Coding Teachers in Inquiry Science Classrooms Using the Inquiry Science Observation Guide

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This paper describes the development and testing of observation procedures for a project awarded to the University of Hawai‘i at Mānoa through the National Science Foundation, studying the scaling-up of the Foundational Approaches in Science Teaching (FAST) science curriculum through professional development institutes. The project is the first phase of a planned seven-year study that is comparing the implementation, student outcomes, and scaling up of two versions of middle-school inquiry-science professional development institutes (Brandon, 2005). In the current two-year phase, an observation instrument has been developed and tested in a small pilot study (*n*=19). The observation procedures described here will be the primary means of measuring teachers' implementation of inquiry strategies in the second phase of the project. Although observations are costly, this method provides a firsthand record of teacher behaviors with little potential for self-reporting bias and great potential for recording the breadth and depth of classroom instruction over time.

The Inquiry Science Observation Guide (ISOG) (Taum, Brandon, & Lee, 2005) was developed for the purpose of conducting observations of teachers in middle school science classrooms. The ISOG was designed as a tool to assist those who are coding and videotaping science classrooms and to ensure that both processes are standardized across videographers and coders. The ISOG is divided into two sections: Part 1 includes coding instructions and Part 2 explains videotaping procedures. Part 1 provides: (a) an overview of the FAST program, the National Science Foundation Scaling-up Project, and the purpose and development process in designing the guide (pp. 1); (b) the Inquiry Science Observation Code Sheet (ISOCS) (pp. 10); (c) the Inquiry Science Observation Recording Sheet (ISORS) (pp. 11); (d) the Inquiry Science Observation Reconciling Recording Sheet (ISORRS) (pp. 12); and (e) a list of coding definitions (pp. 14). The guide also contains general coding guidelines, which include detailed definitions for the broader and other activities as listed in the ISOCS. Part 2 explains the videotaping procedures, describes the videotape-to-DVD transfer process, and presents audio and video quality-check criteria for determining which DVDs should be coded. This paper focuses on Part 1 only, the coding process.

The ISOCS coding schema originated from multiple sources including the FAST student book, the FAST teachers' guide, researchers, FAST teachers, and the FAST program designers. From these sources, aspects of FAST deemed critical for program success were identified. The coding instruments (i.e. ISOCS and ISORS) are intended to focus observations on the teacher while recording the varying degrees to which a teacher is implementing inquiry strategies during one of the lesson phases. The videotaped investigations that are coded are the same across all teachers (e.g. FAST Physical Science Investigation 4 (PS4); PS7; PS9). Although student activities are important to examine in studying science inquiry, the intent of this study is to examine the extent to which FAST-trained teachers implement inquiry-based science in their middle-school classrooms.

The ISOCS was designed to record teacher behaviors that occur during the three typical phases of an inquiry-science student investigation. These phases include an introduction, or review phase, in which the teacher either reviews a lesson or topic that was already covered or introduces a new lesson; an investigation phase, in which students are engaged in small groups in a lab experiment; and an interpretation phase, in which students as a class discuss and analyze their data. Observed teacher behaviors include: (a) teachers' use of questioning strategies, (b) teachers' responses to student questions and statements, (c) teachers' pedagogical practices, (d) teachers' mobility throughout classroom while managing students or engaging in discussions with them, and (e) the extent to which the teacher makes new information relevant to students' previous experiences.

The ISOCS is a *closed observation system*—that is, it has "a finite number of preset categories or units of observation" (Evertson & Green, 1986). There are six "broad activities" and 68 "activity details" in the ISOCS for a coder to observe and record a single "activity string." This type of closed system, using a *checklist sign system,* enables an observer to record a specific teacher behavior (Galton, 1988) and ultimately to create an overall profile of teachers' implementation of FAST using science inquiry practices.

Early drafts of the instrument included 26activities, each comprised of an extensive list of definitions defining the activity. These initial activities were compiled by a FAST teacher and project researcher, with subsequent revisions resulting from collaboration between the curriculum designers, researchers, and coders. The instrument has since gone through more than 30 revisions, refining it to its present form. Throughout the revision process, two coders tested the instrument by observing videotaped FAST lessons and reporting to the project team inconsistencies, misconceptions, and confusion either between the pair of coders or within the instrument.

The six *broad activities* and 68 *activity details* are intended to describe the behavior of a FAST instructor. The broad activities capture the larger activity in which the teacher is engaged, whereas the activity details include words or phrases that serve as descriptors to be inserted into a fill-in-the-blank format describing the broad activity. The completed activity is called an *activity string*, which includes a sequence of A, B, and C activity detail codings. For example, in Activity 2, "Through ___A___ instruction, the teacher ___B___ science ___C___ " (See Figure 1). The A, B, and C activity details might include "direct instruction" (code 2A1), "introduces or provides

SAMPLE of **Inquiry Science Observation Code Sheet (ISOCS)**

Activity	Activity details			Activity descriptors
1 - 6	A	B	C	D
1. Teacher directs student (s) ______A______ to ______B______ relating to ______C______.	1A1. individually 1A2. in a small group	1B1. record 1B2. discuss 1B3. define ***1B4. read materials to whole class***	1C1. observations 1C2. predictions/hypotheses 1C3. procedures 1C4. data 1C5. science (concept, vocab words, mechanics of science, etc…)	1D1. with evidence or examples 1D2. does not apply
2. Through ______A______, the teacher ______B______ science ______C______.	2A1. direct instruction **questioning:** 2A2a. rhetorical 2A2b. interactive	2B1. introduces or provides an overview of 2B2. reviews/summarizes 2B3. demonstrates 2B4. collects 2B5. compares/contrasts 2B6. clarifies	2C1. concepts(idea) 2C2. procedures(activity) 2C3. tools/equipment 2C4. investigation (science experiment) 2C5. problem 2C6. goal ***2C7. -related safety issues*** **2C8 data (unknown):** 2C8a. differences in 2C8b. relationships between 2C8c. quality of 2C8d. analysis of 2C8e. synthesis of 2C8f. evaluation of 2C9. vocabulary words	2D1. new information 2D2. previously learned information 2D3. investigation 2D4. unit 2D5. does not apply

Figure 1: ISOCS

an overview of" (code 2B1), "procedures" (code 2C2). The resulting activity string would read, "Through <u>direct instruction</u>, the teacher <u>introduces or provides an overview of</u> science <u>procedures</u>."

Once the ISOCS was deemed to be reasonably user-friendly, the ISOG was drafted and a coder training session was designed. The guide was developed through collaboration between a researcher and one of the two initial coders, with assistance by two additional coders. A total of seven coders were hired and participated in a 5-day face-to-face, 16-hour training session and eight DVD home-viewing hours. The entire training process extended over a six-week period, which included viewing and coding three teachers during each of the three lesson phases, for a total of nine observed classroom periods. Throughout the training process, videotaped observations of teacher behaviors were first coded individually and then discussed within the larger coder group. A researcher and/or her assistant facilitated the discussions, in which the goal was to reconcile final codings between coders for each teacher.

The coding process involves three general steps: (a) viewing the DVD, (b) coding observed teacher behaviors, and (c) reconciling differences between pairs of coders. In the first step the coder previews the entire lesson to establish a broad sense of how it unfolds. The second step involves a coder carefully recording any observable activities that can be captured using the ISOCS (See Figure 2 for the ISORS). The final step, the most time-consuming, requires that individual coders identify and discuss any differences in codings until consensus is reached. Reconciliation between coders is arguably the most demanding aspect of the entire coding process. It is during this time that pairs of coders must rectify any differences in codings between them. The reconciliation process often requires a concurrent review of the DVD, with references to the exact time and code discrepancies. A third coder "expert" is available to assist if there are unresolvable coding differences. The entire process, from beginning to end, takes approximately four to six hours per coder for each lesson.

The seven individuals hired to code teacher videotape recordings included four who had teaching experience, another with a curriculum design background, a mechanical engineer, and a film festival project manager. As one would anticipate, a teaching background does affect coding. For example, the teaching-background group initially struggled with the notion of ignoring the students and focusing primarily on the teachers while viewing DVDs, despite repeated assurances that the student outcome measurements would be evaluated elsewhere in the research project(but not using the ISOCS), whereas the non-educator-background group appreciated the simplified instructions to observe only the teachers and not the students.

Inquiry Science Observation Recording Sheet (ISORS)

Teacher no. _____
Investigation no. _____
Introduction ____ Investigation ____ Interpretation ____ (check one)
Date investigation videotape recorded ____________________

Date viewed_________________
Viewer ____________________
Viewer team/coder i.d. ____/____

Sample

Time	Broader Activity	Other activities occurring within the Broader Activity	Comments
3:00	2A2b; 2B1; 2C4; 2D5		
6:00		2A1; 2B1; 2C5; 2D3	
8:35		2A2b; 2B2; 2C1; 2D2	
12:14		3A1; 3B1; 3C2; 3C6; 3B1; 3C1; 3D1	

Time	Broader Activity	Other activities occurring within the Broader Activity	Comments

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Figure 2: ISORS

Throughout the training process, coders were encouraged to provide feedback regarding the utility of the code sheet, which prompted fine-tuning of both the ISOCS and ISORS, in addition to the ISOG. Most of the revisions have been minor, such as redefining a word or phrase to ensure a "universal" definition among coders. Redundancies across activities, discrepancies between other activities, and unclear definitions were identified within the larger group of coders once they began familiarizing themselves with the coding sheet. Because the instrument is currently being tested during this pilot phase, undoubtedly there will be further revisions to the instruments and the guidelines.

The behaviors videotaped and coded using the ISOG address some validity characteristics suggested by Evertson & Green (1986). For example, the characteristics measure only those behaviors that teachers are expected to have learned in the FAST professional development training and therefore are likely to be observed in the classroom. Also, the terms used in the ISOG relating to FAST or inquiry science are “consistent with their use in the theory which they represent” (p. 8) and are mutually exclusive. For example, terms embedded within the questioning strategies described in the ISOCS are consistent with the FAST theory. Lastly, the broad activities and activity details are minutely articulated in the ISOG to avoid classification error.

As of the date of preparation of this paper, coders were beginning to code the investigations which have been recorded for 19 FAST teacher participants. Once all videotapes have been coded and analyzed, the extent to which teachers’ use of inquiry methods has been implemented in the classroom will be examined.

References

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