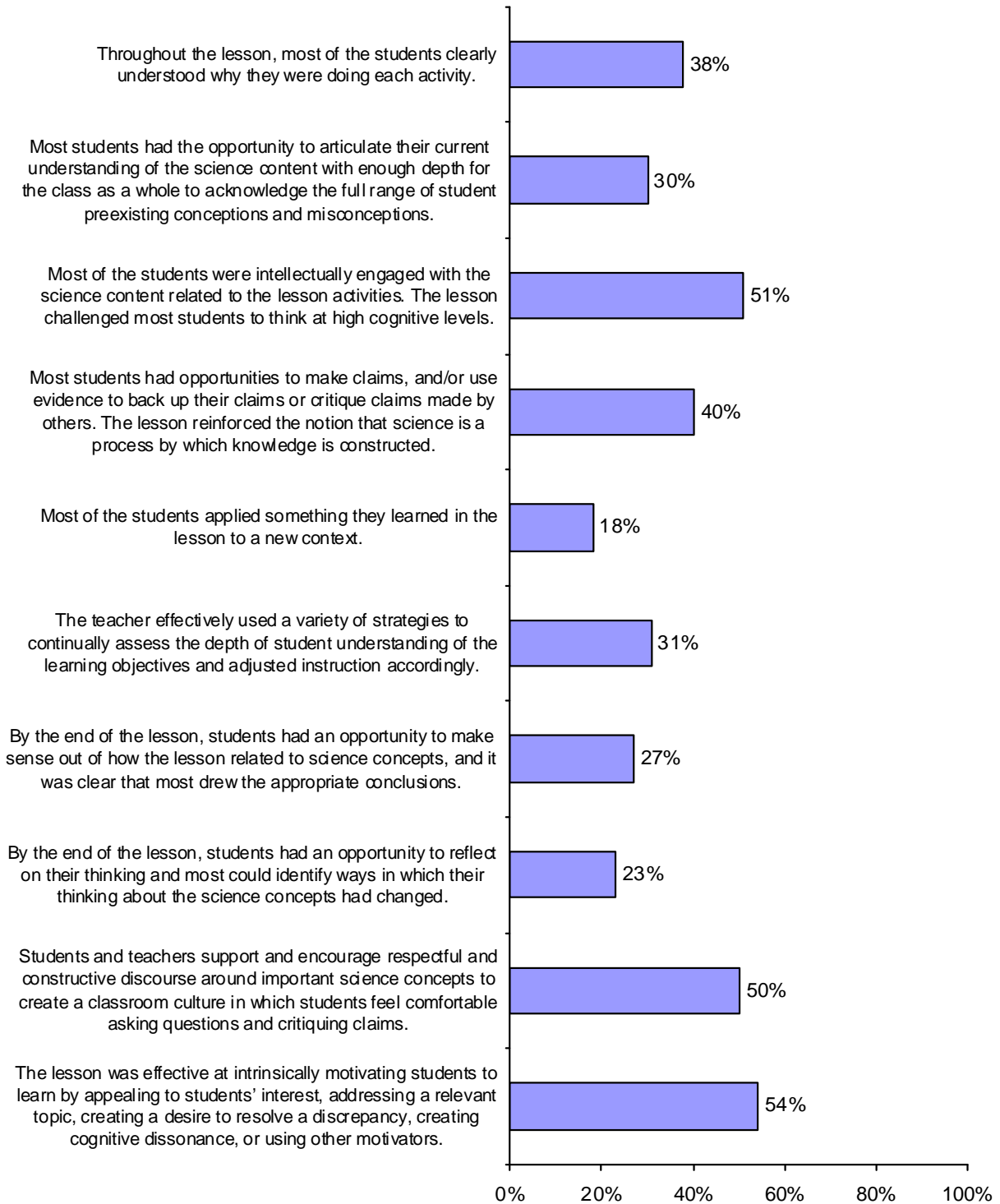
- Most (57%) of the principals who reported observing science classes did so at least monthly, though approximately a quarter observed science classes only once a year (see Exhibit 44).
- The science instruction traits observed most frequently by principals were the intrinsic motivation of students (54%), the intellectual engagement of students (51%), and a classroom climate that supports constructive discourse (50%; see Exhibit 45).
- The science instruction traits observed least frequently by principals were the application of science (18%), opportunities for reflection and metacognition (23%), and sense making (27%; see Exhibit 45).

Exhibit 44
Frequency of Principal Observation of Science Classes



Note. Survey item: "How frequently do you observe science classes?" $n = 53$.

Exhibit 45 Classroom Observation Perceptions of Principals



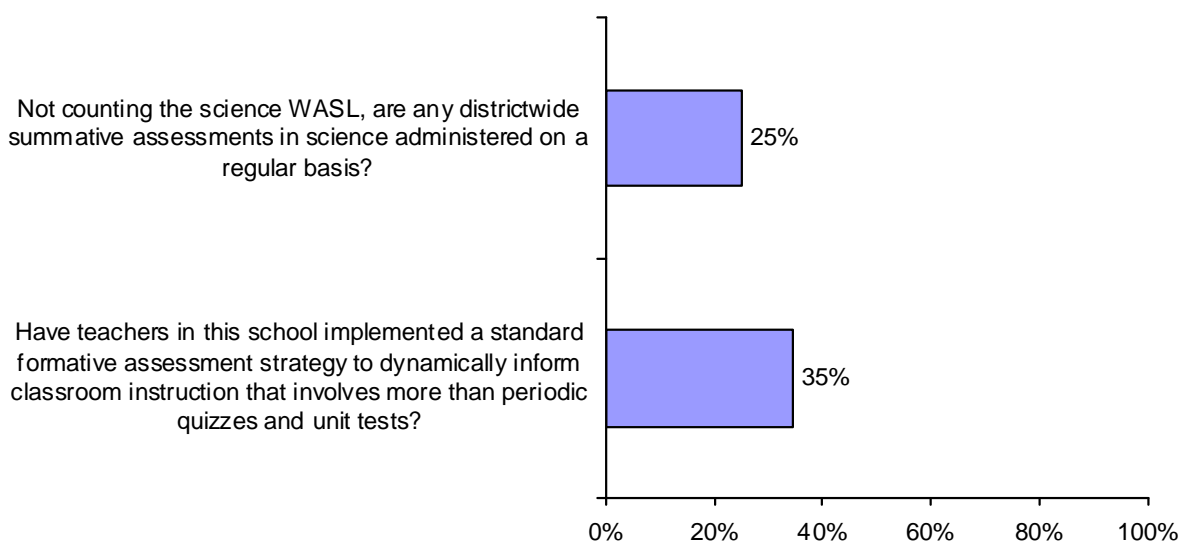
Note. Percentages indicate that the given trait was very evident in most of the science classes observed. $n = 50$ to 53 .

Student Assessment

The principal survey included a brief section on summative and formative science assessments (see Exhibit 46). The key findings include these:

- Twenty-five percent of the principals reported that their school regularly administered some form of standard summative assessment in science. Measures of Academic Progress (MAP) was the assessment most commonly cited. Others cited included end-of-unit assessments provided by a science instructional materials publisher, and teacher-developed unit assessments, and adaptations of Powerful Classroom Assessments provided by OSPI.
- Thirty-five percent of the principals indicated that their school's approach to formative assessment included the use of science notebooks and questioning during instruction.

Exhibit 46
Summative and Formative Assessment



Note. Percentages indicate that principals responded affirmatively.
Summative assessment: $n = 54$; formative assessment: $n = 52$.

Community and Administrative Support

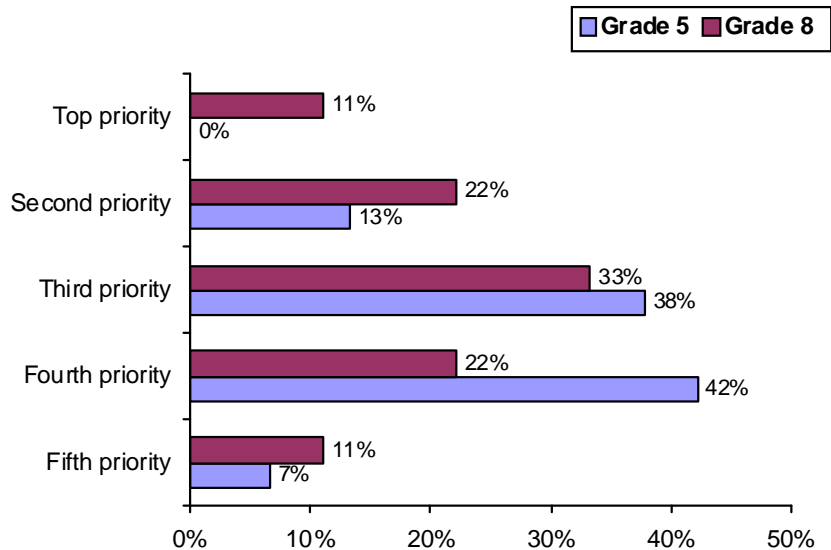
Another section of the principal survey collected information about the support for science compared to other subjects in the school (see Exhibit 47). The key findings include these:

- At the elementary school level few principals (13%) indicated that science was the first or second priority, whereas 33% of the K–8 or middle school principals

reported that science was the first or second priority. Science was the third or fourth priority in 80% of the elementary schools.

- Ninety-four percent of the principals reported that the district administration was very supportive (80%) or somewhat supportive (14%) of inquiry-based science instruction.
- Eighty-one percent of the principals reported that the parents of their students were very supportive (44%) or somewhat supportive (37%) of inquiry-based science instruction.
- Thirty-two percent of the principals indicated that their school maintained a partnership around science education with a local business, informal science organization, or institution of higher education.

Exhibit 47
Priority of Science

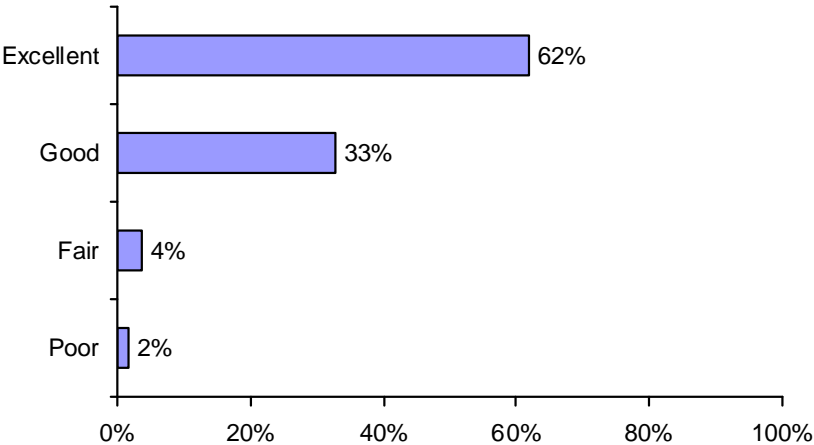


Note. Survey item: “Of these 5 subjects—reading/language arts, writing, mathematics, science, and social studies—what priority do you personally believe science should be for the students in your school?” $n = 45$ at Grade 5, $n = 9$ at Grade 8.

Overall

Overall, the principal survey respondents were very satisfied with the services they received through their Regional Alliance. Exhibit 48 shows that 94% of the principals rated the services their school had received in the past year as excellent (62%) or good (33%).

Exhibit 48
Overall Rating of Regional Alliance Services



Note. Survey item: "How would you rate the services that your school received from your Regional Alliance this past year?"
n = 55.

Regional Alliance Director Survey Results

RMC Research administered the Director Survey to the Regional Alliance directors in January 2009 (see Appendix D). The survey provided an opportunity for the directors to reflect on their Regional Alliance program services and gain a better understanding of the commonalities and differences between Regional Alliances and their operations to inform future planning. All of the Regional Alliance directors completed the survey ($n = 10$).

Regional Alliance Membership

All of the directors except one reported that their Regional Alliance provided individualized services to districts to assist schools with the implementation of their LASER Strategic Plan. The services ranged from providing professional development assistance ($n = 7$) to supplying student assessments ($n = 3$). Most of the directors ($n = 7$) reported that district science team participation in a LASER Strategic Planning Institute is a requirement for receiving Regional Alliance services. One director clarified that districts were allowed to participate in regional networking events without participating in a LASER Strategic Planning Institute but were required to attend the Institute to receive funding for foundational professional development.

Curriculum

The Director Survey included items regarding the role of the Regional Alliance in determining the science curriculum in each of the districts they serve. Only a few directors ($n = 3$) reported that the Regional Alliance required all participating districts to agree to use the same modules. Two of these directors indicated that the modules were initially selected and assigned to grade levels in 2000 and the selection was revised in 2008, and one director noted that the elementary school modules were selected in 2005 (and had not been refined) and the middle school modules were in the process of being selected. Another director stated that all middle schools would use the same modules but not necessarily at the same grade levels.

All of the Regional Alliance directors described similar processes for determining which instructional modules the districts used, although some differences were reported. One Regional Alliance determined the scope and sequence of the modules at the 1999 and 2000 LASER Strategic Planning Institutes based on the experiences of districts in the region that had adopted research-based instructional materials a few years earlier. The Regional Alliance's role in the process was to send members to attend the Institutes and assist in the decision making process. LASER Strategic Planning Institute participants in another region consulted with other Regional Alliances, national experts, state and regional science leaders, the science module developers, and other teachers. At the LASER Strategic Planning Institute the members considered all of the information gathered and determined that at each grade level the instructional modules would provide opportunities for students to explore life, earth, and physical science concepts

every year. One Regional Alliance established a system for soliciting continual feedback from science leaders regarding the science curriculum.

Another Regional Alliance director explained that rather than building on prior work or consulting with experts, the LASER Strategic Planning Institute attendees developed a common vision of high-quality science pedagogy that incorporated various perspectives (e.g., teachers, students, etc.). The group then deepened its understanding of the science grade level expectations (GLEs), used a screening rubric to examine the published materials chosen by the group, and examined standard alignment tools provided by the publisher or developed by others in Washington State. Comparison of the instructional modules selected by this Regional Alliance to the modules selected by other Regional Alliances in the state revealed that the instructional modules selected were similar. All of the participating districts agreed to the outcome of this process, which resulted in reassigning 2 modules to different grade levels. The Regional Alliance director attended the Institute and assisted with the decision-making process.

Seven of the directors described the services their Regional Alliance provided to help districts that joined the Alliance later determine the appropriate instructional modules; 3 directors did not respond to this question. Most of the directors ($n = 5$) reported that the Alliance shared the resources they had developed regarding module selection or provided a science coordinator or science specialist to assist with the decision-making process. Others ($n = 3$) referred districts to other districts using the instructional modules, exemplary teachers who used the modules, or the Center for Inquiry Science (CIS) at the Institute for Systems Biology in Seattle. The Center for Inquiry Science was qualified to assist with selection because it had conducted a series of workshops on Analyzing Instructional Materials in Science (AIMS). One Regional Alliance director also reported providing access to materials so that a district could pilot a module if desired.

Directors were asked what would typically happen if a district that wished to join the Regional Alliance expressed interest in using inquiry-based instructional materials from a vendor that the Alliance did not currently support. Only one Regional Alliance reportedly supported only the modules already selected by the Alliance and the districts already participating in the Alliance. Two directors indicated that the district could purchase the materials, but would need to do so independent of the Alliance. Other directors ($n = 4$) indicated that their Alliance tried to be inclusive and did not place strict limits on the materials they supported. Districts could use materials from other vendors or develop the modules themselves and could ask the Regional Alliance to review the materials. If the reviewed materials were considered exemplary, the materials would be added to the modules supported by the Regional Alliance; if not, the Alliance would help the district choose different materials. Three directors did not respond to this question.

All of the directors ($n = 10$) described the efforts taken by their Regional Alliance to ensure that the grade assignments and sequence of instructional modules aligned with the grade level expectations and Essential Academic Learning Requirements (EARLs). Some ($n = 4$) explained that the Regional Alliance assisted in formulating an alignment document that was distributed to participating districts. One director clarified that because the grade level expectations were developed after the creation of the

alignment document, the grade level expectations section lacked the same detail as the EARL section. Some Regional Alliances ($n = 2$) provided alignment assistance through committees. One director reported holding a meeting in 2006 to help 50 teachers align the instructional modules to the state science standards and to agree upon a sequence of modules for each grade level. Another Alliance had a committee that periodically met to review the sequencing and alignment of the instructional modules with the revised standards. Approximately half of the directors ($n = 4$) indicated that the districts handled this aspect on their own and any involvement on the Alliance's part was minimal.

Almost all of the directors ($n = 8$) indicated that their Regional Alliance assisted districts to fill gaps in the science curriculum that might occur due to the sequence of the instructional modules. Assistance ranged from teacher leaders addressing the gaps in the professional development ($n = 3$) to referrals to other districts for resources ($n = 3$). Three Alliances also offered assistance through organizations such as Pacific Northwest National Labs (PNNL), the Center for Inquiry Science, and the National Science Leadership Academy (NSLA). Other support described by individual directors included distributing information from the LASER website, sharing information on the Alliance Instructional Resource Center, directing the foundational professional development providers to address gaps, and addressing gaps during the content portion of the professional development.

Materials Support

Seven of the 10 Regional Alliances directors indicated that their Alliance operated a science materials center. Another director explained that school districts operated their own centers with the assistance of the Alliance. The science material centers were opened as early as 1984 and as late as 2006. All of the directors explained that funding sources other than LASER were used to establish and operate the centers. In most cases ($n = 5$) these additional funds were from district cooperatives or the districts paid participation fees. Other funding sources included the business and industry sectors ($n = 2$), Educational Service Districts (ESDs) or ESD Science Education Cooperatives ($n = 2$), and Washington State University Vancouver ($n = 1$). Thirty percent of the science materials centers operated in partnership with other organizations including Pacific Northwest National Labs, other districts, or other ESDs.

Exhibit 49 shows the number of module titles the Regional Alliances supported for each vendor. Most of the centers supported either Full Option Science System (FOSS; $n = 7$) or Science and Technology for Children (STC), Science and Technology for Middle School (STC/MS; $n = 6$), or Science Education for Public Understanding Program (SEPUP). On average the science materials centers supported 16 FOSS module titles (from a low of 2 to a high of 28) and 15 STC or STC/MS module titles (from a low of 4 to a high of 33). Directors ($n = 4$) shared that the centers supported module titles from publishers other than those noted in Exhibit 49 including Astro Adventures developed by Pacific Science Center ($n = 2$), Science Companion, and materials from Biological Sciences Curriculum Study ($n = 2$).

Exhibit 49
Supported Module Titles From Each Vendor

Vendor	N	No. of Module Titles		
		Mean	High	Low
FOSS	7	16	2	28
STC or STC/MS	6	15	4	33
GEMS	4	1.5	1	2
SEPUP	2	4	2	6

All of the directors reported that the science materials centers charged schools for the use of the instructional modules; 5 reported that these costs included the delivery of the modules to the schools, and 3 reported that schools were also charged for module refurbishment. One director reported that districts were responsible for the cost of refurbishment only. The fees for the modules varied. The science materials centers charged schools a flat fee per teacher ranging from \$115 to \$125 ($n = 3$), an initial buy-in fee of approximately one third of the module cost ($n = 2$), the cost of the consumable components plus 30% of that cost and, if applicable, the cost of living creatures for life science modules cost plus 29% of that cost ($n = 1$), or \$23 for each full-time teacher served ($n = 1$). The center that charged per teacher clarified that the Alliance was in the process of presenting the schools with an alternative fee structure that charges per module. The refurbishment costs varied from \$110 to \$165 for elementary modules and \$300 to \$330 for middle school modules. One science materials center charged for the delivery of modules and another levied an additional charge for the delivery of modules with living creatures. To avoid the delivery charge districts could pick up modules. In addition, deliveries were combined whenever possible and the maximum total for deliveries was \$650. To track budgets directors reported using Excel software ($n = 3$), Excel software with Saguaro ($n = 1$), WesPac ($n = 1$), or WSIPC ($n = 1$) data systems; or a custom-built software system ($n = 1$).

Directors described the process for delivering and storing the instructional modules. Many ($n = 6$) reported that the Regional Alliance had a set schedule for the delivery and pickup of the modules, whereas others indicated that districts created their own schedule ($n = 3$) or requested modules each trimester ($n = 1$). Most of the science materials centers delivered the modules ($n = 6$), but in some cases district staff ($n = 3$) or a combination of district and ESD staff ($n = 1$) delivered the modules. Many of the directors ($n = 6$) explained that the instructional modules were typically stored at the science materials center when not in use. Others ($n = 3$) reported that the modules were stored at district facilities. In one case modules were stored at multiple locations (e.g., the science materials center, district facilities, schools, and classrooms). Only 20% of the science materials centers reported using a bar coding system to track their module inventory. Various entities owned the modules including the districts ($n = 4$), a district and the science materials center ($n = 1$), the ESD and the Regional Alliance ($n = 2$), a district and the Regional Alliance ($n = 1$), the ESD and a district ($n = 1$), or the Regional Alliance ($n = 1$).

Most of the Regional Alliance directors reported that the science materials centers were responsible for refurbishing the instructional modules. The cost of replacing broken or damaged materials and consumables was borne by the district ($n = 5$), the science materials center ($n = 3$), the school ($n = 1$), or both the district and the science material center ($n = 1$). The majority of the Regional Alliances ($n = 8$) had added additional instructional materials to the modules that were not provided by the vendor. Most ($n = 5$) added reading materials such as trade books, science-themed books, and reading lists. The Regional Alliances also included science notebooks ($n = 2$), artifacts (e.g., skulls, fur, body parts; $n = 1$), consumables ($n = 1$), microscopes ($n = 1$), vocabulary lists ($n = 1$), and assessment information ($n = 1$). One director described these materials as functioning better or lasting longer than the materials provided by the vendor and another director explained that the materials addressed curriculum gaps.

Professional Development

The Regional Alliances were contracted through Washington State LASER to provide each teacher with 18 hours of professional development on each module that they used with students. This professional development is referred to as foundational training. To gain an understanding of the various models of professional development used by the 10 Regional Alliances, the survey asked the directors a series of questions regarding the professional development offered by their Alliance. First they described the composition of the 18 hours of required foundational training on each instructional module. This foundational training addressed pedagogy ($n = 10$), science content ($n = 7$), initial module use ($n = 6$), science notebooks ($n = 6$), science inquiry ($n = 5$), alignment to state science standards ($n = 4$), assessments ($n = 4$), professional learning communities ($n = 2$), and integration of literacy strategies ($n = 2$). In most cases the foundational training session engaged teachers as learners ($n = 9$). The session also offered tips and tricks ($n = 2$) and, in one case, was followed by a 1-day debriefing on teaching the module. Individual directors reported that the foundational training also provided an introduction to the Regional Alliance, an overview of the LASER program, and information on troubleshooting implementation issues as a group, improving teamwork, and the Professional Teaching and Learning Cycle (PTLC) approach developed by the Southwest Educational Development Laboratory in Austin, Texas. Some directors indicated the amount of time dedicated to each topic. For example, most ($n = 9$) indicated that approximately 6 of the 18 hours were dedicated to pedagogy, but the responses ranged from a low of 1 hour to a high of 15. One Alliance reportedly did not have a means of measuring how much of the training was dedicated to pedagogy. Time dedicated to other topics included 6 to 8 hours on content ($n = 3$), 6 to 8 hours on science notebooks ($n = 2$), 6 hours dedicated on subject integration ($n = 1$), and 3 hours on meeting the unique needs of the district ($n = 1$).

Directors were asked to describe how the foundational training ensured that teacher participants developed a thorough understanding of the science concepts addressed in each instructional module. One director claimed that the training did not address teachers' science content knowledge, 4 reported that 6 to 8 hours were devoted to content, and the remainder were unable to specify the amount of time dedicated to science content. Diverse methods were employed to ensure that teachers understood

science concepts: professional development specialists from Regional Alliance developed the content portion of the training ($n = 4$); science content was presented in conjunction with state science standards ($n = 3$); teachers experienced the lessons as learners and had opportunities to ask content questions ($n = 2$); and the training focused on big ideas in science such as “energy” ($n = 1$). Only 2 directors indicated that teachers’ content knowledge was formally assessed using an objective evaluation or by asking participants to rate their understanding of key concepts.

The directors detailed the minimum qualifications for the facilitators of the foundational training. All who responded ($n = 9$) reported that facilitators must complete a training. Many Regional Alliances required facilitators to have experience teaching the instructional module; the required minimums included 3 years ($n = 1$), 2 years ($n = 1$), at least 3 times ($n = 2$), and at least once ($n = 2$). Individual directors reported the following requirements: a reputation as an effective science teacher, permission from an administrator, previous experience working with adult learners, and satisfactory evaluations from the training participants. A few directors reported that new facilitators shadowed experienced facilitators ($n = 3$) and initially co-facilitated the training ($n = 3$).

To prepare facilitators for their role the Regional Alliances provided a range of training opportunities including institutes lasting 3 to 5 days ($n = 3$), train-the-trainer workshops ($n = 3$), opportunities to shadow other facilitators ($n = 3$), individual sessions ($n = 2$), networking with experienced facilitators ($n = 2$), and co-facilitating with experienced facilitators ($n = 2$). One director noted that facilitator training varied by district. Individual directors mentioned an emphasis on collaboration skills and understanding norms of group behavior.

Most directors ($n = 8$) described the mechanisms the Regional Alliance used to ensure that the professional development experience delivered by the facilitators of the foundational training was of the highest quality (1 director did not respond to this question and another reported not monitoring the facilitators in this regard). The most common quality control mechanism was evaluation of the foundational trainings ($n = 7$) followed by observations ($n = 3$; in 1 case observations were unannounced). The other mechanisms cited varied widely and included accepting only facilitators with high recommendations and previous experience; using science professional development specialists whenever possible; and providing annual opportunities for facilitators to update their skills, knowledge. One director noted that the mechanisms used to assess the quality of the professional development varied by district.

In terms of who was charged with monitoring whether teachers using the science instructional modules had attended the foundational training, directors cited the Regional Alliance ($n = 3$), participating districts ($n = 3$), individual schools ($n = 1$), and other entities ($n = 2$). The directors concurred that although various entities monitored this aspect of Washington State LASER, ultimately the participating districts ($n = 7$) or individual schools ($n = 2$) were responsible for ensuring that teachers attend the foundational training for each module they use.

Exhibit 50 shows the extent to which the schools and districts participating in the 10 Regional Alliances reportedly ensured that teachers attended the required foundational trainings. The responses varied from “very well” (the majority of the teachers participated in the foundational training) to “poorly” (less than 50% of the teachers did so). One director observed that oversight varied by district.

Exhibit 50
How Well the Schools and Districts Ensure that Teachers
Have the Required Training

Response		Frequency
Very well	Very few use the kit without foundational training	2
Fairly well	The vast majority, 80% or more, have had the required training	3
OK	More than 50% have had the required training	3
Poorly	A minority, less than 50%, have had the required training	1
Very Poorly	Few, less than 25%, have had the required training	0
No response		1

Directors were also asked to rate how consistent the foundational training was across facilitators on a scale from 1 (*do not know*) to 5 (*very consistent*). Most rated the training as very consistent ($n = 4$) or somewhat consistent ($n = 4$). One Regional Alliance did not collect data on constancy but the director suggested that it varied by district; another director did not respond to this question.

Assessment

The director survey also asked a series of questions regarding how the Regional Alliances addressed assessment. Most directors reported that the foundational training addressed the unit assessments that accompanied the instructional modules ($n = 8$) and their Regional Alliance offered additional workshops on assessment beyond the foundational training ($n = 7$). Although some Alliances ($n = 4$) modeled or discussed the assessments or required teachers to complete the assessments, others ($n = 3$) simply informed the teachers that assessments were included in the modules. Individual directors cited the following efforts to assist teachers with assessment: disseminating Washington State Classroom Based Assessments (CBAs) designed to align with the instructional modules; disseminating assessments development within the Regional Alliance service area; introducing teachers to new benchmark assessments; integrating assessments into science notebook sessions; addressing the alignment of the instructional modules with grade level expectations, and discussing examples of student responses to assessment items. Titles of sessions that addressed the unit assessments outside of the foundational training included CTS Formative Assessment, CBA, Washington Assessment of Student Learning (WASL), Powerful Classroom Assessment (PCA); FOSS Benchmark Assessment Training; ASK-It, and Professional Teaching and Learning Cycle. One director noted that these sessions varied by district

and a variety of titles were listed in the Washington State LASER professional development database.

According to most directors ($n = 8$), the foundational training addressed formative assessment of student understanding, and half of the Regional Alliances ($n = 5$) offered additional formative assessment workshops. A few directors indicated that the inclusion of formative assessment in the foundational training varied by district. Science notebooks were commonly used to address formative assessment of student understanding ($n = 4$). Other approaches cited by individual directors included utilizing the Professional Teaching and Learning Cycle assessments, encouraging teachers to share assessment strategies, and demonstrating how to review student work and adjust instructional practice accordingly. Titles of the sessions that addressed formative assessment outside of the foundational training included Science Notebooking, Following Initial Use, ASK-It, Collaborative Teaching, and CTS Formative Assessment.

Most ($n = 7$) of the directors reported that the foundational training covered a variety of ways teachers could use or adapt the instructional modules to help students prepare for the science WASL:

- Aligning Washington State Classroom Based Assessments with the modules,
- Making teachers aware of the state science standards addressed in the instructional modules,
- Introducing teachers to the WASL Investigation Template and the lessons that work best with the template,
- Providing released WASL items to use as assessments in the classroom, and

Nearly half of the directors ($n = 4$) reported that their Regional Alliance or the Office of Superintendent of Public Instruction (OSPI) provided additional sessions beyond the foundational training to help teachers use or adapt the instructional modules to prepare students for the science WASL. The titles of these sessions included WASL Strategies in Science and Science WASL Orientation.

Administrative and Community Support

Almost all of the directors ($n = 9$) reported that their Regional Alliance used a variety of methods to generate support for science education among superintendents (one director did not respond to this question). Four of the Alliances encouraged superintendents to serve on committees such as the Science Education Cooperative Executive Committee, the Alliance Advisory Committee, the Governance Committee, and the LASER Advisory Board. Three Alliances organized science education-focused functions for superintendents and administrators including an annual retreat, symposia, and a strategic planning meeting refresher. To increase communication with superintendents, Regional Alliance representatives attended superintendent meetings ($n = 4$) and maintained contact via telephone and email ($n = 2$). Individual directors reported disseminating information about science education to ESDs boards and collaborating with district science coordinators.

Likewise, the directors reported fostering support for science education among district administrators and principals. Common strategies included using networking forums, organizing symposia on trends in science education, assisting with the development of classroom observation tools and professional development planning, and inviting district administrators and principals to attend meetings of science liaisons or the Alliance Advisory Committee. Individual directors reported maintaining contact with district administrators and principals, distributing quarterly status bulletins, and pursuing additional grants to increase the focus on science education in the region. One director acknowledged a need to increase efforts to reach out to principals.

Nearly half of the Regional Alliance directors ($n = 4$) reported collaborating with local businesses and other community organizations to foster support for science education. Their strategies included:

- Working with local businesses to procure grants to offset the cost of professional development and instructional modules.
- Soliciting local businesses for financial assistance. For example, a local General Motors dealership funded the Motion and Design training.
- Inviting local businesses and community organizations to participate in the Alliance.
- Disseminating information about LASER at business and community events.

Nearly half of the Regional Alliances ($n = 4$) also cultivated support for science education among parents. Other directors ($n = 5$) reported that districts or schools were responsible for parent support. Strategies for cultivating parent support included:

- Displaying science instructional modules in classrooms during open houses and parent conferences.
- Sending a letter to parents when students started a new instructional module.
- Distributing information about LASER and the science activities in which students were involved through newsletters and websites published by the ESD, the Regional Alliance, and districts.
- Organizing learning events for parents.

Almost all of the directors ($n = 8$) described formal partnerships with institutes of higher education, and half ($n = 5$) reported informal partnerships with science education organizations including Laser Interferometer Gravitational-Wave Observatory, Institute for Systems Biology, Pacific Northwest National Laboratory, Columbia Springs, Mt. St. Helen's Institute, and Olympic National Park. The higher education partners assisted with the delivery of science content professional development ($n = 4$), helped plan the professional development ($n = 2$), assisted with the Washington State Mathematics and Science Partnership program ($n = 2$), served on the LASER Steering Committee ($n = 1$), participated in the North Cascades and Olympic Science Partnership work ($n = 1$), and collaborated on other National Science Foundation grants ($n = 1$).

Literacy

Almost all of the directors ($n = 9$) reported that the foundational training helped teachers integrate literacy activities into science instruction (one director did not respond). Most commonly ($n = 6$) the foundational training involved the teachers in using science notebooks or modeled the use of science notebooks with students. The discussion of supplemental reading materials for the instructional modules was also common ($n = 4$). Individual directors noted that the foundational training addressed reading strategies, writing prompts, assessments, the use of Reading to Learn Science and Writing to Learn Science, and vocabulary terms. Only 2 Regional Alliances offered additional sessions on the integration of literacy activities into science instruction beyond the foundational training.

LASER Professional Development Provider Survey

In the 2007–2009 biennium Washington State LASER was allocated additional funding for 5 of the Regional Alliances to conduct training to expand the cadre of professional development providers capable of delivering foundational training on the use of the instructional modules. RMC Research administered 2 online surveys to all individuals identified by the Regional Alliances as participants in professional development provider training. The first survey, administered in fall 2008, was considered a postinstitute survey because some Regional Alliances had begun training professional development providers in summer 2008. Of the 130 providers invited to participate in the fall 2008 survey, 61 responded for a response rate of 47%. The second survey, administered in spring 2009, was intended to determine how well prepared the professional development providers were at the conclusion of the training. Of the 126 providers invited to participate in the spring 2009 survey, 65 responded for a 52% response rate.

Of those professional development providers who completed either the fall 2008 or the spring 2009 survey, more than 3 out of every 4 were female (76%) and most (69%) had a Master's degree. Approximately half received their degree between 1990 and 1999 (49%) or between 2000 and the present (42%). A few received their degree prior to 1990 (9%). Most of the professional development providers had majored in education (80%), and very few had a science background. The science backgrounds reported included general science (6%), biology (7%), and chemistry (2%). The majority (71%) had experience at the elementary school level; fewer had experience at the middle school level (30%) or high school level (10%). On average the professional development providers had 14 years of teaching experience (responses ranged from a low of 2 years to a high of 39).

The professional development providers had previously held a variety of other positions. Seventy-six percent had taught at the elementary school level and 23% had taught secondary school. More than 1 in 4 (28%) had been a science liaison or advocate, 24% had provided professional development other than LASER, and 10% had served as science department head. The majority (69%) of the professional development providers had attended other in-service professional development in science between July 1, 2005, and just prior to the initial LASER professional development provider training. As Exhibit 51 shows, most ($n = 29$) had received training on non-content-specific science pedagogy. On average the professional development providers had participated in 42 hours of this type of training (hours ranged from a low of 8 to a high 200). With respect to physical, life, and earth sciences, more of the professional development providers had received training on content than on pedagogy. The majority of the survey respondents had completed the most recent training in 2008 (56%), followed by 2007 (15%), 2006 (18%), and 2005 (10%).

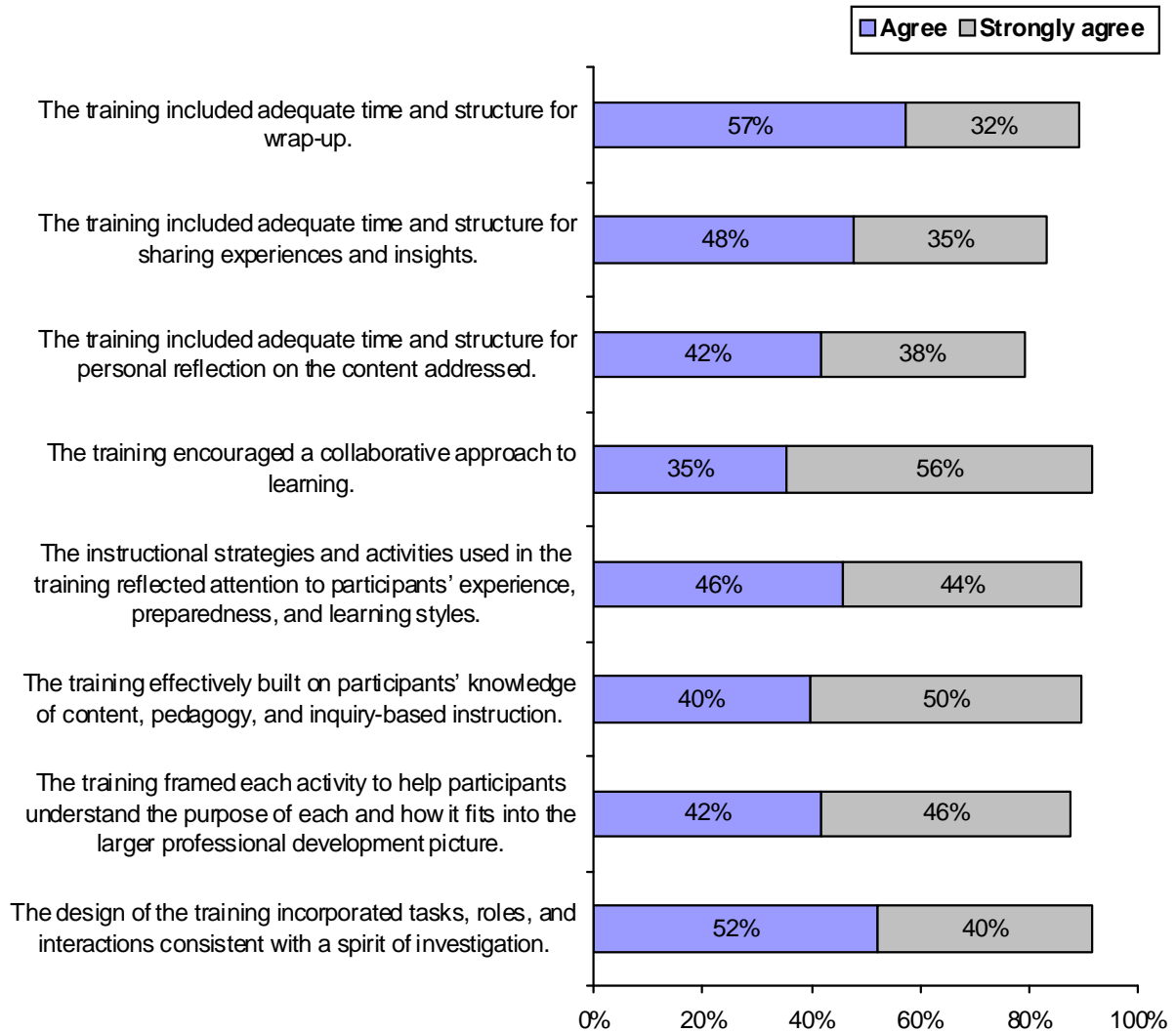
**Exhibit 51
In-Service Training Hours Earned**

Topic	No. of Hours			
	<i>n</i>	<i>M</i>	Min	Max
Physical science content	23	13	3	100
Physical science pedagogy	18	9	3	20
Life science content	22	19	1	100
Life science pedagogy	19	15	2	70
Earth/space science content	22	24	2	150
Earth/space science pedagogy	16	15	3	75
Non-content-specific science pedagogy including inquiry-based instruction methods	29	42	8	200
Leadership including training on delivering high-quality professional development	22	34	3	100
Other science related in-service professional development	17	30	4	150

Training Design

The fall 2008 survey asked the professional development providers to indicate their level of agreement with statements regarding the design of the initial professional development provider training on a scale from 1 (*strongly disagree*) to 5 (*strongly agree*). As Exhibit 52 shows, approximately 80% or more of the professional development providers agreed or strongly agreed with all of the statements regarding the design of the initial training.

Exhibit 52 Design of Initial Provider Training

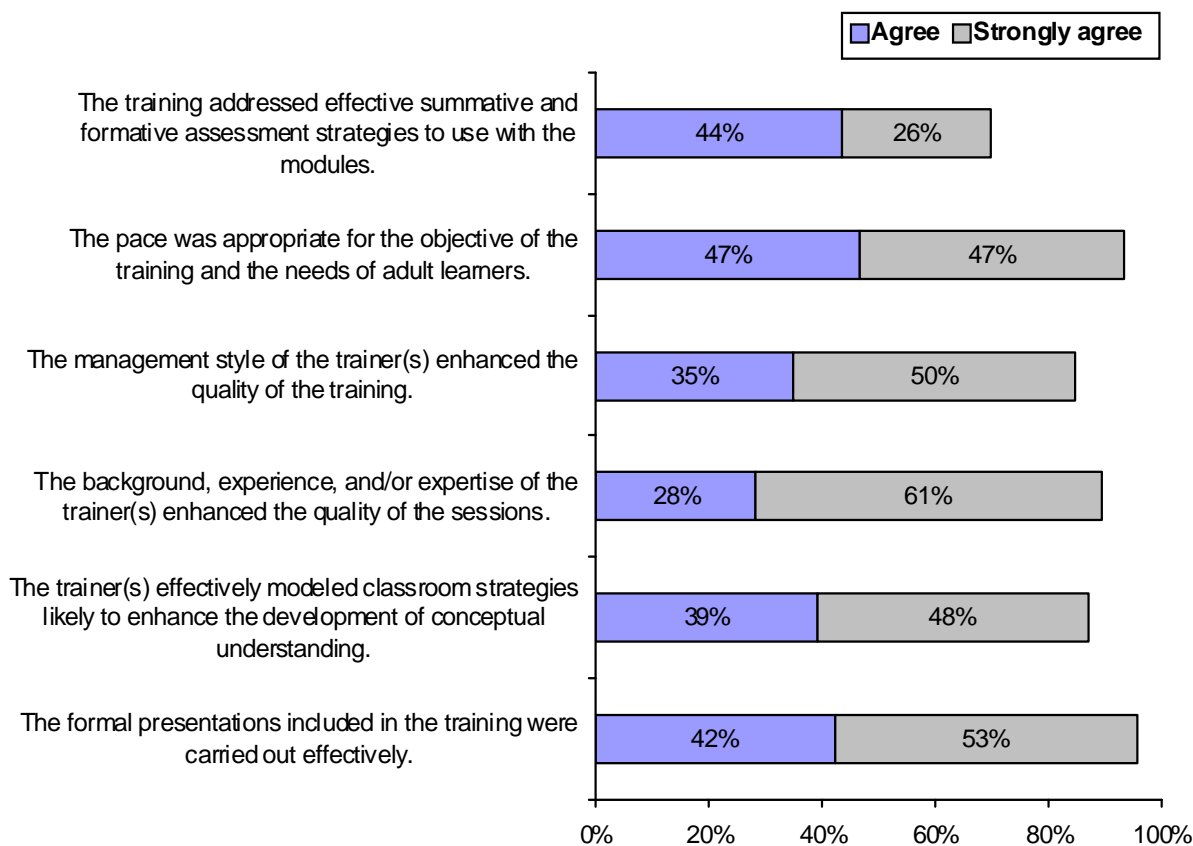


Note. n = 47 or 48.

Training Implementation

The fall 2008 survey asked the professional development providers to indicate their level of agreement with statements regarding the implementation of the initial professional development provider training on a scale from 1 (*strongly disagree*) to 5 (*strongly agree*). The professional development providers generally agreed or strongly agreed with the implementation statements. The formal presentations and the pace of the sessions received the highest ratings (see Exhibit 53).

Exhibit 53 Implementation of Initial Provider Training

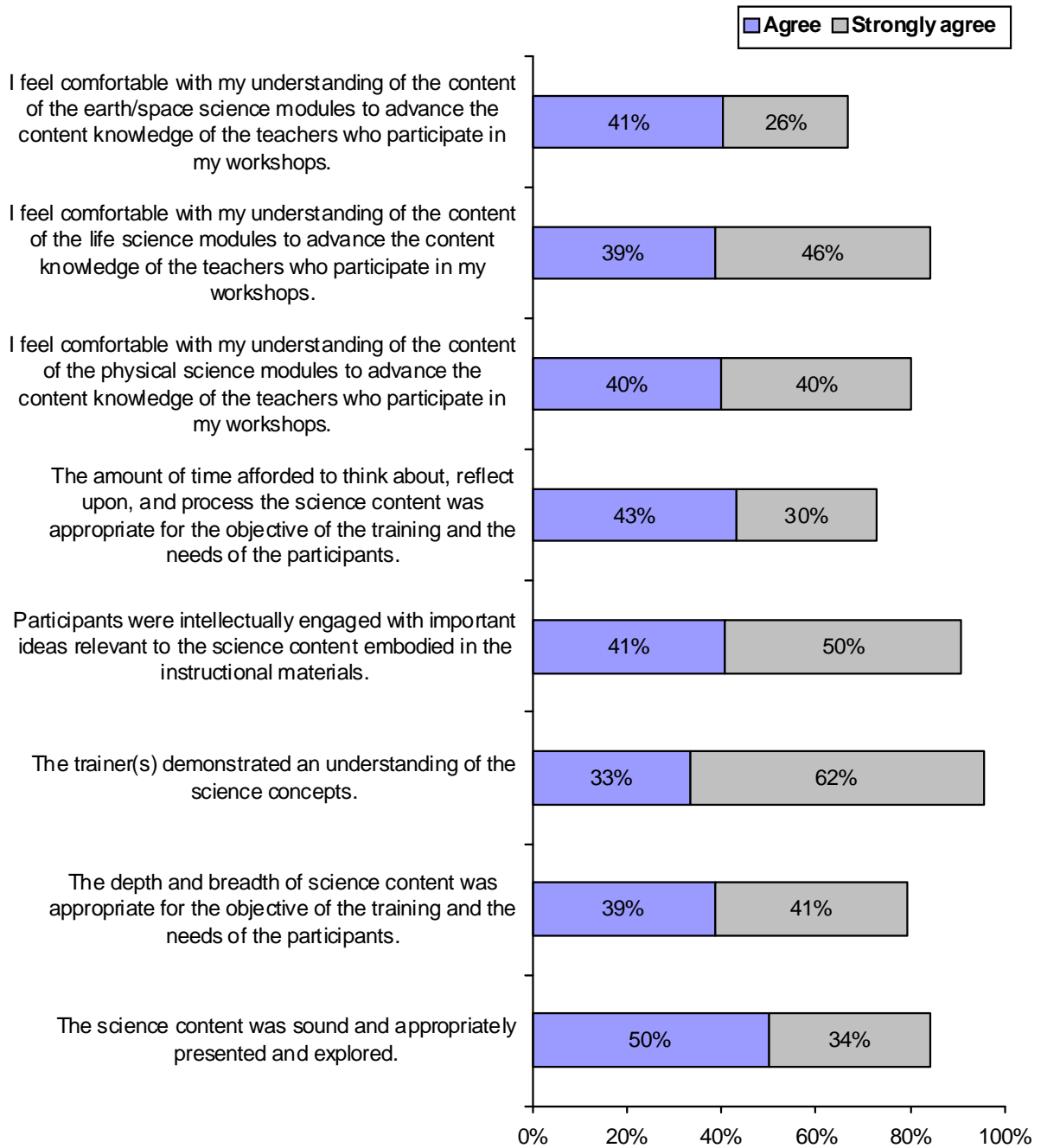


Note. n = 45 or 46.

Science Content

The professional development providers also indicated their level of agreement with statements regarding the science content included in the initial professional development provider training on a scale from 1 (*strongly disagree*) to 5 (*strongly agree*). Most agreed or strongly agreed with the statements (see Exhibit 54). Nearly all respondents (95%) agreed that the trainers demonstrated an understanding of the science concepts. Fewer (67%) reported being comfortable with their understanding of earth and space science content.

Exhibit 54 Science Content of Initial Provider Training

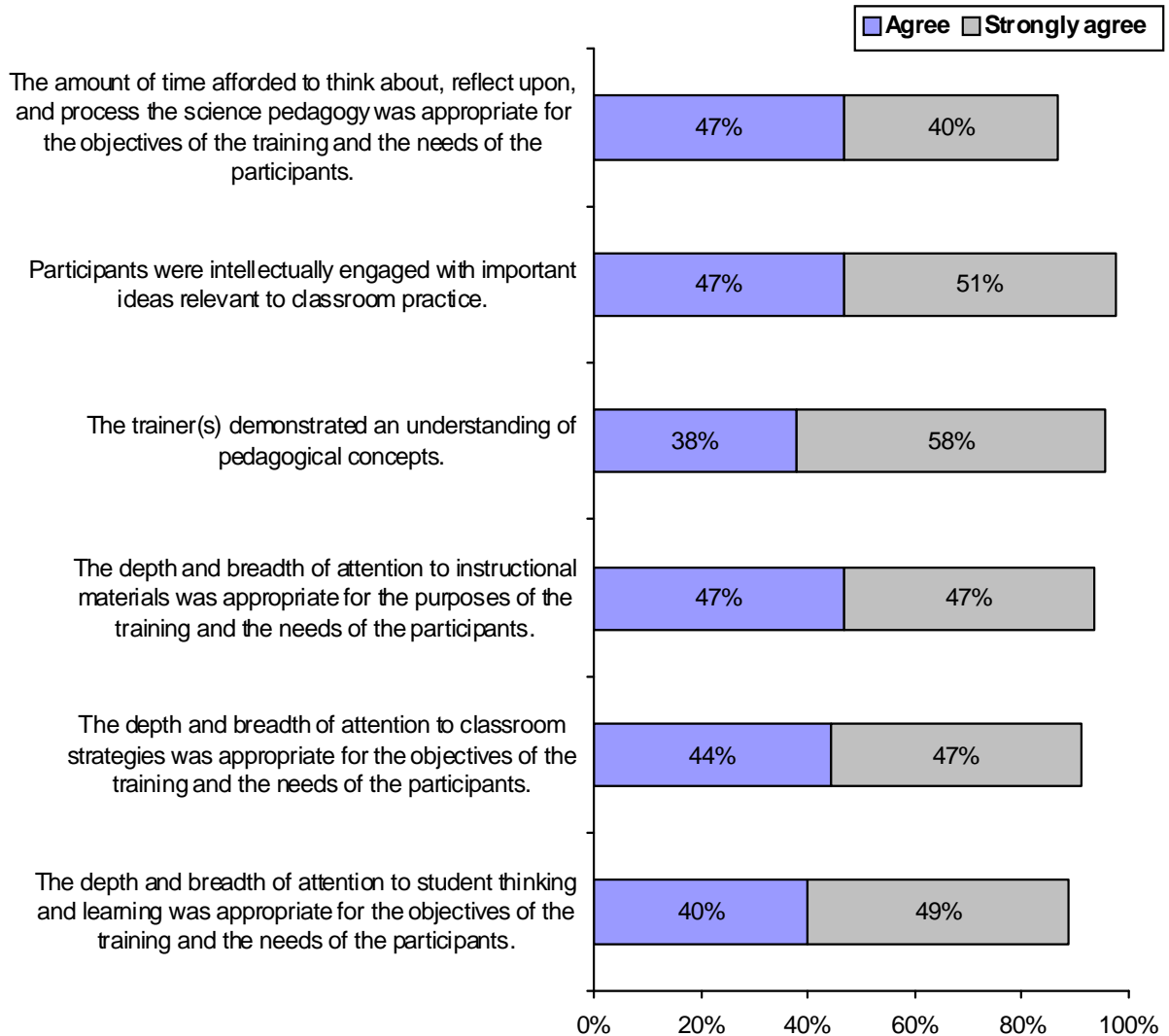


Note. n = 42 to 45.

Science Pedagogy

The professional development providers also indicated their level of agreement on statements regarding the science pedagogy covered in the initial professional development provider training on a scale from 1 (*strongly disagree*) to 5 (*strongly agree*). At least 85% agreed or strongly agreed with the statements (see Exhibit 55).

Exhibit 55
Science Pedagogy of Initial Training



Note. n = 45.

Instructional Module Preparation

The spring 2009 survey asked the professional development providers to identify the specific instructional modules on which they had received training. Exhibits 56 through 59 show that the professional development provider training focused on a wide variety of instructional modules across all science disciplines.

Exhibit 56 Focus of Provider Training: Physical Science

Focus	Percent
FOSS	
Balance and Motion	15%
Chemical Interactions	5%
Electronics	2%
Fabric	3%
Force and Motion	12%
Levers and Pulleys	10%
Magnetism and Electricity	8%
Matter and Energy	13%
Mixtures and Solutions	2%
Paper	2%
Physics of Sound	10%
Solids and Liquids	10%
Wood and Paper	0%
STC	
Balancing and Weighing	12%
Chemical Tests	7%
Comparing and Measuring	7%
Electric Circuits	5%
Floating and Sinking	10%
Food Chemistry	0%
Motion and Design	18%
Magnets and Motors	5%
Solids and Liquids	8%
Sound	0%
Technology of Paper	0%

(exhibit continues)

Exhibit 56 (continued)

Focus	Percent
STC/MS	
Electrical Energy and Circuit Design	2%
Energy, Machines, and Motion	7%
Light	3%
Properties of Matter	15%

Note. $n = 61$.

Exhibit 57 Focus of Provider Training: Life Science

Focus	Percent
FOSS	
Animals 2 x 2	7%
Diversity of Life	7%
Environments	17%
Food and Nutrition	2%
Human Body	8%
Human Brain and Senses	0%
Insects	2%
Living Systems	10%
New Plants	3%
Plants and Animals	5%
Populations and Ecosystems	2%
Structures of Life	8%
Trees	3%
STC	
Animal Studies	0%
Ecosystems	10%
Experiments with Plants	5%
Life Cycle of Butterflies	10%
Microworlds	5%
Organisms	8%
Plant Growth and Development	7%
STC/MS	
Human Body Systems	2%
Organisms—Macro to Micro	5%

Note. $n = 60$.

Exhibit 58
Focus of Provider Training: Earth and Space Science

Focus	Percent
FOSS	
Air & Weather	7%
Earth History	3%
Earth Materials	17%
Landforms	18%
Pebbles, Sand, and Silt	10%
Planetary Science	3%
Solar Energy	0%
Sun, Moon, and Stars	8%
Water	2%
Water Planet	0%
Weather and Water	3%
STC	
Land and Water	17%
Rocks and Minerals	5%
Soils	7%
Weather	5%
STC/MS	
Catastrophic Events	13%
Earth In Space	17%

Note. n = 60.

Exhibit 59
Focus of Provider Training: Earth and Space Science

Focus	Percent
FOSS	
Advanced Organizing	0%
Beginning Organizing	3%
Comparing	3%
Ideas and Inventions	2%
Measurement	5%
Models & Designs	5%
Relating	0%
Variables	7%
STC	
Changes	10%
Measuring Time	5%

Note. n = 60.

Final Preparedness

The spring 2009 survey, administered after the professional development providers had completed the training, asked respondents how well prepared they felt to conduct foundational training on commonly used instructional modules. They were asked to take into consideration both their comfort with both the content addressed in the instructional modules and their familiarity with the activities. Exhibit 60 shows the results for the physical science modules, Exhibit 61 shows the results for the life science modules, and Exhibit 62 shows the results for the earth and space science modules. These exhibits include only the responses of those professional development providers who indicated they were trained and would be conducting foundational training on the instructional modules.

At the conclusion of the professional development provider training in spring 2009, 17% reported feeling very well prepared to conduct foundational training on the instructional modules (see Exhibits 60, 61, and 62), 21% were fairly well prepared and 41% were somewhat prepared. Twenty-one percent of the providers reported being not at all prepared. Only slight variations in the results were evident with respect to the physical science, life science, and earth and space science instructional modules.

Exhibit 60
Preparedness for Physical Science Instructional Modules

Instructional Module	<i>n</i>	Not at All Prepared	Somewhat Prepared	Fairly Well Prepared	Very Well Prepared
FOSS					
Balance and Motion	13	23%	31%	23%	23%
Chemical Interactions	8	25%	50%	25%	0%
Electronics	6	50%	50%	0%	0%
Fabric	5	20%	60%	20%	0%
Force and Motion	11	18%	55%	18%	9%
Levers and Pulleys	9	22%	33%	33%	11%
Magnetism and Electricity	15	13%	40%	40%	7%
Matter and Energy	10	30%	50%	20%	0%
Mixtures and Solutions	9	0%	63%	12%	25%
Paper	8	25%	25%	25%	25%
Physics of Sound	15	7%	20%	33%	40%
Solids and Liquids	13	8%	31%	31%	31%
Wood and Paper	9	33%	33%	11%	22%
STC					
Balancing and Weighing	14	21%	36%	14%	29%
Chemical Tests	10	10%	30%	40%	20%
Comparing and Measuring	14	21%	36%	21%	21%
Electric Circuits	16	13%	31%	38%	19%
Floating and Sinking	14	14%	29%	29%	29%
Food Chemistry	15	33%	33%	20%	13%
Motion and Design	18	22%	17%	39%	22%
Magnets and Motors	13	23%	31%	23%	23%
Solids and Liquids	17	24%	35%	24%	17%
Sound	11	9%	46%	27%	18%
Technology of Paper	8	38%	50%	13%	0%
STC/MS					
Electrical Energy and Circuit Design	10	20%	60%	20%	0%
Energy Machines, and Motion	12	25%	42%	25%	8%
Light	11	18%	64%	18%	0%
Properties of Matter	17	18%	35%	35%	12%
Total	331	20%	38%	26%	17%

Exhibit 61
Preparedness for Life Science Instructional Modules

Instructional Module	<i>n</i>	Not at All Prepared	Somewhat Prepared	Fairly Well Prepared	Very Well Prepared
FOSS					
Animals 2 x 2	12	25%	33%	17%	25%
Diversity of Life	13	15%	39%	31%	15%
Environments	20	15%	35%	20%	30%
Food and Nutrition	11	27%	46%	18%	9%
Human Body	15	20%	27%	27%	27%
Human Brain and Senses	10	40%	40%	10%	10%
Insects	8	25%	25%	50%	0%
Living Systems	10	30%	40%	20%	10%
New Plants	11	27%	46%	9%	18%
Plants and Animals	9	33%	33%	33%	0%
Populations and Ecosystems	11	27%	36%	18%	18%
Structures of Life	16	19%	38%	25%	19%
Trees	11	27%	46%	9%	18%
STC					
Animal Studies	10	40%	60%	0%	0%
Ecosystems	17	18%	47%	6%	29%
Experiments With Plants	11	18%	55%	18%	9%
Life Cycle of Butterflies	17	12%	47%	12%	29%
Microworlds	16	13%	44%	25%	19%
Organisms	13	15%	54%	15%	15%
Plant Growth and Development	15	13%	27%	33%	27%
STC/MS					
Human Body Systems	14	36%	36%	7%	21%
Organisms—Macro to Micro	14	50%	14%	29%	7%
Total	284	24%	39%	19%	18%

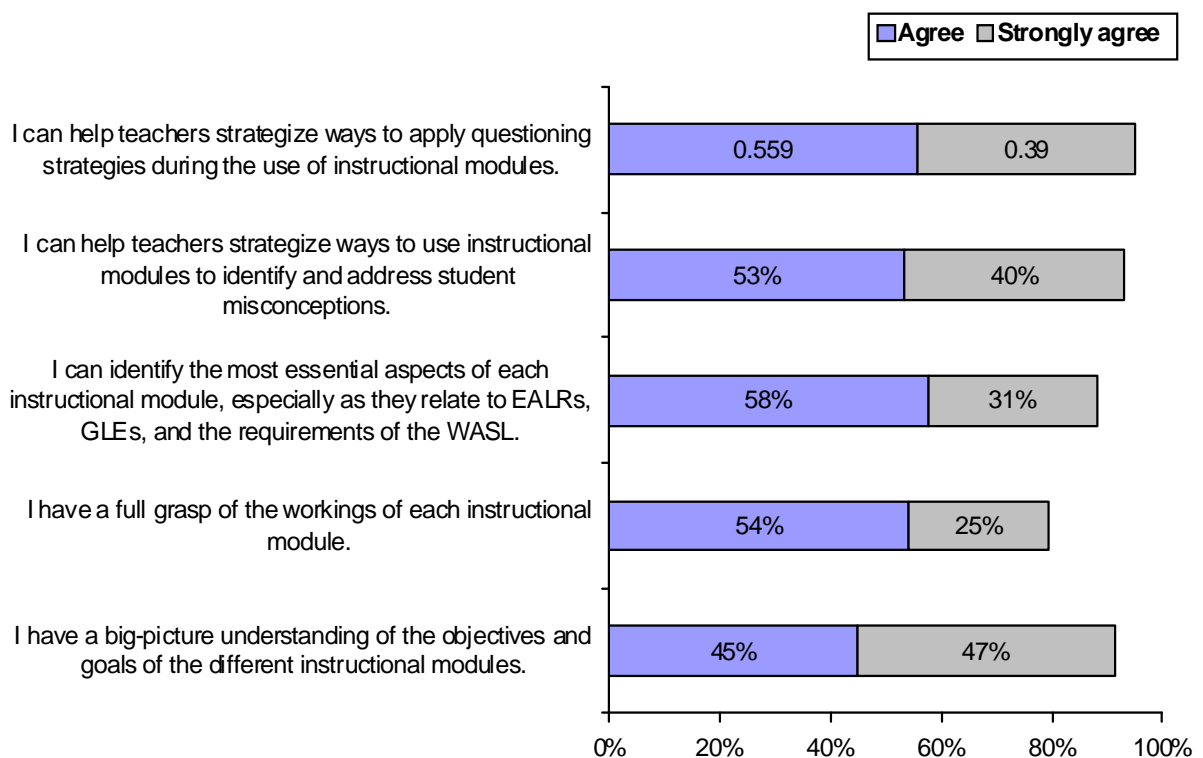
Exhibit 62
Preparedness for Earth Science Instructional Modules

Instructional Module	<i>n</i>	Not at All Prepared	Somewhat Prepared	Fairly Well Prepared	Very Well Prepared
FOSS					
Air and Weather	10	30%	30%	40%	0%
Earth History	9	33%	56%	0%	11%
Earth Materials	13	15%	39%	8%	39%
Landforms	16	19%	25%	13%	44%
Pebbles, Sand, and Silt	11	18%	55%	9%	18%
Planetary Science	10	20%	80%	0%	0%
Solar Energy	9	33%	44%	0%	22%
Sun, Moon, and Stars	10	30%	60%	0%	10%
Water	12	17%	50%	25%	8%
Water Plants	8	25%	63%	13%	0%
Weather and Water	9	22%	78%	0%	0%
STC					
Land and Water	22	9%	50%	14%	27%
Rocks and Minerals	16	13%	56%	13%	19%
Soils	18	22%	28%	28%	22%
Weather	14	14%	64%	21%	0%
STC/MS					
Catastrophic Events	17	0%	47%	35%	18%
Earth in Space	16	19%	38%	31%	13%
Total	220	18%	49%	16%	17%

Overall Preparedness

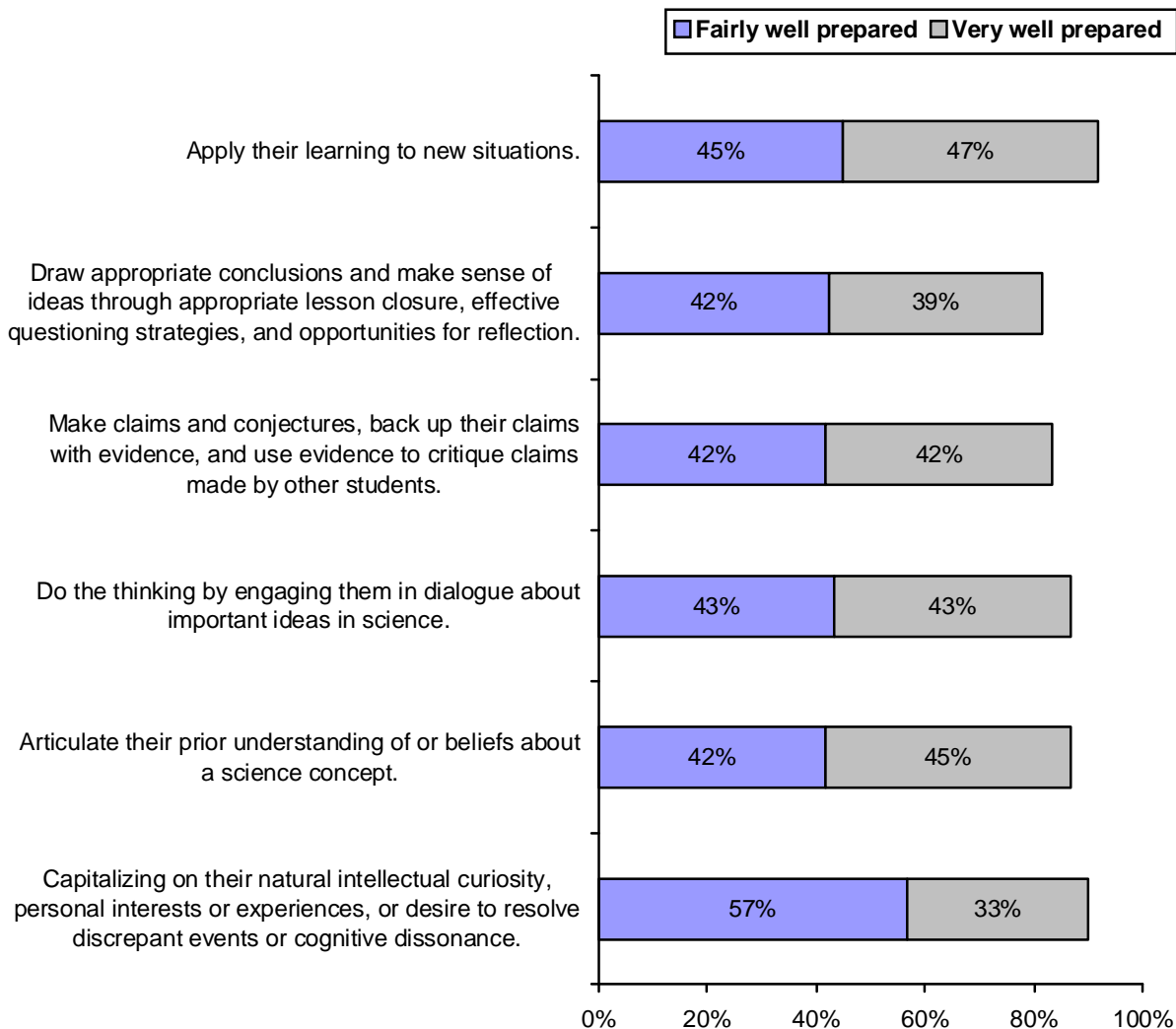
On the spring 2009 survey professional development providers rated their preparedness to assist teachers with pedagogy considerably higher than their preparedness to train teachers on specific instructional modules. The spring 2009 survey asked the professional development providers a series of questions about their overall preparedness to help teachers and to create effective classroom experiences for students. In most cases the providers agreed or strongly agreed with statement about their preparedness in these areas (see Exhibits 63 and 64).

Exhibit 63
Overall Preparedness to Help Teachers



Note. n = 58 or 59.

Exhibit 64 Overall Preparedness to Create Effective Classroom Experiences for Students



Note. Survey item: “How well prepared you are now to help teachers create a classroom environment in which students are able to be engaged in each of the following . . . “ *n* = 59 or 60.

The spring 2009 survey asked the professional development providers how their position would allow them time to conduct the foundational training on the instructional modules (see Exhibit 65). More than half of the respondents (55%) indicated that they were full-time school district employees who would provide professional development in addition to their regular duties for additional pay. They were least likely to report (2%) being part time Regional Alliance employee who would conduct foundational training as

a major part of their responsibility. Some professional development providers (19%) reported being independent consultants available for hire on an as-needed basis.

Exhibit 65

How Employment Status Affects Availability to Conduct Foundational Training

Employment Status	Availability	Percent
Part-time Regional Alliance employee	Conduct training as a major part of responsibility	2%
Independent consultant	Available for hire or on an as-needed basis	19%
Full-time district employee	Conduct training as part of regular duties	8%
Full-time district employee	Conducting training in addition to regular duties for additional pay	55%
Part-time district employee	Conducting training in addition to regular duties for additional pay	2%
Other		9%

References

- Banilower, E., Cohen, K., Pasley, J., & Weiss, I. (2008). *Effective science instruction: What does research tell us?* Portsmouth, NH: RMC Research Corporation, Center on Instruction.
- Dear, S. (2007). *Science: It's elementary, Year one highlights*. Harrisburg, PA: Pennsylvania Department of Education.
- North Cascades and Olympic Science Partnership. (2008). *Science classroom observation guide*. Manuscript in preparation.

Appendix A
Module-Level Assessment Recruitment Materials

Appendix B
Assessment Instructions and Other Materials

Appendix C
Sentinel Site Data Collection Instruments

Appendix D

Survey Instruments
