A Presentation to the

Committee on High School Science Laboratories

Center for Education

Division of Behavioral and Social Sciences and Education

National Research Council

Large Scale Assessment and the High School Science Laboratory

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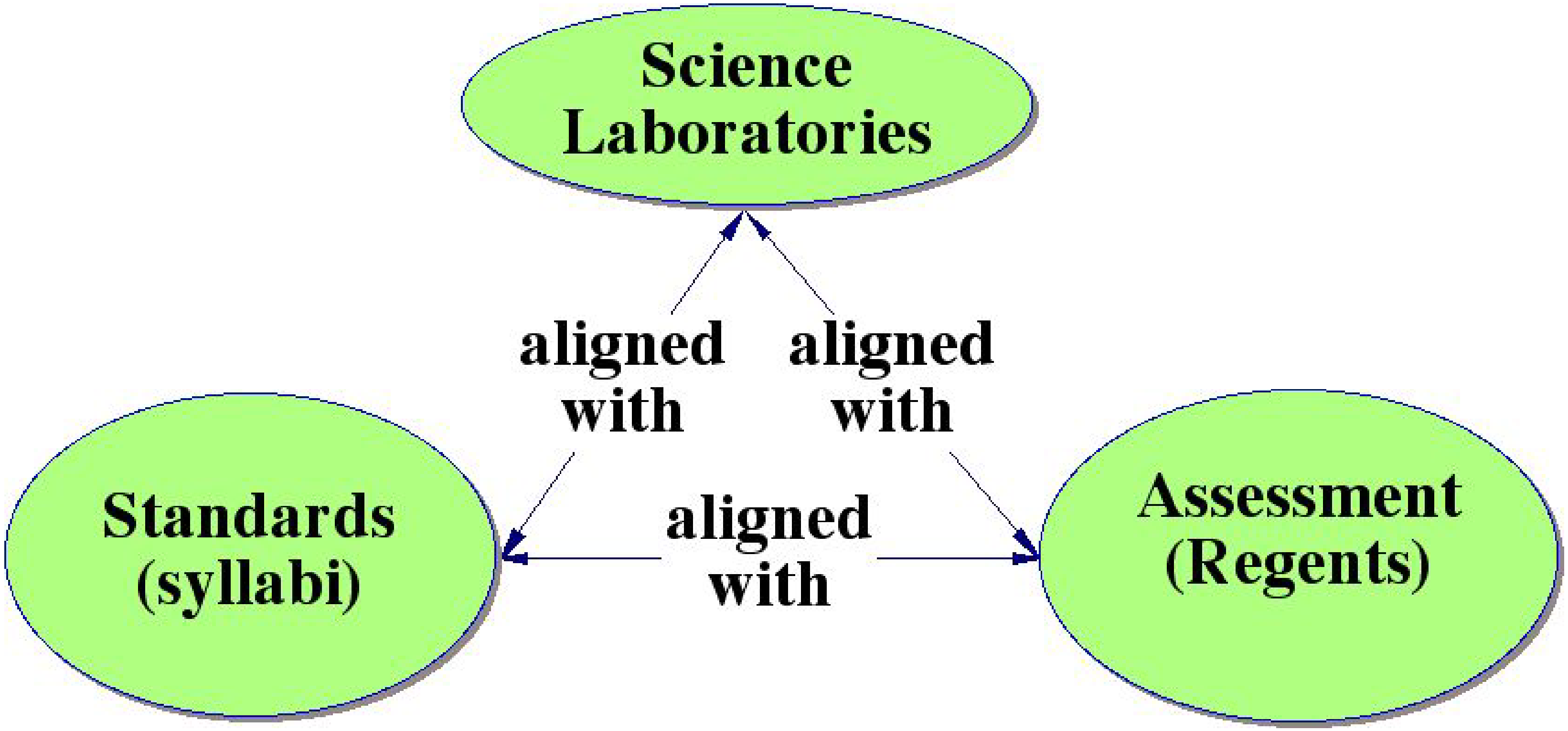
STANDARDS-BASED REFORM



QUESTION 1

What are the challenges in assessing students' learning from laboratory experiences?

Our Response

The challenge is reaching consensus on definition in assessable terms what students should learn from their laboratory experiences.

QUESTION 2

How do state education standards and accountability systems (particularly state assessments) enable or constrain effective learning and teaching in high school labs?

Our Response

Enable:	Levers for resources
	Standardize opportunities to learn
Constrain:	Set low minimum requirements for resources
	Set lower than desirable requirements for student achievement

QUESTION 3

To what extent and how can classroom assessment of skills and knowledge developed through laboratory experiences be linked to large-scale assessments used by districts and states?

Our Response

States have used different models to link classroom level assessment to large scale assessment of laboratory. At issue are reliability and validity of the data obtained from classroom level assessment for accountability.

QUESTION 4

To what extent and how can large-scale assessments used by districts or states be designed and implemented in ways that are sensitive to (or capture) the learning that occurs through laboratory experiences?

Our Response

Sensitive assessments can be designed. Challenges are consensus on definition of outcomes and resources.

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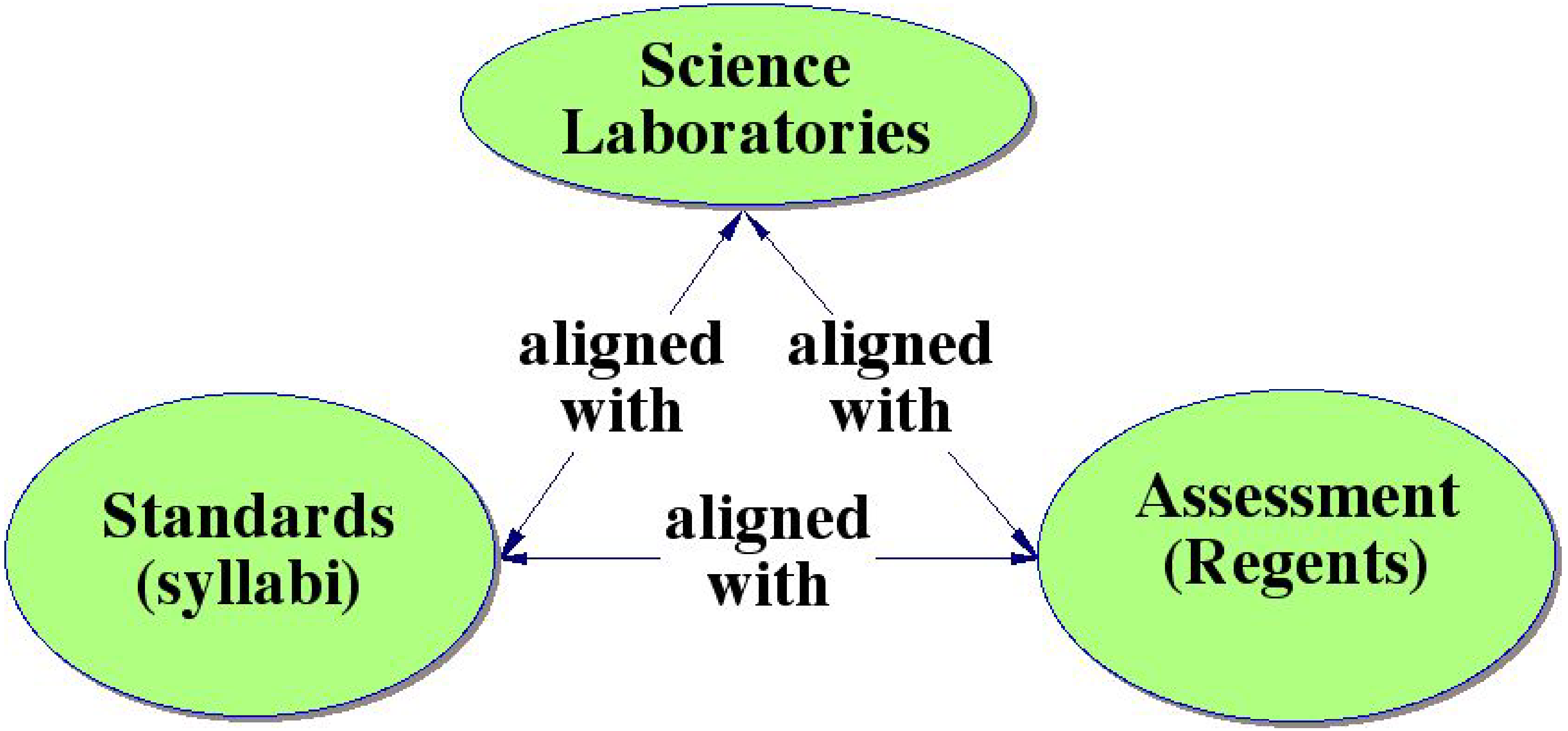


LABORATORY and the REGENTS EXAMINATIONS

1865 First Regents Administered

~1882 Science Syllabus

1890 Regents contain items related to experiments

~ 1900 Laboratory for Chemistry and Physics appeared in the Syllabus

1910 Requirement for 30 Labs taking Double Periods Instituted

EARLY LABORATORY RELATED ITEMS

What are properties of oxygen? Describe an experiment which will illustrate its chemical energy.

(From the January 23, 1890 Chemistry Exam)

Describe an experiment illustrating the difference in the expansion of any two metals by heat.

(From the March 17, 1892 Physics Exam)

State what method you would pursue in making an original investigation of a one celled animal.

(From the August, 1895 Zoology Exam)

SCIENCE GRADUATION REQUIREMENT

Three Year-Long Science Courses

- For One of the Courses
  - Pass the Regents Examination
  - Complete 1200 Minutes of Laboratory

LABORATORY REQUIREMENT

100.5 (b) (7) (iv) (d) Science, three units of credit and one of the Regents examinations in science or an approved alternative pursuant to section 100.2(f) of this Part. In order to qualify to take a Regents examination in any of the sciences **a student must complete 1200 minutes of actual hands-on (not simulated) laboratory experience with satisfactory documented laboratory reports.** The 1200 minutes of laboratory experience must be in addition to the required classroom instruction associated with earning a unit of credit.

CHALLENGES WITH THE LAB REQUIREMENT

- Vague definition of a “satisfactory” report
- Local control- No standard set of laboratory experiences are required
- Infrequent state review of reports (although reports must be kept on file for 6 months)

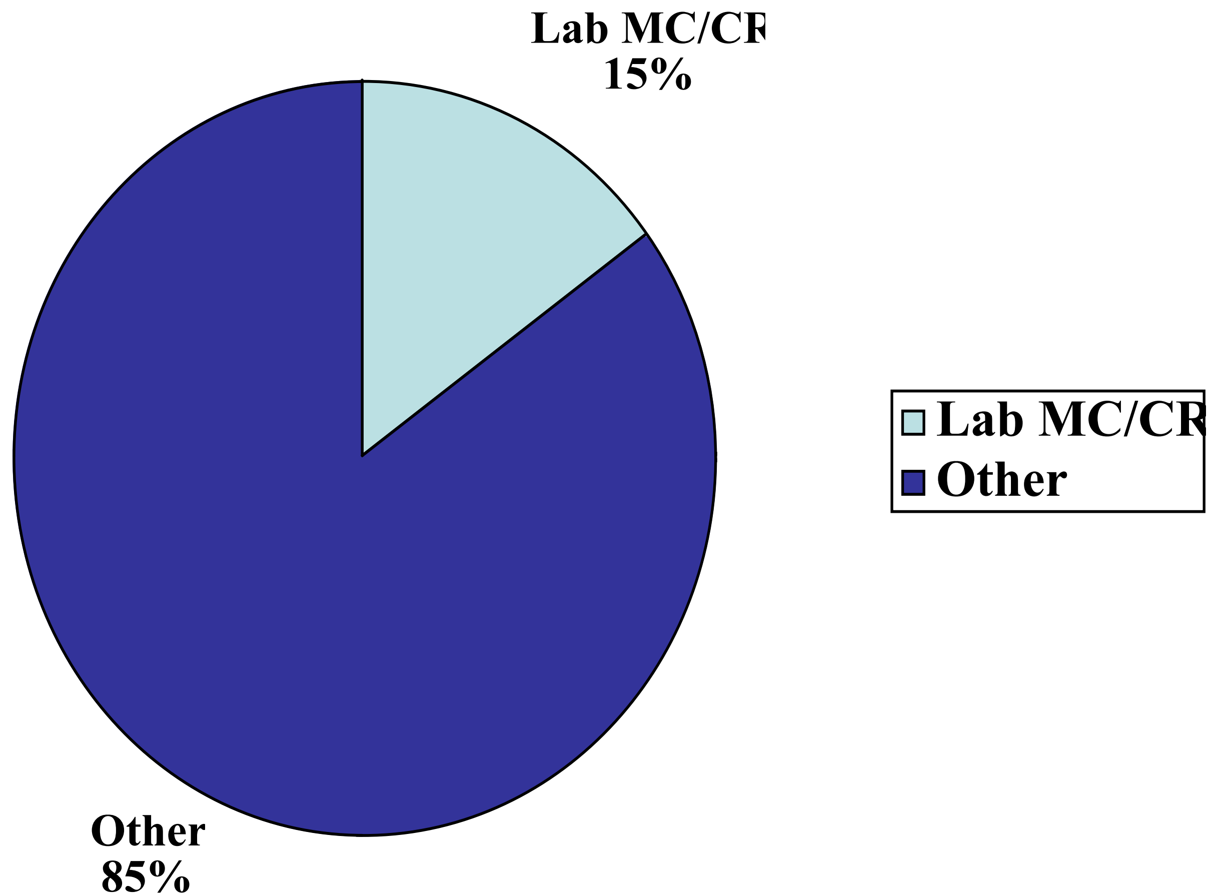
APPROACHES TO LABORATORY ASSESSMENT

	Course	Laboratory Reports on File	Multiple choice/ constructed response	Performance Assessment
Biology	Living Environment	√	√	None
Physical Setting	Earth Science	√	√	Operational
	Chemistry	√	√	Under development
	Physics	√	√	Under development

REGENTS EXAMINATION SCIENCE LABORATORY RELATED MULTIPLE CHOICE/CONSTRUCTED RESPONSE ITEMS

- Percentage of score points (85 score points/Regents Examination)
- Item Content
- Challenges

PERCENTAGE OF LAB-RELATED SCORE POINTS (MULTIPLE CHOICE and CONSTRUCTED RESPONSE ITEMS)



PERCENTAGE of LAB-RELATED SCORE POINTS (MULTIPLE CHOICE and CONSTRUCTED RESPONSE ITEMS)

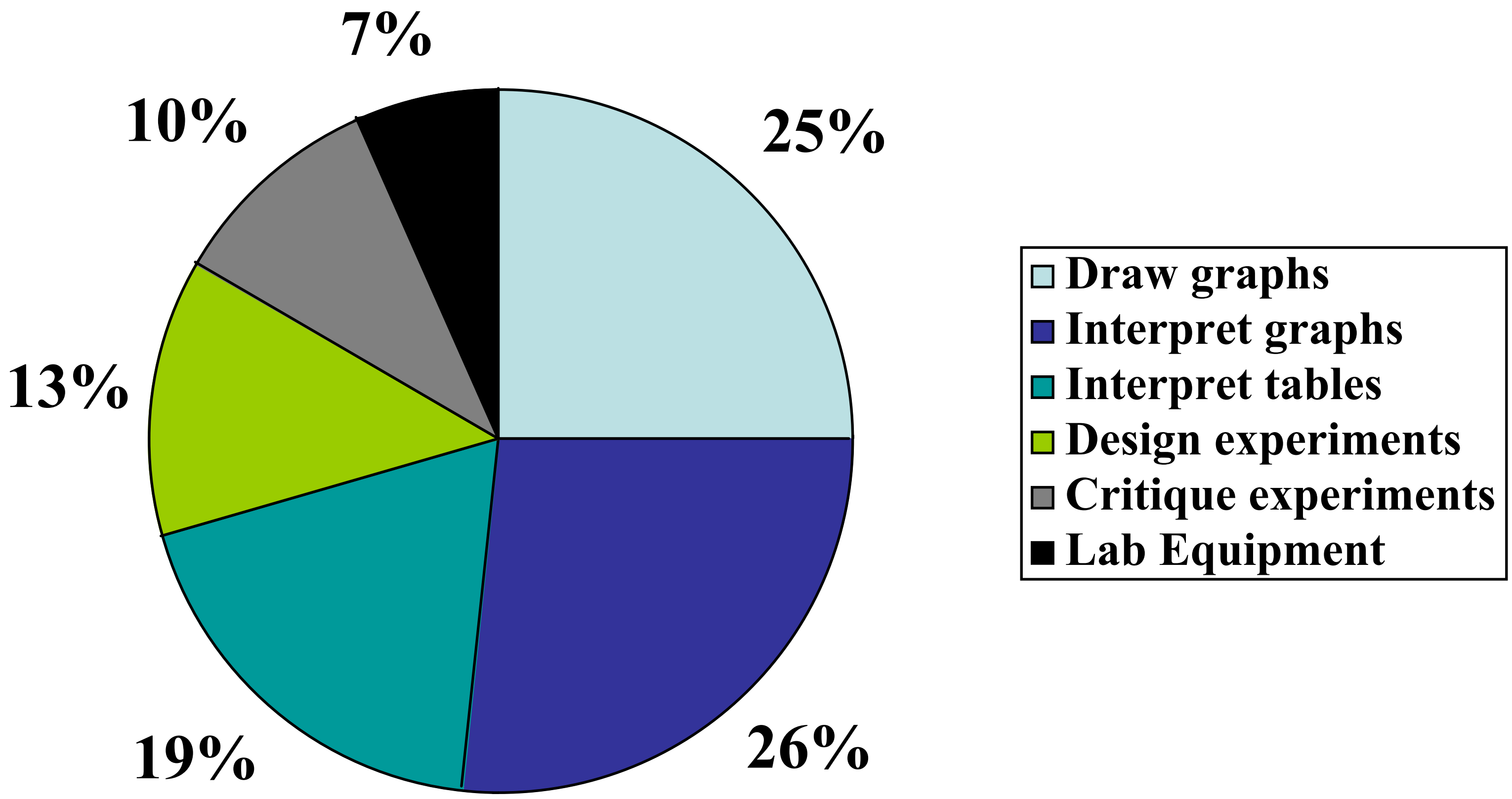
Exam Date	Living Environment	Earth Science	Chemistry	Physics
June 2002	20	12 (35)	8	18
August 2002	27	11 (23)	15	12
January 2003	26	9 (48)	11	8
June 2003	18	13 (34)	9	16
August 2003	21	9 (36)	20	No exam
January 2004	22	19 (42)	11	12
Total	22	12 (37)	12	13

SCORE POINT DISTRIBUTION ACROSS LABORATORY SKILLS/ABILITIES/UNDERSTANDINGS

Type	Biology	Earth Science	Chemistry	Physics	Total
Draw graphs	22	11	14	19	66
Interpret graphs	24	26	10	11	71
Interpret tables of data	14	18	13	5	50
Design experiments	22	0	0	12	34
Critique experiments	26	0	0	0	26
Lab equipment, Technique, etc.	6	12	0	0	18
Maps, other data	0	112	0	0	112
Total	114	179	37	47	377

SCORE POINT DISTRIBUTION ACROSS LABORATORY SKILLS/ABILITIES/UNDERSTANDINGS

(ALL SUBJECTS JUNE 2002- JANUARY 2004)



SAMPLE ITEM
CRITIQUE EXPERIMENTS

An experimental design included references from prior experiments, materials and equipment, and step-by-step procedures. What else should be included before the experiment can be started?

(1) a set of data

(2) a conclusion based on data

(3) safety precautions to be used

(4) an inference based on results

(From NYS Living Environment Exam June 2002)

SAMPLE ITEM
DESIGN EXPERIMENTS

Your school's physics laboratory has the following equipment available for conducting experiments: accelerometers, lasers, stopwatches, ammeters, light bulbs, thermometers, bar magnets, meter sticks, voltmeters, batteries, power supplies, wires, electromagnets, spark timers. Explain how you would find the resistance of an unknown resistor in the laboratory. Your explanation must include: a) Measurements required [1] b) Equipment needed [1] c) Complete circuit diagram [2] d) Any equation(s) needed to calculate the resistance [1]

(From the August, 2002 New York State Physics Regents)

CHALLENGES POSED BY MULTIPLE CHOICE/CONSTRUCTED RESPONSE ITEMS

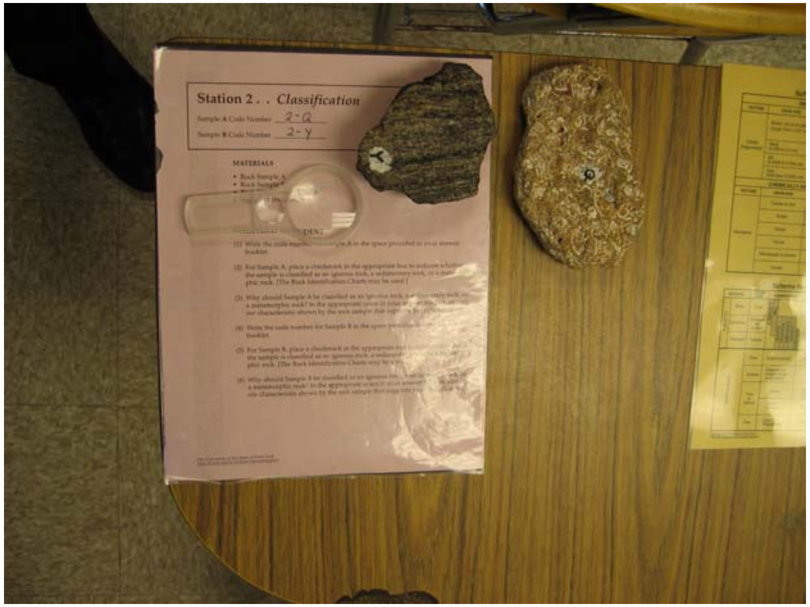
- Reliability
- Validity
- Weak alignment with standards
- Over-emphasis on easily measured skills
- Few required laboratories
- No consensus on terminology

PERFORMANCE ASSESSMENTS STATUS

Subject	Performance Assessment	Description
Living Environment	None	Uses MC/CR questions on 4 required labs- about 15% of final grade
Earth Science	Operational	6 stations- 6 minutes at each station- about 15% of final grade
Chemistry	Under design	Station model
Physics	Under design	Station model

PERFORMANCE ASSESSMENT EXAMPLE

- Identifying Rocks as Part of the 2004 Earth Science Performance Test



PERFORMANCE ASSESSMENT CHALLENGES

- Logistics
- Security
- Validity
- Reliability
- Resources to design assessments
- Resources to administer assessments

QUESTION 1

What are the challenges in assessing students' learning from laboratory experiences?

Many states still use traditional student outcome measures not tightly aligned with reform goals. (Lawrenz and Huffman; Klein, et, al.: Webb, Kane, Kaufman & Yang)

The challenge is reaching consensus on definition in assessable terms what students should learn from their laboratory experiences

QUESTION 2

How do state education standards and accountability systems (particularly state assessments enable or constrain effective learning and teaching in high school labs?

Mandated public testing encourages teachers and administrators to focus their planning and instructional efforts on test content, to mimic the tests' multiple-choice formats and devote more and more time to preparing students to do well on tests. (Corbett & Wilson; Shepard,; Herman and Golan)

Assessments influence allocation of resources and classroom practice. Good tests equal good practice.

QUESTION 3

To what extent and how can classroom level assessment of skills and knowledge developed through laboratory experiences be linked to large-scale assessments used by districts or by states?

Committee on Test Design for K-12 Science Achievement

QUESTION 4

To what extent and how can large-scale assessments used by districts or states be designed and implemented in ways that are sensitive to (or capture) the learning that occurs through laboratory experiences?

•Large-scale tests typically favor breadth of content coverage over depth of reasoning and employ decontextualized items, primarily using the multiple-choice format.

•Scant coverage of most NSES Standards for Science as Inquiry.
•Multiple choice items relate to use of mathematics. (Quellmalz & Kreikemeier)

Sensitive assessments can be designed. Challenges are consensus on definition of outcomes and resources.

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