DOCUMENT RESUME

ED 410 297 TM 027 174

AUTHOR	Lai, Morris K.; Young, Donald B.
TITLE	(Science) Education Standards Yield Standard Data-Collection of Instruments.
PUB DATE	Mar 97
NOTE	12p.; Paper presented at the Annual Meeting of the American Educational Research Association (Chicago, IL, March 24-28, 1997).
PUB TYPE	Reports - Evaluative (142) -- Speeches/Meeting Papers (150)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	Curriculum Development; *Data Collection; Elementary Secondary Education; Feedback; Program Evaluation; Rating Scales; *Science Education; *Standards; Teaching Methods; *Test Construction

ABSTRACT

The final versions of nationally developed standards for science education have recently been published for use by practitioners, and it is obvious that these standards will have some influence on how science education is conducted. The effects of the standards on teaching and curriculum development can be anticipated, but their effects on evaluation in science education are not as obvious, although it does follow that instruments developed for evaluating a specific program that are true to the standards should be applicable to evaluation of other science education programs. Some evaluation tasks related to relevant standards found in recent literature are listed and described for STEP, a science education staff development program. Data collection instruments usually flowed readily from the standards, although their construction often required careful reading and interpretation. The STEP project was able to produce standards-based instruments such as Likert-type self-report rating scales, open-ended interview schedules, observation instruments, and program evaluation checklists. Some examples are given for: (1) teacher feedback on classroom teaching; (2) teacher feedback on effectiveness of a teacher institute; and (3) observational data collection during a training institute. The standards-based approach to evaluating a standards-based program seems to be worthwhile and efficient. An evaluation form is attached. (Contains 14 references.) (SLD)

(Science) Education Standards Yield Standard Data-Collection Instruments

Morris K. Lai & Donald B. Young
Curriculum Research and Development Group
University of Hawai'i

Paper presented at the annual meeting of the
American Educational Research Association
Session 23.04
26 March 1997
Chicago, Illinois

(Science) Education Standards Yield Standard Data-Collection Instruments

Overall approach

Only recently have the final versions of nationally developed standards for science education been published (e.g., the *National Science Education Standards* (*NSES*) released by the National Research Council in late 1995) for use by practitioners. Some associations are still developing their version of science education standards (e.g., the Association for the Education of Teachers of Science), some have posited principles or models (e.g., The National Institute for Science Education), some have developed frameworks based on the *NSES* (e.g., National Science Teachers Association's *A Framework for High School Science Education* (1996)), and some have published benchmarks (e.g., American Association for the Advancement of Science (AAAS), 1993). Also relatively recent are various professional development standards (e.g., National Staff Development Council (1994) and *The Program Evaluation Standards* (1994) sponsored by AERA and 14 other major educational organizations.

It is obvious that these standards will have some influence on how science education is conducted. In a June/July 1996 article in the *Educational Researcher*, Linn and Muilenburg noted "Recently published standards for science, mathematics, history, and other fields challenge educators to design instruction that set in motion a lifelong habit of learning." This requires, they go on to say, the redesign of instruction.

Although many believe the standards will help improve the way they teach, they expect to face a variety of obstacles (the top three being (a) time for planning, (b) financial support for professional development, and (c) materials, resources, and facilities), reported Meg Sommerfield in the April 10, 1996 issue of *Education Week*. Her findings were based on a survey sent to a random sample of members of the National Science Teachers Association.

Effect of standards on evaluations of science education programs

Not as obvious as the effects of the standards on teaching and curriculum development are the standards' effects on evaluation in the field. It is noteworthy to realize that if one buys into the science education standards, then it directly follows that instruments developed for evaluating a specific program that are true to the standards should be essentially applicable to evaluation of other science education programs. Just as is the case for curriculum development, however, certainly different versions of standards-based data-collection instruments can emerge.

Here we show a listing of the major relevant standards found in the recent literature. Evaluation tasks (ET_) for STEP, a science education staff development program, are given in the second column and are subsequently described in more detail.

Source of Standards	**Evaluation Task(s) or Rationale**
American Association for the Advancement of Science (AAAS), *Benchmarks for Science Literacy* (11/93) [Also *Science for All Americans*, 1989]	ET4, ET10, ET13; Most states use these standards.
Education Department General Administrative Regulations (EDGAR), 1994 revision	Overall evaluation and future proposals
National Center for Improving Science Education (NCISE) [In *Promising Practices*]	*ESTEEM* (1995) instruments to measure teaching practices and students outcomes. "...no other constructivist classroom observation instrument." ET6, ET7, ET8 (?)
National Research Council, **National Science Education Standards*, 1996. Teaching, Professional Development, and Assessment.	ET1, ET3, ET4, ET5, ET6, ET7, ET8 (?), ET10, ET12. Also for system, program, and content. Our focus is on the teaching standards.
National Staff Development Council (NSDC), *Standards for Staff Development*, 1994	ET5, ET6, ET10
Program Effectiveness Panel (U.S. Dept. of Education) guidelines (e.g., as outlined in *Making the Case*, 1988)	ET2, ET4, ET11, E12, E13
Program Evaluation Standards (AERA, NEA, & many others), 1994	Overall STEP evaluation design. ET9
Other Standards (less emphasis on)	E.g., US Dept. of Education (1994 draft), ASCD (11/94 draft), AETS.

*Available at http://www.nap.edu/nap/online/nses/FrontDoors.html
The ETs refer to the following delineated list of 13 evaluation tasks that constitute the essential tasks of the evaluation.

STEP Evaluation Tasks

ET1. Videotape teacher's rendition of best lesson before training and one year later—grades 4 and/or 5

- Identify 10 sites; 2 teachers per site; total 20 teachers
- Identify local coordinator to videotape to standardize data collection
- Develop protocol for videotaping and send out
- Develop selection criteria (If more than 2 teachers at site, random selection; length of lesson, tape format, etc.)
- Contract for IOTA analysis of tapes
- Conduct live IOTA analysis and tape analysis to establish reliability
- Develop NRC National Science Education Teaching Standards Checklist; contract an external evaluator to conduct the analyses
- Identify teacher at same sites for post taping only
- Tape and analyze best lesson one year later

ET2. Case studies, grade 4

- Clarify status of single case studies
- Complete Hawai'i case studies (2) following established guidelines
- Test Speitel's program for qualitative analysis and videotape analysis; use as appropriate
- Contract an external evaluator to conduct cross case analysis
- Conduct cross case analysis
- Link to content and teaching standards; which are addressed?

ET3. Videotape best lesson before training and one year later—grades 7–9

- Identify 5 rural sites and 5 urban sites
- Identify local coordinator type to videotape to standardize data collection
- Send out protocol for taping
- Develop selection criteria
- Identify teacher at same sites for post taping only
- Tape and analyze best lesson one year later

ET4. Test data collection on FAST

- Analyze National Assessment of Educational Progress (NAEP) items
- Administer Landscape Survey (NAEP items) grades 8 and 9 in Cincinnati
    - Identify possible comparison groups within schools
- Collect school impact data with comparison groups on grades, attendance, cuts, electing more science, etc.

ET5. Impact on teaching after training and first year implementation

- Revise instrument based on pilot
- Revise methodology based on pilot
- Establish criteria for observation (grade, length of observation, number of sites)

ET6. Institute Data—DASH, FAST, HMSS

- Review and summarize participant evaluation data from summer ‘95, ‘96, and ‘97.
  - by institute
  - by state
- Review & revise free response to standards-based instruction
- Use instruments at end of institutes
- Apply revised RFI instrument with revised methodology

ET7. Self-rating instruments—DASH, FAST, HMSS

- Develop NRC teaching standards checklist
- Develop standards-based free response instrument
- Administer NRC teaching standards instrument first day of instruction at all sites
- Randomly select 150 teachers for post follow up

ET8. Artifacts as evidence of achievement

- Adapt or develop artifact review procedures
- Develop criteria for selecting teachers/classes for artifacts
- DASH—Collect artifact data (actual; photo; videotape) grade 4 and 5. Evaluate using criteria. Have some grade 4.
- FAST—Collect student notebooks as portfolios. Evaluate using criteria

ET9. Collect data addressing evaluation standards

ET10. Collect teacher institute data addressing

- Objectives 1–3; Numbers of new trainers trained, numbers of teachers trained, numbers of teachers provided support services
- Objective 4. Level of achieving standards
  - Correct and revise RFI draft progress report
  - Repeat data collection and reporting

ET11. Existing achievement test data at implementation sites

- Adapt or develop new form for processing achievement data (Standardized test data by class/school; school demographics; comparison data; performance testing; reading/mathematics scores; other indicators of impact)
- Solicit partners to systematically collect data
- Collect existing data
- Categorize, analyze, report

ET12. Teachers as leaders data

- Collect and catalog all indicators or developing leadership. (Awards, anecdotes; professional meetings attended; presentations at professional meetings; within school faculty development; becoming certified trainers; action research reports; supervisor testimonials; enrolling for advanced degree; school, district, state, or professional committees; publications; newspaper reports; other)
- Survey institute participants
- Compile data and report

ET13. HMSS
Design and collect impact data as appropriate (this curriculum has not been as extensively evaluated as have DASH and FAST)

Standards-based data-collection instruments

Data-collection instruments usually readily flowed directly from the standards but often required a careful reading and interpretation of the standards. With some modest modifications of wording and scope, we were able to produce standards-based instruments such as Likert-type self-report rating scales, open-ended interview schedules, classroom and teacher training observation instruments, and overall program evaluation checklists. Here we give some specific examples.

1. Teacher feedback on classroom teaching

In the original statement of the standards, examples of what teachers do to carry out each standard are given. We used these examples to create a Likert-type scale for teachers to give feedback on their classroom teaching (as opposed to their feedback on the effect of the teacher-training workshop). We selected from the examples those which we used virtually verbatim if that made sense or did some modest editing as we felt was appropriate. Here we give an example of each type:

NRC original wording	**Wording for Likert scale (strongly agree to strongly disagree)**
"Work together as colleagues within and across disciplines and grade levels."	"I work together with my colleagues within and across disciplines and grade levels." (may want to write two or three separate items so as to avoid multiple stem—see example that follows)
"Encourage and model the skills of scientific inquiry, as well as the curiosity, openness to new ideas and data, and skepticism that characterize science."	"In my class, I encourage the skills of scientific inquiry." "In my class, I model the skills of scientific inquiry." "In my class, I encourage skepticism that characterizes science." "In my class, I model skepticism that characterizes science."

2. Teacher feedback on effectiveness of teacher institute

First we give an example of a data-collection instrument that can be used to get teacher feedback on how effective the institute was in addressing the standards:

Usefulness of the STEP Institute in Meeting Science Education Standards

(Room for teachers' responses have been reduced for this paper.)

Please give an example of how you could use what you learned in this STEP Institute to address the following science education standards (use the back of this sheet if more space is needed):

1. Teachers of science plan an inquiry-based science program for their students.
2. Teachers of science guide and facilitate learning.
3. Teachers of science engage in ongoing authentic assessment of their teaching and of student learning.
4. Teachers of science design and manage learning environments that provide students with the time, space, and resources needed for learning science.
5. Teachers of science develop communities of science learners that reflect the intellectual rigor of scientific inquiry and the attitudes and social values conducive to science learning.
6. Teachers of science actively participate in the ongoing planning and development of the school science program.
7. Science education is accessible to all students
8. Science learning builds on students' prior experience and knowledge.
9. Teachers help students relate to personal and social needs.

Items 1–6 are based on the teaching standards from the National Research Council (NRC). In most cases, the exact wording of the NRC standard itself was used (e.g., items 1, 2, 4, 5, and 6). For item 3, we added the word "authentic" to reflect a standard from the National Center for Improving Science Education's (NCISE) list ("Use authentic assessments to chart teaching and learning."). Thus item 3 represents both the NRC and the NCISE standard.

3. Observational data collection during training institute

We developed an observation instrument based on staff development standards. As expected, it was somewhat more difficult to develop an instrument in this area. The instrument we developed for the staff development institutes has observers rate standards (e.g., as follows: "Observed—Clear focus; Observed—Adequately addressed; Observed—Somewhat addressed; Not observed").

Inappropriateness of some standards for developing items for immediate feedback

In our attempt to directly address some of the standards, we found that a number were longitudinal in nature or were to be addressed at the teachers' schools rather than at a workshop. That made us rethink our evaluation design in the following way. We are asking teachers to videotape their "best lesson" before the workshop. We will ask them to do the same a year later. These videotapes will then be analyzed using IOTA and science education teaching standards from the National Research Council. We also had them fill out before the start of the workshop a Likert-type scale addressing how they taught in their classroom. We will give them the same questionnaire during the end of the current school year.

Use of method to design and conduct other evaluations

We found the standards-based approach to evaluating a standards-based program to be a worthwhile one. To the extent that professional standards are accepted in a given field, it should be possible to develop evaluation data-collection instruments that, with modest adjustments, can be valid for most evaluation efforts. Not only would this approach be relatively efficient, but it would also have the benefit of being based on outcomes and processes that the leading professional organizations in the field have deemed as standards worthy of addressing and meeting. Two sample data-collection instruments are attached.

References

American Association for the Advancement of Science. (1993). *Benchmarks for science literacy.* Washington, DC: Author.

The Joint Committee on Standards for Educational Evaluation. (1994). *The program evaluation standards* (2nd ed.). Thousand Oaks, CA: Sage.

Linn, M. C., & Muilenburg, L. (1996). Creating lifelong science learners: What models form a firm foundation? *Educational Researcher*, *25*(5), 18–24.

National Policy Board for Educational Administration. (1994, November). *Proposed NCATE curriculum guidelines* (5th draft). Unpublished document.

National Research Council. (1995). *National Science Education Standards.* Washington, DC: Author.

National Staff Development Council. (1994). *National Staff Development Council's standards for staff development: Middle Level Edition.*

O'Sullivan, R. G. (Ed.). (1995). Emerging roles of evaluation in science education reform. *New Directions for Program Evaluation*, 65 (spring).

Program Effectiveness Panel. (1993, December). *Guidelines for preparation and review of submissions for revalidation by the Program Effectiveness Panel.* Washington, DC: Author.

Ralph, J., & Dwyer, M. C. (1988). *Making the case: Evidence of program effectiveness in schools and classrooms.* Washington, DC: U. S. Department of Education, Office of Educational Research and Improvement.

Smith, C., & Beno, B. (1993, March). *Guide to staff development evaluation.* (ERIC Reproduction Document No. ED363381)

Stevens, F., Lawrenz, F., Sharp, L. (1993). *User-friendly handbook for project evaluation: Science, mathematics, engineering and technology education.* Washington, DC: National Science Foundation.

U. S. Department of Education. (1994, October). *Draft mission statement and principles of professional development.* Washington, DC: author.

U. S. Department of Education, Office of Educational Research and Improvement. (1994). *Mathematics, science & technology education programs that work.* Washington, DC: Government Printing Office.

U. S. Department of Education, Office of Educational Research and Improvement. (1994). *Promising practices in mathematics & science education.* Washington, DC: Government Printing Office.

ML 4/21/97

Usefulness of the STEP Institute in Meeting NRC Science Education Standards

Please give an example of how you could use what you learned in the STEP Institute to address the following science education teaching standards (use the back of this sheet if more space is needed):

1. Teachers of science plan an inquiry-based science program for their students.

2. Teachers of science guide and facilitate learning.

3. Teachers of science engage in ongoing authentic assessment of their teaching and of student learning.

4. Teachers of science design and manage learning environments that provide students with the time, space, and resources needed for learning science.

5. Teachers of science develop communities of science learners that reflect the intellectual rigor of scientific inquiry and the attitudes and social values conducive to science learning.

6. Teachers of science actively participate in the ongoing planning and development of the school science program.

Self-Report about Teaching

Name ____________________ School ____________________ Date ________

Directions: For the following statements, circle "SA" is you strongly agree, "A" if you agree, "D" if you disagree, or "SD" if you strongly disagree.

1.	I have developed a framework for yearlong and short-term science education goals for my students.	SA A D SD
2.	I select teaching and assessment strategies that nurture a community of science learners.	SA A D SD
3.	I work together with my colleagues within and across disciplines and grade levels.	SA A D SD
4.	I use an inquiry-based approach to teaching science.	SA A D SD
5.	I orchestrate discourse among my students about scientific ideas.	SA A D SD
6.	I challenge my students to accept and share responsibility for their own learning in science.	SA A D SD
7.	In my class, I encourage the skills of scientific inquiry.	SA A D SD
8.	In my class, I model the skills of scientific inquiry.	SA A D SD
9.	In my class, I encourage skepticism that characterizes science.	SA A D SD
10.	In my class, I model skepticism that characterizes science.	SA A D SD
11.	I analyze assessment data to guide my science teaching.	SA A D SD
12.	I guide my students in self-assessment.	SA A D SD
13.	I use student data, observations of teaching, and interactions with colleagues to reflect on and improve my teaching practice.	SA A D SD
14.	I structure the time available so that my students are able to engage in extended investigations.	SA A D SD
15.	For my science teaching, I identify and use resources outside the school.	SA A D SD
16.	I engage my students in designing the science learning environment.	SA A D SD
17.	I nurture collaboration among my students.	SA A D SD
18.	I have helped plan and develop my school's science program.	SA A D SD
19.	I have participated fully in planning and implementing my professional growth and development strategies.	SA A D SD

AREA 1997

TM027174

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement (OERI)
Educational Resources Information Center (ERIC)

REPRODUCTION RELEASE

(Specific Document)

I. DOCUMENT IDENTIFICATION:

Title: (Science) Education Standards Yield Standard Data-Collection Instruments	
Author(s): Morris K. Lai & Donald B. Young	
Corporate Source: University of Hawaii	Publication Date: 3/26/97

II. REPRODUCTION RELEASE:

In order to disseminate as widely as possible timely and significant materials of interest to the educational community, documents announced in the monthly abstract journal of the ERIC system, *Resources in Education* (RIE), are usually made available to users in microfiche, reproduced paper copy, and electronic/optical media, and sold through the ERIC Document Reproduction Service (EDRS) or other ERIC vendors. Credit is given to the source of each document, and, if reproduction release is granted, one of the following notices is affixed to the document.

If permission is granted to reproduce the identified document, please CHECK ONE of the following options and sign the release below.

[X] ← Sample sticker to be affixed to document

Check here
Permitting microfiche (4"x 6" film), paper copy, electronic, and optical media reproduction

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Sample
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Level 1

Sample sticker to be affixed to document → [ ]

"PERMISSION TO REPRODUCE THIS MATERIAL IN OTHER THAN PAPER COPY HAS BEEN GRANTED BY
Sample
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Level 2

or here
Permitting reproduction in other than paper copy.

Sign Here, Please

Documents will be processed as indicated provided reproduction quality permits. If permission to reproduce is granted, but neither box is checked, documents will be processed at Level 1.

"I hereby grant to the Educational Resources Information Center (ERIC) nonexclusive permission to reproduce this document as indicated above. Reproduction from the ERIC microfiche or electronic/optical media by persons other than ERIC employees and its system contractors requires permission from the copyright holder. Exception is made for non-profit reproduction by libraries and other service agencies to satisfy information needs of educators in response to discrete inquiries."

Signature: Morris K. Lai	Position: Director of Evaluation
Printed Name: Morris K Lai	Organization: Curriculum Research & Development Group
Address: Univ. of Hawaii 1776 University Ave. Honolulu, HI 96822	Telephone Number: (808) 956-7900
	Date: 4-23-97

OVER

CUA

THE CATHOLIC UNIVERSITY OF AMERICA
Department of Education, O'Boyle Hall
Washington, DC 20064
202 319-5120

February 21, 1997

Dear AERA Presenter,

Congratulations on being a presenter at AERA[1]. The ERIC Clearinghouse on Assessment and Evaluation invites you to contribute to the ERIC database by providing us with a printed copy of your presentation.

Abstracts of papers accepted by ERIC appear in *Resources in Education (RIE)* and are announced to over 5,000 organizations. The inclusion of your work makes it readily available to other researchers, provides a permanent archive, and enhances the quality of *RIE*. Abstracts of your contribution will be accessible through the printed and electronic versions of *RIE*. The paper will be available through the microfiche collections that are housed at libraries around the world and through the ERIC Document Reproduction Service.

We are gathering all the papers from the AERA Conference. We will route your paper to the appropriate clearinghouse. You will be notified if your paper meets ERIC's criteria for inclusion in *RIE*: contribution to education, timeliness, relevance, methodology, effectiveness of presentation, and reproduction quality. You can track our processing of your paper at http://ericae2.educ.cua.edu.

Please sign the Reproduction Release Form on the back of this letter and include it with **two** copies of your paper. The Release Form gives ERIC permission to make and distribute copies of your paper. It does not preclude you from publishing your work. You can drop off the copies of your paper and Reproduction Release Form at the **ERIC booth (523)** or mail to our attention at the address below. Please feel free to copy the form for future or additional submissions.

Mail to:

AERA 1997/ERIC Acquisitions
The Catholic University of America
O'Boyle Hall, Room 210
Washington, DC 20064

This year ERIC/AE is making a **Searchable Conference Program** available on the AERA web page (http://aera.net). Check it out!

Sincerely,

Lawrence M. Rudner, Ph.D.
Director, ERIC/AE

[1]If you are an AERA chair or discussant, please save this form for future use.