TAMI-OP
Toolkit for Assessing Mathematics Instruction – Observation Protocol

Charles N. Hayward[1], Sandra L. Laursen[1], and Timothy Weston[2]

[1]Ethnography & Evaluation Research, [2]ATLAS Institute
University of Colorado Boulder

August, 2017
This version: September 27, 2018

What is TAMI?

TAMI, Toolkit for Assessing Mathematics Instruction, is a suite of tools designed by Charles Hayward, Sandra Laursen, and Timothy Weston at the University of Colorado Boulder. TAMI is for researchers, evaluators, or anybody else who may be interested in characterizing and measuring instructional practices in college mathematics courses. Currently, TAMI includes an observation protocol (TAMI-OP) and instructor survey (TAMI-IS). Work is underway to expand it to include other tools as well. This document explains the observation protocol in detail and answers some common questions about it. The instructor survey is not yet available to researchers.

The TAMI Observation Protocol (TAMI-OP) should be cited as:

Hayward, Charles N., Laursen, Sandra L., & Weston, Timothy J. (2017). *TAMI-OP: Toolkit for Assessing Mathematics Instruction – Observation Protocol*. Boulder, CO: Ethnography & Evaluation Research, University of Colorado Boulder.

How is TAMI-OP different from existing observation protocols?

Every protocol is designed for a specific purpose. Some are designed just to describe what is happening in a class, while others aim to evaluate the quality of instruction. Some are granular and measure repeatedly in short intervals, while others are based on holistic ratings of the entire class period. The main purpose of TAMI-OP is to describe what practices are being used in mathematics classrooms in 2-minute intervals throughout the class, and not to consider the effectiveness of these practices or the expertise with which they are implemented. However, it also includes some evaluative items, some holistic items, and space for qualitative descriptions.

In each two-minute interval throughout class, both student and instructor behaviors are recorded. Additionally, frequency and types of student and instructor questioning are also coded. TAMI-OP also incorporates the ICAP framework (Chi & Wylie, 2014) as an evaluative component for the effectiveness of those practices. TAMI-OP is adaptable – it allows users to add one custom code of their choosing, which can be used to focus on a specific target activity. For example, users could adapt this feature to measure when instructors provide sufficient wait time after a question, use Think/Pair/Share activities, or employ a participation strategy such as calling on a randomized student. There is also a space to take notes, which can be used to record additional detail not captured in the coding choices. At the conclusion of the interval-based classroom observation, TAMI-OP also includes some holistic end-of-class rating items.

While this may sound like a lot for an observer to accomplish, TAMI-OP is quite easy to use for real-time coding, either in-person or through video recordings. Training can be accomplished in a few hours, and sufficient inter-rater reliability can usually be achieved in just a handful of practice sessions. Conducting a classroom observation takes only a minute or two longer than the actual class session.

Where did TAMI-OP come from?

TAMI-Observation Protocol draws heavily on some existing descriptive, segmented protocols but was adapted specifically for use in college mathematics classes. TDOP: Teaching Dimensions Observation Protocol (Hora, Oleson, & Ferrare, 2013) is the intellectual 'grandparent' of TAMI-OP. It captures various dimensions of what is happening during a class, measured in 2-minute intervals. Smith, Jones, Gilbert, and Wieman (2013) shortened and modified the TDOP to produce a similar observation protocol specifically for use in undergraduate STEM courses. Their instrument is called the COPUS: Classroom Observation Protocol for Undergraduate STEM. We attempted to use the COPUS in college mathematics classes but found that mathematics instructors' practices did not quite align with the COPUS codes, perhaps because these codes were developed for science courses. We adapted the COPUS to better capture the practices we were seeing in college mathematics courses and tested our items through multiple rounds of interviews and observations with college mathematics instructors. Our work was funded by a grant from the National Science Foundation (*DUE 1245436: Development of a Validated Self-Report Instrument for Measuring the Classroom Impact of Student-Centered Professional Development for College Instructors)*

The main portion of TAMI-OP is descriptive – it simply describes what instructor and student behaviors are present in each two-minute interval and does not evaluate their quality. This was by design, because we were interested in measuring instructors' efforts to incorporate particular instructional practices rather than their skill in doing so. Moreover, evaluative protocols often require extensive training over multiple days (e.g. RTOP; Sawada, et al., 2002). We added the ICAP framework (Chi & Wylie, 2014), a simple categorization of students' cognitive engagement, to TAMI-OP so that we could include an evaluative component that does not require extensive training. Additionally, at the end of the class, TAMI-OP contains 16 holistic, evaluative questions to rate the overall quality of the class. Again, these are simple evaluative measures that do not involve complicated rubrics or extensive training. We developed and used these items in an earlier study (Laursen, Hassi, Kogan, Hunter, & Weston, 2011).

How does the TAMI-OP electronic protocol work?

The TAMI-OP electronic protocol is an Excel-based coding protocol. It relies heavily on the use of macros to accomplish helpful features. It requires a fully featured version of Excel running on a regular computer. Functionality may be limited on tablet-type PCs, like the Microsoft SurfacePro. It will not run on tablets or computers unable to run Excel (iPads and Chromebooks, for example.) Questions about the electronic protocol should be directed to chuck.hayward@colorado.edu

The Excel-based design overcomes problems of both paper and web-based protocols:

- It is a stand-alone Excel file that doesn't require internet access or any registration.
- There is a built-in timer. Macros visually help to align the coder with the current time interval, but do not force the coder to advance at the end of the two minutes. Coders are free to continue coding or may go back and edit information for a previous interval if needed. There is no loss of data this way or need to edit the data at the end of the session.
- Files are stored locally and automatically using unique identifying information from the observation (course, time, and coder). So, even with multiple coders, the files will not be accidentally overwritten.
- Programming is written to be responsive to adjustments. For example, if the class runs longer than anticipated, the coder can continue coding - up to a maximum of 190 minutes. The length of class will automatically be adjusted to the completed time on the timer.
- The timer can be started with any time on it for observations that start after class begins.
- Automatic recoding: filled cells are converted to '1' whereas blank cells are converted to '0' in the DatabaseTransfer sheet to prepare for data analysis. Any character in the cell is coded as a 1 so coders are free to code with any value, and double-keyed typos do not result in errors.
- Additional options for coders, sites, etc, can easily be added for various contexts.
- Filled cells are colored blue to help visually interpret the flow of the class.
- It can easily be customized and creates new templates with one extra code for a target behavior or by creating pre-filled cells. These may be helpful in repeated observations of the same course.

What does TAMI-OP measure?

Activities are coded if they are present in each two-minute interval, so the code may indicate the activity happened throughout the full interval or for only a portion of it. Thus, within any given time interval, there may be two seemingly independent codes if activities switch within the 2-minute interval. For example, a sheet like the one below might result if the instructor started class with some quick announcements ("Adm – administrative"), then spent the first 10-11 minutes of class lecturing ("Lec") while writing on the board ("RtW" – real time writing). During this time, the instructor asked 2 informational questions ("QIn"), which students answered ("AnIn"), possibly by just providing answers to calculations. After this lecture, the instructor had students work on a problem individually ("Ind"). Students spent about 2-3 minutes working individually, and then the instructor reviewed the problem ("Rvw") for a couple of minutes before resuming lecturing. During the review, the instructor answered ("AnQ") one student question ("Q"). Looking at coding patterns over time helps to reveal the flow of the class and general trends in how class time is spent.

	1. Students doing														2. instructor doing													
Start minute	SP	GP	RtW	WG	OG	Ind	Q	AnIn	AnRs	WC	C/V	T/Q	W	O	Rvw	Lec	RtW	MG	1o1	QMd	QIn	QRs	AnQ	Adm	W	O	TA	Bth
0																x	x							x				
2																x	x											
4								2								x	x				2							
6																x	x											
8																x	x											
10						x										x	x											
12						x	1								x								1					
14															x	x	x											

The cells shaded in light green indicate the number of different types of questions & answers exchanged between instructor and students. Q&A are only marked during times of full-class activity. During activities like groupwork, the noise makes it too difficult to reliably code numbers or types of questions and answers occurring across multiple groups. In general, if instructors engage in question and answers with students during group or individual activities, it is coded as "MG" for moving and guiding.

TAMI-OP Code Definitions

1. Students are doing	
SP	Student presenting solution or proof to the class (code until student sits down) • *Continue to code until the student sits down or is no longer "on" (for example, continue coding if students are asking questions to the presenter even if the presentation part has ended.)*
GP	Group presenting solution or proof to the class (code until students sit down) • *Continue to code until the group sits down or is no longer "on" (for example, continue coding if students are asking questions to the presenters even if the presentation part has ended.)*
RtW	Real-time writing on the board, doc projector, etc. • Code while students are presenting to help indicate if it is prepared or in the moment. <u>Do not</u> code while students do individual work or take notes.
WG	Working in groups on structured group work (worksheet, whiteboards, etc.) – activities that were part of instructor's lesson plan
OG	Other group activity (such as a Think/Pair/Share) – activities that are designed in the moment to respond to student difficulties or needs that become apparent during class
Ind	Individual thinking/problem solving. • Mark when instructor explicitly asks students to think about question/problem on own. • Can also be used if instructor gives no explicit directions but the norm or assumption seems to be that students work individually.
Q	Student asks question (use tick marks in box to count the number of questions) • Code when a student asks a question to an instructor or student presenter.
AnIn	Student answers question/makes comment by providing specific information (usually a short answer) • Code when students answer questions from instructors or another student by providing information (commonly a computational result or reciting something they have previously learned.)
AnRs	Student answers question/makes comment by providing reasoning or justification • Code when students provide a reasoning why or how to do something, or explain their thinking. • <u>Do not</u> code justifications that are just recitations of procedures, e.g. Instructor asks "How do we find this?" and student responds "Factor". Those can be coded as AnIn instead.
WC	Engaged in whole class discussion by offering explanations, opinions, judgment, etc. to whole class (often facilitated by instructor) • Code when students respond to each others' comments or questions. Can be moderated *through* the instructor, but students should be responding to each others' ideas, not just back and forth with instructor.
C/V	Students interacting with computers/simulations (code student interaction, even if instructor is operating the computer) • Can code for students *using* manipulatives to help understand mathematical concepts. <u>Do not</u> code if the students are just watching the instructor model them.
T/Q	Taking a test or quiz
W	Waiting (instructor late, working on fixing AV problems, instructor occupied, etc.) • Code when students could be doing something mathematical, but are not.
O	Other • Code for unique situations that don't fit other categories.

2. Instructor is doing

Rvw Instructor reviewing students thinking or student contributions (presentations, homework, test, in-class, etc.)
- Code only when reviewing student contributions or student thinking. Do not code if instructors are just reviewing a topic they've already covered without attending to student work.

Lec Lecturing (presenting content, deriving mathematical results, presenting a problem solution, etc.)
- Code when instructor is presenting mathematical content to the entire class.

RtW Real-time writing on the board, doc projector, etc. (often checked off along with Lec)
- Code while lecturing/reviewing to help indicate if it is prepared materials (slides) or in the moment.

MG Moving through class guiding on-going student work during active learning tasks
- Code when instructor is interacting with students during active learning by answering or asking questions, providing help, etc.

1o1 1-on-1 extended discussion with one/few individuals, not paying attention to rest of the class
- Can be coded along with MG or AnQ.

QMd Questions intended to moderate or invite student participation (may also be done in the form of a comment)
- Code for things such as instructor asking a student to present, checking for understanding, asking students if they want to see another example, etc. Non-content related questions.

QIn Question requesting information (looking for a specific answer)
- Only code when instructor waits for or expects an answer from students. Do not code hypothetical questions instructor asks him or herself as a teaching strategy.

QRs Question requesting reasoning (looking to understand why)
- Only code when instructor waits for or expects an answer from students. Do not code hypothetical questions instructor asks him or herself as a teaching strategy, for example, "Why would we want to find this?" immediately followed by instructor answering the question.

AnQ Listening to and answering student questions with entire class listening

Adm Administration (assign homework, return tests, general announcements about deadlines or grading, etc.)

W Waiting when there is an opportunity for an instructor to be interacting with or observing/listening to student or group activities and the instructor is not doing so
- Do not code during tests or quizzes.

O Other
- Code in unique situations (such as instructor leaving the room to get materials, working on grading while students are busy)

TA Teaching Assistant is doing the activity marked in "Instructor doing" portion of time slot

Bth Both instructor and Teaching Assistant are doing the activity in "Instructor doing" portion of time slot

3. ICAP Framework from Chi & Wylie (2014)

Examples of Learning Activities by Mode of Engagement

	PASSIVE *Receiving*	ACTIVE *Manipulating*	CONSTRUCTIVE *Generating*	INTERACTIVE *Dialoguing*
LISTENING to a lecture	Listening without doing anything else but oriented toward instruction	Repeating or rehearsing; Copying solution steps; Taking verbatim notes	Reflecting out-loud; Drawing concept maps; Asking questions	Defending and arguing a position in dyads or small group
READING a text	Reading entire text passages silently/aloud without doing anything else	Underlining or highlighting; Summarizing by copy-and-delete	Self-explaining; Integrating across texts; Taking notes in one's own words	Asking and answering comprehension questions with a partner
OBSERVING a video	Watching the video without doing anything else	Manipulating the tape by pausing, playing, fast-forward, rewind	Explaining concepts in the video; Comparing and contrasting to prior knowledge or other materials	Debating with a peer about the justifications; Discussing similarities & differences

Works Cited

Chi, M. T., & Wylie, R. (2014). The ICAP framework: Linking cognitive engagement to active learning outcomes. *Educational Psychologist , 49* (4), 219-243.

Hora, M. T., Oleson, A., & Ferrare, J. J. (2013). *Teaching Dimensions Observation Protocol (TDOP) user's manual.* Madison, WI: Wisconsin Center for Education Research.

Laursen, S. L., Hassi, M.-L., Kogan, M., Hunter, A.-B., & Weston, T. (2011). *Evaluation of the IBL Mathematics Project: Student and instructor outcomes of Inquiry-Based Learning in college mathematics.* (Report to the Educational Advancement Foundation and the IBL Mathematics Centers. Boulder, CO: Unversity of Colorado Boulder, Ethnography & Evaluation Research, Assessment & Evaluation Center for Inquiry-Based Learning in Mathematics.

Sawada, D., Piburn, M. D., Judson, E., Turley, J., Falconer, K., Benford, R., et al. (2002). Measuring reform practices in science and mathematics classrooms: The Reformed Teaching Observation Protocol. *School Science and Mathematics , 102* (6), 245-253.

Smith, M. K., Jones, F. H., Gilbert, S. L., & Wieman, C. E. (2013). The classroom observation protocol for undergraduate STEM (COPUS): A new instrument to characterize university STEM classroom practices. *CBE- Life Sciences Education , 12* (4), 618-627.