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ABSTRACT

The problem of major concern to the Physics Education Evaluation Project (P.E.E.P.) involved the improvement of university physics teaching and learning. The present paper describes instruments and procedures developed for systematic formative evaluation of physics lectures. The data was drawn from two sections of a first year university physics course. Guided by Stake's evaluation framework, descriptive data about the lecture environment was collected and analyzed. At formative evaluation sessions immediately following the lecture, the instructor and an evaluator-observer processed the data and suggested improvements for subsequent lectures. The techniques are foreseen as potentially useful for improving teaching and learning in other lecture situations. (Author)

Abstract

Formative Evaluation of Lectures: An Application of Stake's Evaluation Framework

Walter W. Westphal, Philip G. Bashook, and Walter B. Boldt

The problem of major concern to the Physics Education Evaluation Project (P.E.E.P.) involved the improvement of university physics teaching and learning. The present paper describes instruments and procedures developed for systematic formative evaluation of physics lectures. The data was drawn from two sections of a first-year university physics course. Guided by Stake's evaluation framework, descriptive data about the lecture environment was collected and analyzed. At formative evaluation sessions immediately following the lectures, the instructor and an evaluator-observer processed the data and suggested improvements for subsequent lectures. The techniques are foreseen as potentially useful for improving teaching and learning in other lecture situations.

Formative Evaluation of Lectures: An Application of Stake's Evaluation Framework*

Walter W. Westphal, Philip G. Bashook, and Walter B. Boldt+

Objectives of the inquiry

The work reported here constitutes part of the Physics Education Evaluation Project (P.E.E.P., 1970) undertaken during 1969-1970 at the University of British Columbia. The problem of major concern to the project involved the improvement of physics teaching and learning at the university level. The present paper describes instruments and procedures developed for systematic formative evaluation of university lectures.

Formative evaluation of a lecture refers to the feeding back of data about the lecture to concerned individuals (i.e. the instructor, the students) in order to improve ongoing teaching and learning. In the P.E.E.P. project, an attempt was made to utilize Robert Stake's (1967) evaluation framework as a guide in organizing and identifying descriptive data. Since Stake's framework is a recent addition to the evaluator's tool chest, the work reported here represents an initial application of the framework for formative evaluation of university lecturing.

The first phase of this study was initiated in May, 1969, after lengthy discussions with the major instructor of the physics course on problems of educational evaluation, and was completed in December, 1969. It involved clarifying the descriptive categories of Stake's framework, establishing the course rationale, and developing instruments and procedures for formative lecture evaluation. The second phase, applying the instruments and procedures, was undertaken during the second term of the course and was completed in May, 1970. Both phases were part of the initial stage of the P.E.E.P. study (Bashook, Boldt, Page, Westphal, 1971).

Descriptions of the course environment constitute the Descriptive Matrix of Stake's Framework (Figure 1). Data from single or grouped lectures can be evaluated separately with the framework (miniature model) or the complete lecture series for the course can be evaluated (global model) (Bashook, et al, 1971).

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Techniques of obtaining data for each model differ. For the global model, methods must be devised for data collection concerning the well-articulated course rationale, for pre- and post-course measuring instruments in both the cognitive and affective domains, and for the collection of considerable background information about the students (See P.E.E.P., 1970, for example). The methods described in this paper are for the "miniature model".

Methods

Instruments and procedures were devised to obtain data from four sources: (1) the instructor, (2) students, (3) evaluator-observer, and (4) lecture verbal and written events. The instructor completed questionnaires describing his lecture intents before each lecture. He also made available a copy of his notes and all written material. Student reactions to the lecture were gathered by a rating scale distributed randomly at each lecture and returned at the conclusion of the lecture. The evaluator-observer identified student interest levels using an observation instrument and recorded pertinent lecture events. Lectures were audio-taped and all written material presented during lectures retained. However, audio-tapes were only used as a reference source and did not contribute to the formative evaluation procedures.

After reviewing the student ratings and the observational instrument records, the instructor and evaluator-observer discussed the lecture events. These formative evaluation sessions usually occurred immediately following the lecture. By applying the "miniature model" (Figure 2), the instructor and evalutor tried to identify contingencies and congruencies in the lecture events which were useful for deciding upon improvements in the lecture environment. During the sessions, suggestions were made concerning subsequent lectures, and strengths and weaknesses in the educational setting were discussed.

An important consideration throughout the evaluation process was maintaining a close cooperation between the instructor and the evaluator in order to insure thorough understanding of the usefulness and limitations of the instruments and procedures. Moreover, students were encouraged to participate in course decision-making and to ask questions about the evaluation project.

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of the Physics Department, Faculty of Science and the Science Department, Faculty of Education of the University of British Columbia.

Data sources

Two sections of a first-year university physics course taught by the same instructor formed the data source for the study. Data from additional courses in chemistry, physics, and education were used for refining some of the instruments. The physics course presented general physics content, but the sections used different textbooks and applied different teaching strategies. There were 419 students enrolled in the lecture section used as a data source in the first stage of the study. The other section had 213 students enrolled. Each section met for one hour three times a week and once each week alternately for a two-hour tutorial session (discussion) or a three-hour laboratory session. The lectures were held in a theater-like hall containing standard lecturing facilities.

Results

Individual lectures were evaluated using the "miniature model" of Stake's Framework (Figure 2). Lecture intents, in terms of antecedents, transactions, and outcomes were obtained from the instructor by means of a Lecture Pre-Analysis Questionnaire (Figure 3). The instructor completed the questionnaire prior to giving the lecture, usually when he was preparing material for presentation. Among other things, he was asked to identify the specific purpose or purposes of each lecture event or transaction. Depending on the nature of the lecture and the number of purposes for each transaction, the instructor completed between 8 and 10 questionnaires per lecture. Further information about the instructor's intents was obtained from his lecture notes. The "Lecture Pre-Analysis Questionnaire" also served as a source of data for each lecture rationale. The specific purposes stated in the questionnaire were assumed to be his lecture goals. Additional lecture goals were teased from the instructor's course rationale. The data from these sources feed into the "miniature model" as shown in Figure 2.

Observational data describing observed lecture antecedents, transactions, and outcomes for a lecture were obtained in four ways. A Student Response Questionnaire (Figure 4) distributed randomly to 10-15 students each lecture yielded information about students' observations of lecture antecedents, transactions, and outcomes. The instructor's verbal and non-verbal comments served as the second source of observational data. An observer using the Lecture Observation Instrument (Figure 5) constituted another data source for lecture transactions and outcomes. Finally, information

about lecture content was obtained from lecture audio-tapes and copies of written materials including homework assignments and tests. Figure 2 shows schematically where observational data fit into the miniature model.

Since the evaluator could not be painted invisible, he served as an additional change-agent for the course. The close cooperation between evaluator and clients (instructor and students) seemed to facilitate the instructor's attempts to improve the educational climate in the lectures. An important effect of the evaluator in this role was his influence in getting the instructor to focus upon specific teaching or learning activities which seemed beneficial to the students and should be retained or events which seemed counter to the instructor's goals and needed to be reconsidered. In addition, based upon educational science, the evaluator suggested alternate teaching actions which would be more likely to lead to the instructor's specified goals.

Besides teaching, the instructor served in the role of evaluator by helping develop formative evaluation instruments and mechanisms. As a result, the instructor was more attuned to the goals of evaluation and more willing to adopt some of the evaluator's suggestions. A question unanswered by the study is whether such a double role might be necessary for a successful application of the model.

The students initially seemed hesitant to accept the presence of an outsider in the lecture. However, once his role in the lecture was explained and the purpose of the P.E.E.P. project described, most students took an active part in any positive attempts at altering the lecturing situation. The students viewed the "Student Response Questionnaire" as an important channel for communication with the instructor. Frequently, students would make comments to the instructor via the questionnaire about their concerns. Just as frequently, students would request an opportunity to complete a questionnaire.

Educational importance

The arbitrariness of designing lectures can be greatly lessened by introducing data-gathering instruments, procedures, and a framework which helps systematize the descriptive data required for decision-making. The instruments and procedures described in this paper demonstrate a successful application of Stake's Framework to the problem of systematic formative evaluation of Physics lectures. These techniques are foreseen as potentially useful for improving teaching and learning in any setting where lecturing is the dominant teaching format. In conclusion, it should be noted that the study described here is only one facet of an initial attempt to systematically describe and judge a college course.

REFERENCES

Robert E. Stake (1967). "The Countenance of Educational Evaluation", Teachers College Record, 68, 523-540.

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Figure 1. Rationale and Descriptive Matrix of Stake's Evaluation Framework

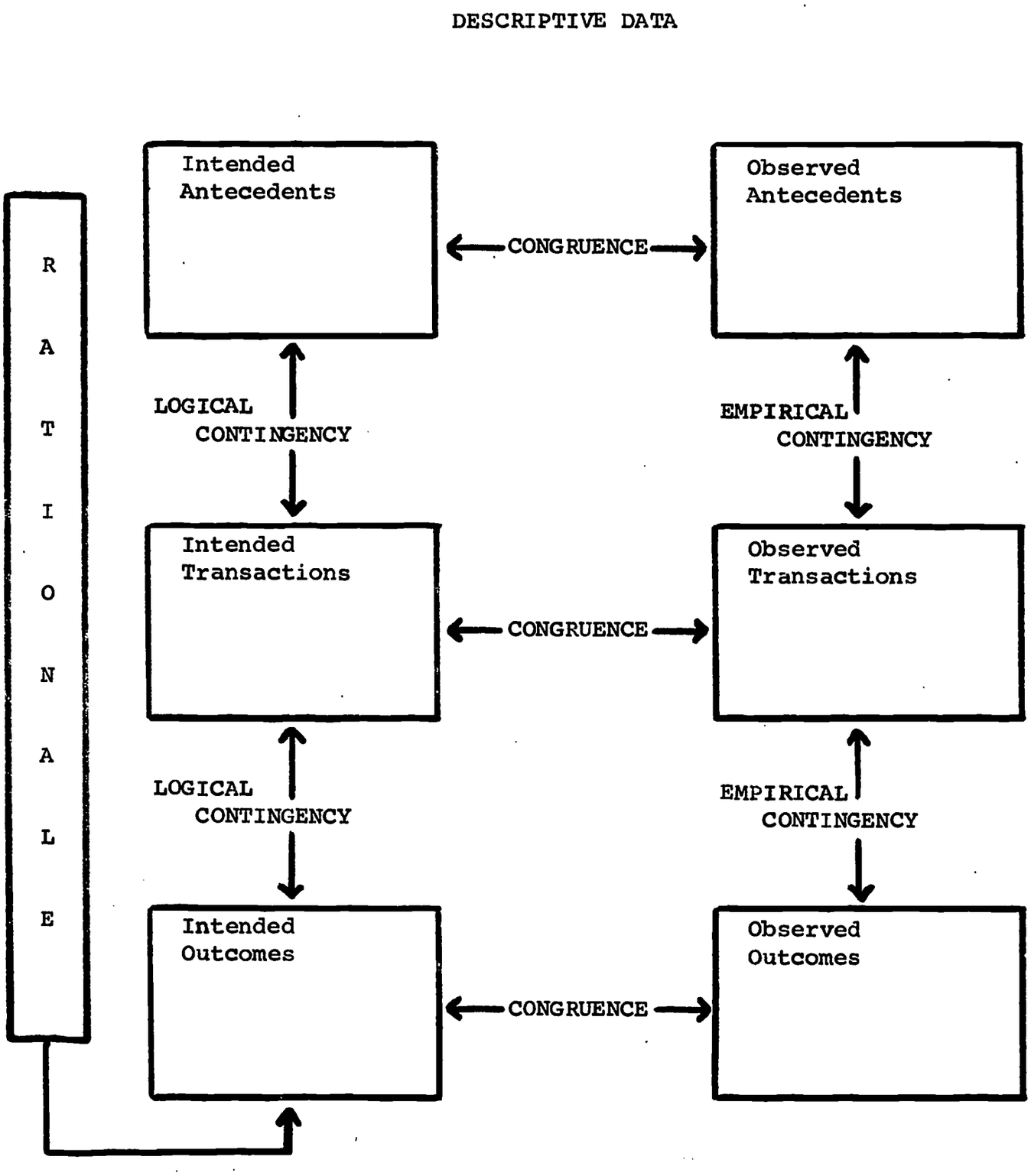
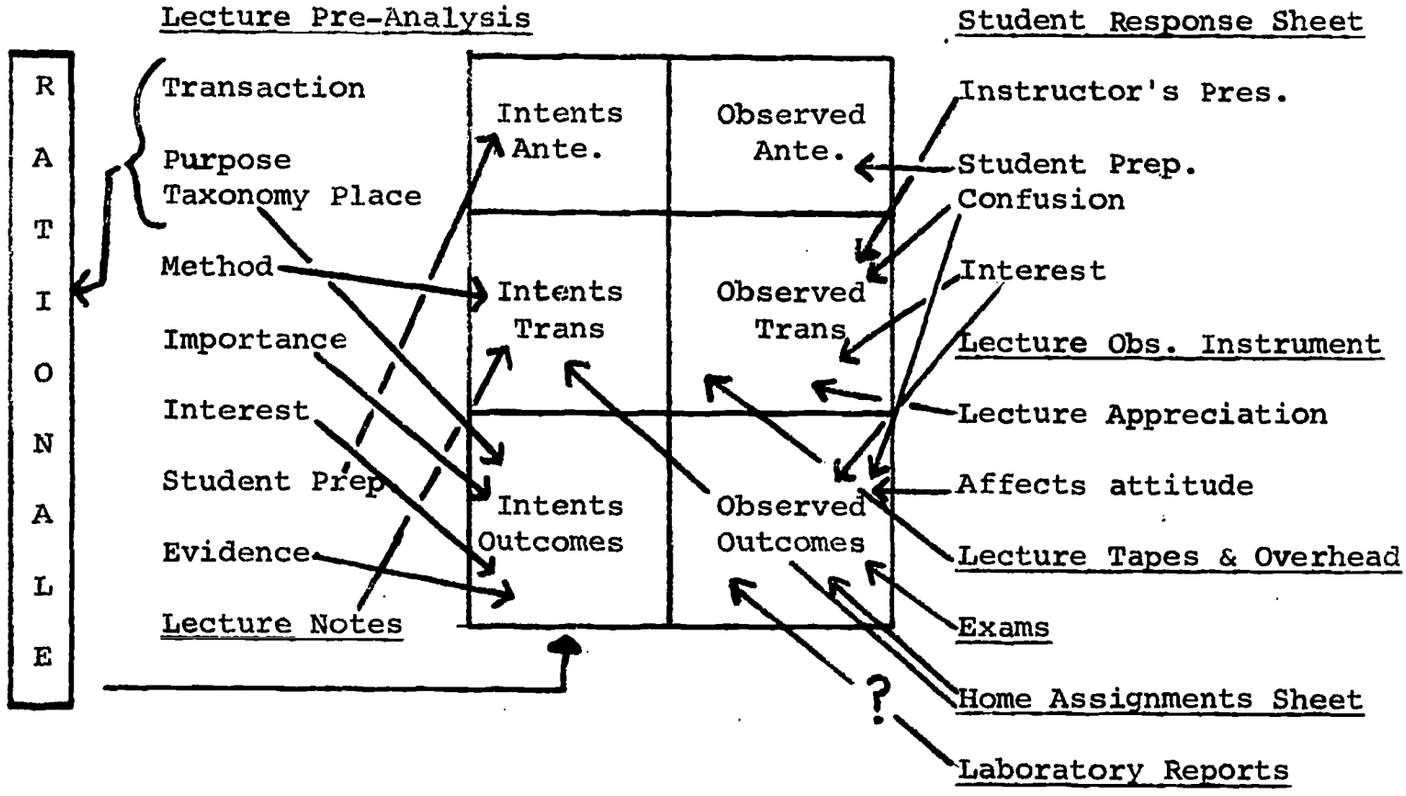


FIGURE 2. Instruments for Evaluating a Lecture Using Stake's Categories for the Miniature Model



Lecture section I Figure 3 Number of sheets for this transaction 1 of 2

Lecture date DEC 3 Lecture Pre-Analysis

TRANSACTION: FORCE ON INDUCED DIPOLE, INHOMOG. FIELD

PURPOSE: RELATE EVERYDAY'S EXPERIENCE TO PHYSICS

APPROPRIATE TAXONOMY POSITION: 2.00 COGNITIVE, 4.1 AFFECTIVE
(Cognitive domain, or if applicable Affective domain)

METHOD OF PRESENTATION: (please circle appropriate method(s))

(Lecture)
Film
(Slides)
(Demonstration:
Token demonstration
Other (specify)

IMPORTANCE: For each group of students how important is this purpose of this transaction? Please use a five point scale with 5= very important, and 1 = unimportant, Use a questionmark (?) for not sure.

		all	1st	2nd	up pass	low pass
Cognitive	for "scientific literacy"	4				
	for reinforcing a concept					
	for technical purpose in course					
	for technical purpose in lecture					
Attitude	for physics in general	4				
	for this course					
	for this lecture	4				

EXPECTED STUDENT INTEREST: (please circle the appropriate level for each)

Students		low					high
	1st class	1	2	(3)	4	5	
	2nd class	1	2	3	(4)	5	
	Upper Pass	1	2	(3)	4	5	
	Lower pass	1	(2)	3	4	5	
	Probable fail	(1)	2	3	4	5	

EXPECTED STUDENT PREPARATION:
Previous lecture(s): DEC 2nd
(please indicate date)
Text material: CHAPTER 7-3
Lab. Experience: /
Other (specify): EVERYDAY'S EXPERIENCE WITH, e.g. COMBS

EVIDENCE OF STUDENT UNDERSTANDING WILL BE OBTAINED: (circle appropriate)

(Do not know)
Not at all
Attitude test
Lab. reports
Home assign.
1st midterm
2nd midterm
Christmas exam
Final exam
Other (specify)

11/69

Date of Lecture Jan. 6 (Mo./Day)

Lecture Section 1

Figure 4

LECTURE RESPONSE QUESTIONAIRE

INSTRUCTORS PRESENTATION	Degree of Satisfaction 1 low	2	3	4	5 high	No Opinion
Informed class ahead of time about material to be discussed in class.						✓
Discussed the intended material.						✓
Presented the material in a well organized way.					✓	
Made transitions between topics clearly discernible.					✓	
Answered questions (If none, please check No Opinion).						✓
Lecture material presented at an even pace.				✓		
Spoke clearly and precisely.				✓		
Emphasized key ideas.				✓		
Clarified unfamiliar terms.				✓		
Started with familiar material and built on previous knowledge.	✓					
STUDENT PREPARATION						
My physics background for this lecture.		✓				
My mathematical background for this lecture.						✓
Preparation suggested by the lecturer for this lecture.						✓
My preparation for this lecture.	✓					✓

PLEASE NOTE, TWO MORE RESPONSES ARE REQUESTED ON THE BACK OF THIS SHEET.

Did you feel lost on any part of the lecture?	YES ☑ NO ☐					
If so, please state the part(s) of the lecture that you could not understand. Indicate the degree of confusion in the appropriate space on the right for each part.	Degree of Confusion					
	low 1	2	3	4	high 5	
Part: Wheatstone Bridge.				✓		
Part: Electricity					✓	
Part:						
Part:						

Did you find any part of the lecture interesting or boring?	YES ☑ NO ☐					
If so, please state the part(s) of the lecture and indicate the degree of interest in the appropriate space on the right for each part.	Degree of Interest					
	very boring 1	2	3	4	very inter-esting 5	
Part: Lecture generally						
Part: but it was		✓				
Part: necessary.						
Part: Will help later.						

PLEASE MAKE ANY ADDITIONAL COMMENTS IN THE SPACE BELOW. THANK YOU.

OBSERVATION SHEET

FIGURE 5

Date 1 (mo) 6 (da) 70 (yr) Lecture P110/1 Time 8:30 Observer Bashook Lecturer Westphal Page

Number late 44 Weather, etc. COLD, CALM, OVERCAST-SLIGHTY DARK OUT Comments 1ST DAY RETURNING FROM CHRISTMAS HOLIDAYS. Initials PB

11/69 p.b.

Time 10:	Lower Section: Interest → Receiving 0.1	0.2	1.1	1.2	1.3	Responding 2.1	2.2	2.1	Upper Section: Interest → Receiving 0.1	0.2	1.1	1.2	1.3	Responding 2.1	2.2	2.3	Comments and Observed Transactions
1	✓								✓								Lecturer enters
2		✓								✓							BELL
3				✓								✓					START LECTURE
4				✓								✓					
5				✓								✓					
6					✓								✓				MIDCOURSE CORRECTION
7				✓								✓					LABS SCHEDULE
8				✓								✓					
9				✓								✓					
10				✓								✓					
11				✓								✓					
12					✓							✓					
13					✓								✓				
14				✓								✓					
15						✓								✓			TELLS THEM TO TAKE NOTES
16		✓								✓							
16		✓								✓							
17				✓								✓					
					✓							✓					
					✓								✓				