Alberta Provincial Achievement Testing

GRADE 9

Mathematics

Alberta Government

This document contains assessment highlights from the 2016 Grade 9 Mathematics Achievement Test. The examination statistics included in this document represent all writers in English. To obtain French-only statistics which may apply to your school, please refer to the French version of this document.

Assessment Highlights provides information about the overall test, the test blueprint, and student performance on the achievement test that was administered in 2016. Also provided is information on student performance at the acceptable standard and the standard of excellence on selected items from the 2016 Grade 9 Mathematics Achievement Test. This information is intended for teachers and is best used in conjunction with multi-year and detailed school reports that are available in schools via the extranet. Assessment Highlights reports for all achievement test subjects and grades will be posted on the Alberta Education website every year in the fall.

All released achievement tests, including test blueprints, answer keys with the item difficulty, reporting category, test section, and item description for each test item, are posted on the Alberta Education website (see Achievement Documents).

These materials, along with the program of studies and subject bulletins, provide information that can be used to inform instructional practice.

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The Alberta Education Internet address is education.alberta.ca.

This document was written primarily for:

Students	
Teachers	✓ of Grade 9 Mathematics
Administrators	✓
Parents	
General Audience	
Others	

Contents

The 2016 Grade 9 Mathematics Achievement Test

This report provides teachers, school administrators, and the public with an overview of the performance of those students who wrote the 2016 Grade 9 Mathematics Achievement Test. It complements the detailed school and jurisdiction reports.

How Many Students Wrote the Test?

A total of 38 693 students wrote the 2016 Grade 9 Mathematics Achievement Test. The English form of the test was written by 35 990 students, and the French form of the test was written by 2 703 students.

What Was the Test Like?

The 2016 Grade 9 Mathematics Achievement Test consisted of 40 multiple-choice and 10 numerical-response questions based on four strands: Number, Patterns and Relations, Shape and Space, and Statistics and Probability. In keeping with the intent of the 2007 Program of Studies, the questions on the test required students to apply their understanding of one or more mathematical concepts from within and/or across the four strands. As they solved the mathematical problems, students were expected to use the interrelated mathematical processes of Communication, Connections, Mental Mathematics and Estimation, Problem Solving, Reasoning, and Visualization. A detailed explanation of these mathematical processes is in the [Alberta K–9 Mathematics Program of Studies](.).

How Well Did Students Do?

The percentages of students meeting the acceptable standard and the standard of excellence in 2016 are shown in the graph below. Out of a total score of 50 on the test, the provincial average was 30.77/50 (61.54%). The results presented in this report are based on scores of students who wrote the English version of the test. Detailed provincial assessment results are provided in school and jurisdiction reports.

Percentage of Students Meeting the Acceptable Standard & Standard of Excellence (%)
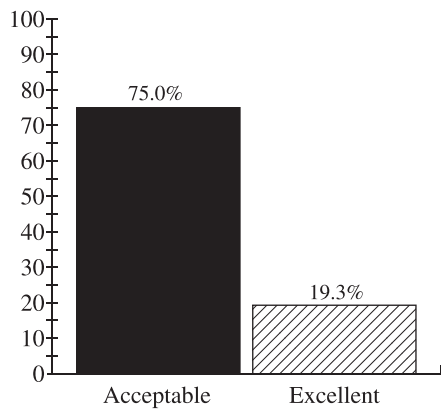
■ 2016 Achievement Standards: The percentage of students in the province who met the acceptable standard on the 2016 Grade 9 Mathematics Achievement Test (based on those who wrote)

▨ 2016 Achievement Standards: The percentage of students in the province who met the standard of excellence on the 2016 Grade 9 Mathematics Achievement Test (based on those who wrote)

2016 Test Blueprint and Student Achievement

In 2016, 75.0% of students who wrote the test achieved the acceptable standard on the Grade 9 Mathematics Achievement Test, and 19.3% of students who wrote achieved the standard of excellence.

Out of a total score of 50 on the test, the provincial average was 30.77/50 (61.54%). The blueprint below shows how the questions on the test were classified and includes the average raw score in each category for all Grade 9 students who wrote this test.

Strand	Level of Complexity*			Provincial Student Achievement (Raw Score and Percentage)
	Low	Moderate	High	
Number	6	7	2	9.3/15 (62.0%)
Patterns and Relations	10	9	0	11.8/19 (62.1%)
Shape and Space	2	7	3	6.8/12 (56.7%)
Statistics and Probability	2	1	1	2.9/4 (72.5%)
Provincial Student Achievement (Average Raw Score and Percentage)	13.3/20 (66.5%)	14.0/24 (58.3%)	3.4/6 (56.7%)	Total Test Raw Score 30.8/50 (61.54%)

*Each question is categorized according to its level of complexity (low, moderate, or high). Descriptions of the levels of complexity are in the *2016–2017 Mathematics 9 Subject Bulletin*.

2016 Grade 9 Mathematics Achievement Test Design Commentary

The 2016 Mathematics Achievement Test for Grade 9 was based on the 2007 Alberta K–9 Mathematics Program of Studies that was implemented in the 2011–2012 school year. The test blueprint provides information about new test design features (i.e., complexity) and modified test design features (i.e., item format and strand). Items now are selected not only in terms of the knowledge and skills that they assess, but also in terms of their complexity in the form of content and cognition. The introduction of item complexity will provide more information about the depth to which students have mastered particular learning outcomes, as well as provide one more control in the selection of test items to better ensure that tests are equivalent from year to year. Please refer to the *2016–2017 Mathematics 9 Subject Bulletin* for detailed information about item complexity.

The selection of test items within each of the four strands is now based on two primary factors: item difficulty and item complexity.

> **Item difficulty** refers to the percentage of students who actually chose the correct answer. Items for which the correct answer is selected by more than 70% of the students are generally considered easy. Items for which the correct answer is selected by 50–70% of the students are about average in difficulty. Items for which the correct answer is selected by less than 50% of the students are regarded as challenging.

> **Item complexity** refers to the cognitive and content demands associated with an item. The rationale for classifying items by their level of complexity is to focus on the expectations underlying the item and not the ability of the student. The cognitive demands that an item makes on a student (i.e., what an item requires the student to recall, understand, analyze, and do) are made with the assumption that the student is familiar with the basic concepts of the task.

The categories—low complexity, moderate complexity, and high complexity—form an ordered description of the demands an item may make on a student. For example, low-complexity items may require a student to solve a one-step problem. Moderate-complexity items may require multiple steps. High-complexity items go even further and require a student to analyze and synthesize information. It is therefore important to consider both the content being assessed by an item and the item complexity when making inferences about student performance on any one outcome. Although there is a logical and predictable relationship between item difficulty and item complexity (i.e., items that are of high complexity tend to be more challenging), there are exceptions.

The following ten items have been released to illustrate significant performance differences between three groups of students: those students who achieved the standard of excellence, those who achieved the acceptable standard, and those students who were below the acceptable standard. The purpose of these comparisons is to provide additional information that may be used for instructional purposes.

Sample Questions from the 2016 Grade 9 Mathematics Achievement Test

The following ten items illustrate significant performance differences between students who obtained the standard of excellence, the acceptable standard, or below the acceptable standard.

Item #	Strand	Specific Outcome	Item Complexity	Item Description
1	N	2	Low	Apply knowledge of the exponent laws to represent a power in an alternate form.

	% of Student Responses (*Correct)			
	A	**B**	**C**	**D***
Students Achieving Standard of Excellence	0.1	0.4	1.0	98.6
Students Achieving Acceptable Standard	0.4	3.4	7.0	89.2
Students Below Acceptable Standard	3.1	12.8	21.1	62.8

1. Another representation of the expression $\left(\dfrac{2}{3}\right)^4$ is

   A. $\dfrac{2+4}{3+4}$

   B. $\dfrac{2\times4}{3\times4}$

   C. $\dfrac{2+2+2+2}{3+3+3+3}$

   D. $\dfrac{2\times2\times2\times2}{3\times3\times3\times3}$

Item #	Strand	Specific Outcome	Item Complexity	Item Description
7	PR	4	Low	Translate a given problem into a single variable linear inequality and solve the inequality algebraically.

	% of Student Responses (*Correct)			
	A	B*	C	D
Students Achieving Standard of Excellence	5.5	94.2	0.2	0.1
Students Achieving Acceptable Standard	22.5	67.3	6.2	3.8
Students Below Acceptable Standard	26.4	35.3	23.1	14.6

Jennifer's goal is to save $1 200. Each week she saves 20% of her weekly income of $576.

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7. How many weeks will it take Jennifer to reach her goal?

    A. 10

    B. 11

    C. 24

    D. 29

Item #	Strand	Specific Outcome	Item Complexity	Item Description
10	SP	4	Low	Identify an assumption that was made in order to reach a given conclusion given the results of the survey.

	% of Student Responses (*Correct)			
	A	B	C*	D
Students Achieving Standard of Excellence	1.8	1.6	94.7	1.8
Students Achieving Acceptable Standard	9.4	10.8	76.4	3.3
Students Below Acceptable Standard	22.5	25.6	44.8	6.7

A manager selected 25 watches to test from a batch of 750 watches. He determined that 3 of the selected watches were defective. Based on the results of his survey, the manager concluded that 12% of the 750 watches were defective.

10. Which of the following assumptions did the manager use to reach his conclusion?

A. The process for testing the watches was unreliable.

B. The parts used in the watches are rarely defective.

C. The sample was representative of the population.

D. The watches were made by the same employee.

Item #	Strand	Specific Outcome	Item Complexity	Item Description
11	N	1	Moderate	Explain the difference between two given powers that have the base and the exponent interchanged.

	% of Student Responses (*Correct)			
	A	**B**	**C**	**D***
Students Achieving Standard of Excellence	0.1	0.1	12.2	87.6
Students Achieving Acceptable Standard	5.1	1.8	33.3	59.7
Students Below Acceptable Standard	29.6	12.1	33.7	24.2

11. *The values of 4^5 and 5^4 are* ___*i*___ *because* ___*ii*___ .

The statement above is completed by the information in row

	i	*ii*
A.	equal	4×5 has the same value as 5×4
B.	equal	both powers represent the same model
C.	not equal	two powers cannot have the same value
D.	not equal	they cannot be written using the same repeated multiplication

Item #	Strand	Specific Outcome	Item Complexity	Item Description
12	SS	1	High	Apply one or more circle properties to determine the distance between two points on a given circle diagram. (Gr.8, SS.1)

	% of Student Responses (*Correct)			
	A*	B	C	D
Students Achieving Standard of Excellence	85.6	7.0	2.3	4.8
Students Achieving Acceptable Standard	54.0	20.7	14.8	10.0
Students Below Acceptable Standard	24.0	24.9	37.7	12.8

The letter *W* is in the centre of the diagram below and represents the location of a wireless router for Internet access in a square house. The router provides access to the area represented by the dotted circle in the diagram below. This circular area has a diameter of 20 m.
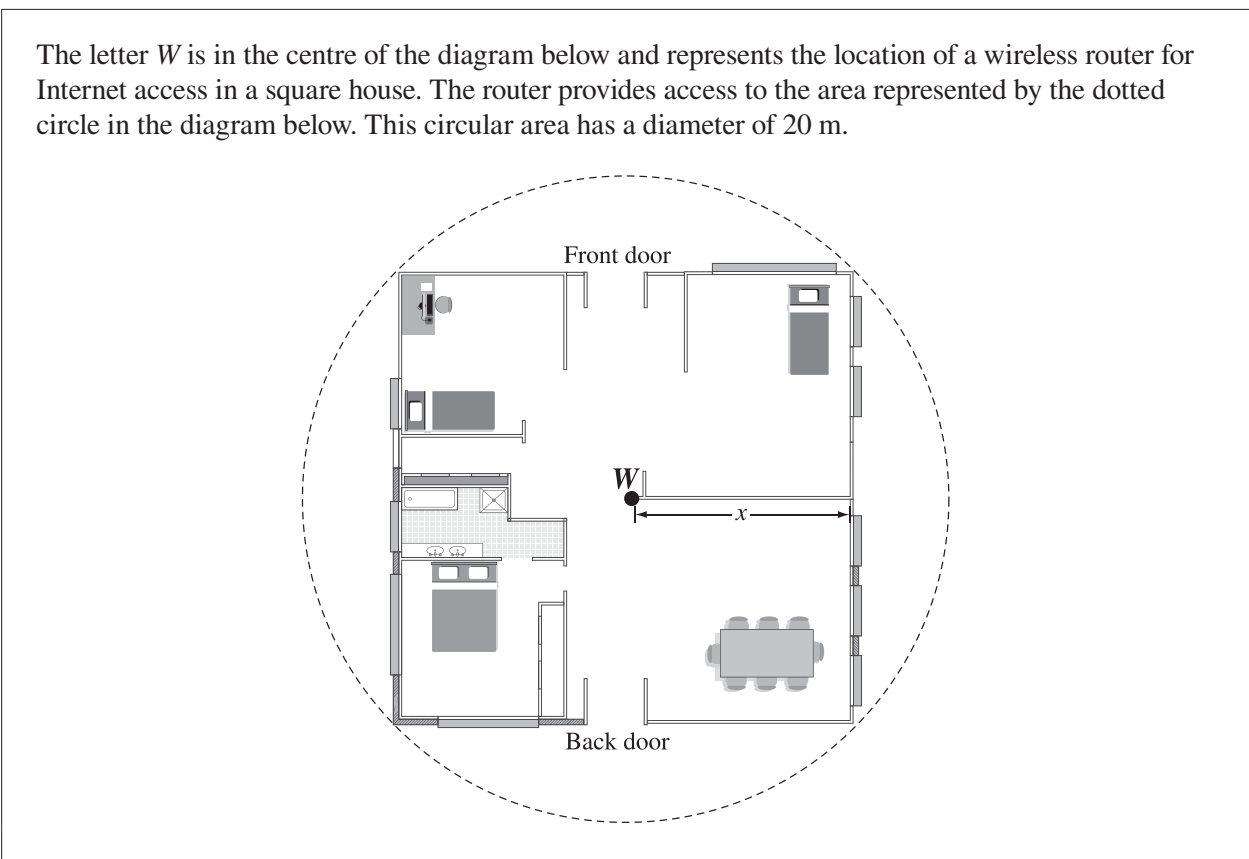
12. To the nearest tenth of a metre, the distance, x, from the router, *W*, to the middle of one outside wall is

    A.   7.1 m

    B.   8.9 m

    C.   10.0 m

    D.   14.1 m

Item #	Strand	Specific Outcome	Item Complexity	Item Description
14	PR	3	Moderate	Solve a given linear equation to determine the value of the variable. (Gr.8, PR.2)

	% of Student Responses (*Correct)			
	A	B*	C	D
Students Achieving Standard of Excellence	5.0	87.4	3.2	4.3
Students Achieving Acceptable Standard	19.7	56.2	13.0	10.6
Students Below Acceptable Standard	31.9	32.6	19.7	14.8

14. The value of x in the equation $3(2x - 1) = \dfrac{1}{2}(x + 6)$ is

    A. $\dfrac{8}{11}$

    B. $\dfrac{12}{11}$

    C. $\dfrac{14}{11}$

    D. $\dfrac{18}{11}$

Item #	Strand	Specific Outcome	Item Complexity	Item Description
26	PR	6	Low	Simplify a given polynomial expression. (Gr.8, PR.2)

|	% of Student Responses (*Correct)			
	A*	B	C	D
Students Achieving Standard of Excellence	89.6	2.7	2.0	5.8
Students Achieving Acceptable Standard	51.1	10.8	10.6	27.4
Students Below Acceptable Standard	21.9	19.6	26.1	31.7

26. When the expression $(x^2 - 5x + 4) - (3x^2 + 8x - 20)$ is simplified, the result is

A. $-2x^2 - 13x + 24$

B. $-2x^2 - 3x + 16$

C. $2x^2 + 13x - 24$

D. $2x^2 + 3x - 16$

Item #	Strand	Specific Outcome	Item Complexity	Item Description
NR 5	SS	4	Moderate	Identify the location of one vertex on the enlarged image of a 2-D shape.

	% of Student Responses	
	Correct	**Incorrect**
Students Achieving Standard of Excellence	85.7	14.3
Students Achieving Acceptable Standard	42.2	57.8
Students Below Acceptable Standard	9.2	90.8

Kate begins to create an image of the shaded 2-D shape shown below by applying a scale factor of $\frac{3}{2}$. The location of Point P' is given.
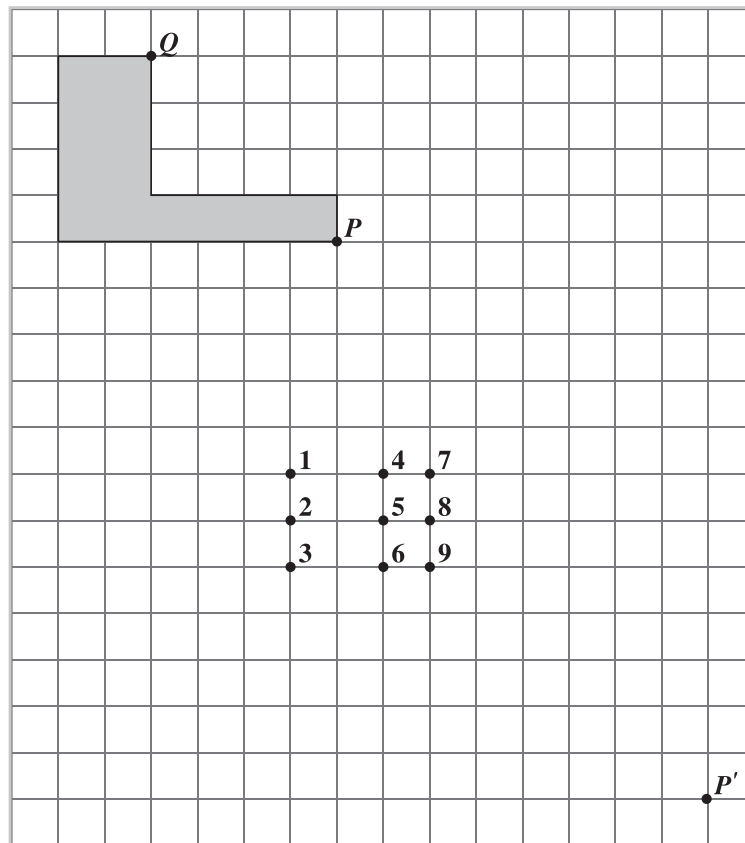
Numerical Response

5. Which numbered point shown above represents the location of Point Q' in Kate's image?

Answer: Point _____

(Record your answer in the numerical-response section on the answer sheet.)

Item #	Strand	Specific Outcome	Item Complexity	Item Description
NR 8	N	3	Low	Solve a given problem involving operations on rational numbers in decimal form.

	% of Student Responses	
	Correct	**Incorrect**
Students Achieving Standard of Excellence	88.8	11.2
Students Achieving Acceptable Standard	57.2	42.8
Students Below Acceptable Standard	13.3	86.7

A store owner pays a sales clerk $12/h for each hour worked. The assistant manager of the store earns one-and-a-half times the clerk's hourly wage and the manager of the store earns two-and-a-half times the clerk's hourly wage.
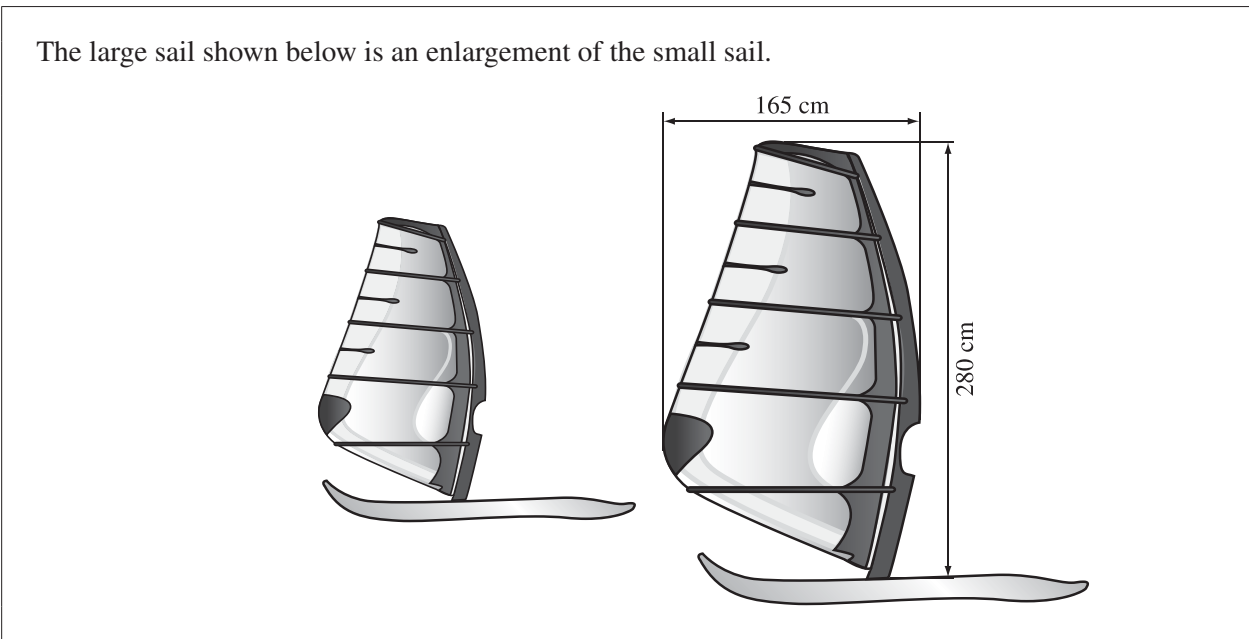
Numerical Response

8. In total, how much money is paid to the three employees in one day if the sales clerk, the assistant manager, and the manager each work 7.25 h?

Answer: $_____

(Record your answer in the numerical-response section on the answer sheet.)

Item #	Strand	Specific Outcome	Item Complexity	Item Description
NR 9	SS	4	Moderate	Calculate the height of a given 2-D object given the measurements and scale factor of its image after an enlargement.

	% of Student Responses	
	Correct	**Incorrect**
Students Achieving Standard of Excellence	97.9	2.1
Students Achieving Acceptable Standard	87.2	12.8
Students Below Acceptable Standard	40.1	59.9

The large sail shown below is an enlargement of the small sail.

Numerical Response

9. What is the height of the small sail if the scale factor of the enlargement is 2.50?

Answer: _____ **cm**

(Record your answer in the numerical-response section on the answer sheet.)

Achievement Testing Program Support Documents

The Alberta Education website contains several documents that provide valuable information about various aspects of the achievement testing program. To access these documents, go to the Alberta Education website. Click on one of the specific links to access the following documents.

Achievement Testing Program *General Information Bulletin*
The *General Information Bulletin* is a compilation of several documents produced by Alberta Education and is intended to provide superintendents, principals, and teachers with easy access to information about all aspects of the achievement testing program. Sections in the bulletin contain information pertaining to schedules and significant dates; security and test rules; test administration directives, guidelines, and procedures; calculator and computer policies; test accommodations; test marking and results; field testing; resources and web documents; forms and samples; and Provincial Assessment Sector contacts.

Subject Bulletins
At the beginning of each school year, subject bulletins are posted on the Alberta Education website for all achievement test subjects for grades 6 and 9. Each bulletin provides descriptions of assessment standards, test design and blueprinting, and scoring guides (where applicable) as well as suggestions for preparing students to write the tests and information about how teachers can participate in test development activities.

Examples of the Standards for Students' Writing
For achievement tests in grades 6 and 9 English Language Arts and Français/French Language Arts, writing samples are designed for teachers and students to enhance students' writing and to assess this writing relative to the standards inherent in the scoring guides for the achievement tests. The exemplars documents contain sample responses with scoring rationales that relate student work to the scoring categories and scoring criteria.

Previous Achievement Tests and Answer Keys
All January achievement tests (parts A and B) for Grade 9 semestered students are secured and must be returned to Alberta Education. All May/June achievement tests are secured except Part A of grades 6 and 9 English Language Arts and Français/French Language Arts. Unused or extra copies of only these Part A tests may be kept at the school after administration. Teachers may also use the released items and/or tests that are posted on the Alberta Education website.

Parent Guides
Each school year, versions of the *Alberta Provincial Achievement Testing Parent Guide* for grades 6 and 9 are posted on the Alberta Education website. Each guide answers frequently asked questions about the achievement testing program and provides descriptions of and sample questions for each achievement test subject.

Involvement of Teachers
Teachers of grades 6 and 9 are encouraged to take part in activities related to the achievement testing program. These activities include item development, test validation, field testing, and marking. In addition, arrangements can be made through the Alberta Regional Professional Development Consortia for teacher in-service workshops on topics such as interpreting achievement test results to improve student learning.