

AC 2008-1148: A RUBRIC TO EVALUATE STANDARDS-BASED LESSON PLANS AND STUDENTS' ACHIEVEMENT OF THE STANDARDS

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A Rubric to Evaluate Standard-Based Lesson Plans and Students' Achievement of the Standard

Abstract

Standards-based lesson plans requires a different way of planning that includes an alignment of student work expectations and classroom assessments to the standards and the learning objectives and expected outcomes of the lesson, and establishment of criteria by which it can be determined whether students have achieved the particular standard or indicator. Teachers need to learn how to align their teaching practices with the state content standards and how to develop and implement standards-based lesson plans. A rubric has been developed to evaluate teachers' standards-based lesson plans based a set of criteria for developing effective standards-based lesson plans. The rubric has been pilot tested and Kappa statistics have been calculated to evaluate the reliability of the rubric as a method to evaluate the effectiveness of standard-based lesson planning and the impact it has on student learning.

Introduction

Typically, state content standards, derived and/or developed from national standards, are designed to provide minimum competencies and provide the scientific and technological knowledge needed for modern society. Districts develop curricula from state standards, and teachers develop lesson plans for the classroom using the district curricula. Curricular materials in support of the integration of engineering into science instruction have been made available through professional organizations such as ASME and IEEE, as well as through universities and teacher-developed lesson plans¹⁻⁷. However, only concepts included in the standards are taught in the classroom, as teachers believe they will only be accountable for what is in the standards. As a result, students who take only the minimally required science classes, as opposed to advanced placement classes, will only learn what is included in the standards. Usually the only curriculum materials considered, let alone implemented, are those that reinforce state content standards, since student achievement (and schools' and districts' achievement) is measured largely by student performance on statewide assessment tests⁸. So, if teachers are to make engineering principles a part of their instruction for student learning, then engineering principles and design must be a part of the state science standards. Unfortunately, most existing engineering curricula lack an appropriate translation into standards-achieving lessons for enriching the science curriculum. Translation into standards-achieving lessons is critical.

Aligning with Standards

Most states have promulgated content standards in important subject matter, and school districts are working on the alignment of their curricula. Curriculum frameworks have been prepared, lesson and unit plans have been revised, and new assessments are intended to measure achievement of the standards by students at all grade levels. Unfortunately, the adoption of content standards hasn't as yet had a significant impact in science classrooms⁸.

Most school districts focus on other means besides lesson plans in their efforts to become "standards based." The textbook adoption process is a popular approach. Textbook adoption

committees use standards alignment as a criterion for selecting new textbooks. Typically, topics in the textbook for a subject are compared with the standards and indicators for that subject. The result is usually a list of “applicable standards/indicators for each topic in the text.”⁹ Alignment of this type is simply a match of standards with contents in the curriculum. District leaders can justify this strategy through a simple deduction. If adopted textbooks contain the knowledge and skills of the standards, then students will learn the information when teachers plan lessons using the textbook. But does such a process, by itself, raise expectations for student achievement? Another popular approach uses standards-based test results and information about the tests’ content to identify critical standards. Knowledge about test content information is helpful, but it does not assure changes in teaching behavior that will improve student achievement in areas of curriculum weakness and research studies have raised questions regarding the validity of using standards-based test results as a reliable measure of student achievement¹⁰⁻¹¹.

While substantial energy has been devoted to the identification of standard-based curriculum materials and achievement tests, little is known about new lesson planning, teaching, and student activities that may be needed in a standards-based classroom. Teachers need to be able to translate the state content standards as described in the district’s curriculum guide into effective practices of differentiated instruction. However, many teachers lack the knowledge about standards-based lesson planning, and the availability of resources for standards-based lesson planning. Moreover, teacher preparation programs do not focus on preparing teachers to plan outcomes-based instruction where the outcomes of lessons are behaviors and products described by the standards¹¹.

Research suggests that lesson and unit plans are essential and powerful tools for instructional improvement and increased student achievement⁹⁻¹⁰. When teachers prepare truly standards-based lessons, their teaching is focused on student achievement in relation to specific standards¹². Teachers can set higher expectations that meet the standards if they begin their lesson planning with expectations of the standards in mind. Plans can be changed and adjusted in response to student learning efforts and test results as part of a continuing cycle of improvement consistent with the findings of the AAAS that aligning curriculum, instruction, and assessment to goals for student learning (i.e., learning objectives) is an essential first step to achieve alignment with standards¹³.

The use of standards-aligned curriculum materials is necessary but not sufficient to achieve the standards¹⁰. Curriculum with topics aligned to engineering standards is also not sufficient. For students to achieve the standards there must be more than just a matching or referencing of topics of a textbook to standards. Alignment with standards must also include the assessment of student achievement of the skills and knowledge defined by the standards. Actual standards achievement requires altered expectations of student outcomes, a different way of planning lessons, and a specific sequencing of learning outcomes so that expectations and learning activities relate directly to the standards and their indicators. Teachers need an explicit protocol for planning standards-based lessons, aligning student work expectations and classroom assessments to the standards and the learning objectives of the lesson, and establishing criteria by which they can determine whether students have achieved the particular standard or indicator. Several of the curriculum efforts have reported developing similar procedures for relating learning objectives with standards and assessment of student performance¹²⁻¹³. However, the

reported alignment of standards is mostly a referencing to standards only, and assessments generally do not measure student achievement of the learning objectives, or are not present at all.

An analysis of lesson plans reported as “aligned with the standards” that are available in print or from websites shows one or more of the following problems for many of the lessons:

- Too many standards selected for one lesson, or the wrong standard is chosen in relation to the selected curriculum materials. Grade level statements of the specified skills and knowledge are not used. Identified standard is not related to the central concept of the lesson.
- The learning objective is not related to the central concept of the lesson, or to the selected standard. Objective is vague or describes general knowledge, not the intended student learning.
- The intended learning outcome (assessment) is not related to the stated learning objectives or the chosen standards.

Standards-Based Lesson Planning

A standards-based lesson uses measurable learning objectives to assess student actions or work products. Alignment of a lesson and the instruction requires that the standards are bridged with desired student outcomes specified by the grade appropriate indicator(s) of the standard(s). Within this context,

- Standards are meant to define what students should know (content) and be able to do (process).
- Learning objectives, aligned with standards, must be stated in terms of a measurable student behavior.
- Assessment must measure the student achievement of the skills and knowledge defined by the learning objectives and the standards.
- Standards do not mandate a particular curriculum, or textbook, and may be achieved in a variety of ways.

A process for the creation and implementation of standards-based lesson plans has been developed. The process starts with the concept that is to be taught. One or more measurable learning objectives are identified for the lesson. For each learning objective the corresponding statement from the content standards is then specified. A performance descriptor is identified for each objective. The performance descriptor provides the assessment criterion for student mastery of the content of the lesson (e.g. level of acceptable competence). An activity is developed to provide students the opportunity to acquire the skill and/or knowledge specified by the learning objective and the appropriate statement of the standards. Finally, performance descriptors are used for the analysis of student behaviors and work products, which provide evidence that the student has acquired the skill and/or knowledge of the learning objective specified by the indicator(s) of the standard(s). The key to the process is the identification of the learning objective(s) for the lesson¹⁴. The learning objectives should be achievable by students and documented through student work that can be evaluated. Learning objectives use behavioral verbs to indicate, and communicate to others, specific, observable student behavior (skills and knowledge). Behavioral verbs describe an observable student product or action that allows inferences about student learning. A synthesis of the behavioral verbs that exemplify Bloom’s higher order learning is critical for assessing mastery of the performance indicators¹⁴.

Identifying the learning objectives related to each selected indicator, in terms of outcome-based language, should lead to student performances or work products which are assessable. Thus, matching the learning objectives(s) to the appropriate skills and knowledge specified by the grade-appropriate indicator(s) of the standard(s) begins the process of aligning the lesson and the instruction with the standards. Performance descriptors are then derived from the objectives, which in turn determine the content of the lesson, so that appropriate opportunities are provided for the students to achieve the skills and knowledge defined by the indicators of the standards. Evaluation should be based on each objective. Thus, performance descriptions can guide the selection and enhancement of the instructional process, and activities can be selected or designed to elicit the behavior or products described in the learning objective. The performance descriptors provide the criteria for assessing the student behavior/work product resulting from the lesson. Thus, learning objectives are used to evaluate student performance. The criteria identify work that is sufficient in relation to the expectations of the standards, providing a link back to the learning objectives and the indicators of the standards.

Evaluating the Quality of Standards-Based Lesson Plans

A substantial amount of time has passed since standards were developed, yet lesson planning in relation to standards has only begun to emerge as an approach for meeting the standards. For the most part, states and localities have concentrated on curriculum alignment to assure standards are met by students, as described earlier. More effort has been expended in the development of state and district assessment systems that measure student achievement of state standards, and the emergence of *No Child Left Behind* in 2002 provided the assessment industry with the impetus to develop products that measure student achievement of the standards.

The process for standards-based lesson planning allows teachers to systematically assess learning outcomes that are aligned with state and national content standards. Less obvious, although already recognized by some as critical¹⁵, is the need to gauge the quality a lesson plan as to how well the learning objectives and standards are being met. Reports of techniques to measure the effectiveness of standards-aligned lesson plans appear to be limited to studies of teacher efficacy (i.e., attitudes, comfort and confidence)¹⁶ and program evaluation¹⁷. A tool called “Analysis of Unit Plans and Lesson Plans” was developed for principals to use for evaluative purposes¹⁸, but it appears to be more of a checklist for the different components of a lesson plan rather than a focus on the criteria that identify and measure the parameters of a standards-based lesson plan.

A Rubric for Assessing Standards-based Lesson Plans

The development and use of a rubric for assessing the quality of standards-based lessons plans depends on the determination of quality indicators for standards-based planning and teaching. Since 1991, the Center for Pre-college Programs (CPCP) at New Jersey Institute of Technology (NJIT) has focused on the development of teacher knowledge and skills for implementing curriculum standards and effective lesson planning. Through support from the National Science Foundation, faculty and staff at CPCP have developed programs for math and science teachers to help refine their instructional planning skills and provide them with an effective protocol for developing standards-based lesson plans, including:

- Identifying a specific state or federal curriculum standard as the basis for planning a lesson;
- Selecting elements of the standard that would constitute appropriate content and skills to convey in a lesson;
- Writing instructional objectives that describe student outcomes demonstrating achievement of skills and content of the standard;
- Planning or selecting instructional activities that would elicit high quality student products or performances described in lesson objectives;
- Evaluating student work products by comparing them with expectations found in the instructional objectives, and;
- Preparing instructional objectives that would result in student products or performances.

Through collaboration with a pedagogical consultant, who is also an educator, a rubric has been developed to evaluate standards-based lesson plans for science and pre-engineering instruction following the protocol above. An initial set of criteria intended to answer the following questions was developed and pilot tested:

- Has a reasonably small portion of a standard or indicator been chosen for the lesson that maps to no more than four outcomes that are achievable in the time period of instruction?
- Are the lesson objectives stated in outcomes language that describes products or behaviors that will be provided by students?
- Does each of the objectives include qualifying statements or phrases that describe proficient or “good enough” performance for each product or behavior expected of students?
- Are the lesson objectives sufficient to meet all critical learning expectations included in the content descriptions of the selected standard or indicator? Was anything left out?

As a result, a rubric with seven elements has been developed. Each is evaluated on a three point scale where in general 0 indicates poor, vague, or non-existent, 1 indicates somewhat lacking but acceptable and 2 indicates clear, concise, objective, measurable or complete (see Appendix).

For example, the first element is whether “Standards or indicators appear in the plan.” The second element is, “Objectives are derived from content statement of standard.” A zero (0) would indicate that the “Objective is not related to the selected standard” (given in element one), a 1 would indicate “Objective related, but not sufficient to assess expected learning”, and a 2 would indicate “Objective matches student performances to content of selected standard”. The third element examines “What the Objective will produce, i.e. the level of knowledge.” The fourth element determines the degree to which the “Objective is observable and measurable.” The fifth element evaluates the quality of the “Performance Descriptors.” The sixth element examines the learning activities specified in the lesson plan, for example 0 would indicate “No activity provided, or students’ action is vague,” 1 would indicate “Student actions clear but objectives may not be obtainable,” and 2 would indicate “Student actions clear, likely to result in product specified in objective” (third element). And the seventh element examines the evaluation of the lesson. A zero (0) would indicate “No evidence for student products will result,” a 1 would indicate “Assessment tool does not match product or performance of objective,” and a 2 would indicate “Assessment tools clearly indicate products of objectives are produced.”

Reliability

For the current study, 200 standard-based science lesson plans were drawn from multiple sources:

- Lesson plans developed and used by teachers in our summer engineering enrichment programs for middle and high school students.
- Lesson plans in science (includes engineering) from “the Educator’s Reference Desk” data base¹⁹.
- Lesson plans from the “IEEE Pre-University Education Lesson Plans” data base²⁰.
- Lesson plans from the “Teach Engineering Resources for K-12” data base²¹.
- Lesson plans prepared by pre-service science teachers and alumni from the Teacher Preparation program at California State University – Monterey Bay.

Several raters were trained to understand the seven elements of the rubric and the use of the three point rating scale for each. Training included independent practice using the rubric after which raters discussed disagreement until they could agree. Each of the 200 lesson plans were evaluated by two different raters. Kappa statistics were used to evaluate the inter-rater reliability of each element (see Table I). The results are favorable but not strong.

Table I
Inter-rater Reliability of Rubric Measured by Kappa Statistics

Element 1: Standards or indicators appear in the plan	.63
Element 2: Objectives derived from Content statement of standard	.68
Element 3: Objective Knowledge	.69
Element 4: Objective, observable and measurable	.73
Element 5: Performance Descriptors	.63
Element 6: Lesson Activities	.63
Element 7: Evaluation of the lesson	.74

Results from this study will be evaluated further. Points for which raters disagreed will be examined to determine why raters disagreed and this information will be used to revise the definition of quality indicators. The scoring protocol and training will be revised as necessary and the rubric will be re-evaluated with a larger sample.

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Appendix

Standards-Based Lesson Plan Rubric

<u>Standards and indicators appear in the plan</u>	4 or more standards cited, unfeasible	Full text of standards with No editing	Standard and indicator trimmed and feasible
<u>Objectives derived from content statements taken from Science framework</u>	Objectives unrelated to selected standard	Objectives related, but not sufficient to assess expected learning in standard	Objectives result in student performance matched to content of standard
<u>Objectives: Value</u> Objective #1...	Objective leads to trivial product, or no product	Objective at comprehension or knowledge level	Objective at analysis or higher level
Objective #2...			
Objective #3...			
Objective #4...			
<u>Objectives: observable and measurable</u> Objective #1...	Verb choice not visible, e.g. "learn", "know"	Observable, for some students only or, does not display knowledge	Behavioral verb and product that can be evaluated
Objective #2...			
Objective #3...			
Objective #4...			
<u>Performance Descriptors</u> Descriptor #1...	No qualifying statement to identify proficient performance	Qualifying statement vague w/out clear criteria of proficiency	Subjective and Quantitative expectations describe proficient product
Descriptor #2...			
Descriptor #3...			
Descriptor #4...			
<u>Lesson activities</u>	Not provided or vague, no products evident	Student action clear but unlikely that objectives will result	Student actions likely to result in products of objectives
<u>Evaluation</u>	No evidence that student products will result	Assessment tool does not match products of objectives	Assessment tools assure products of objectives are all produced

