Genetics (BIO 101)

Data from classroom observations and student evaluations using the Instructional Systems-of-Practice (ISOP) framework

REPORT PREPARED FOR:
Dr. Johnson, Department of Biology
University of X
Genetics (BIO 101), Thursday, January 15th, 2015 (10:00 am class session)

SUMMARY:
This report includes two sets of data: (1) Results from an observation of your BIO 101 class, and (2) results from mid-term evaluation surveys from 11 of your students. Several conclusions are drawn from the data and suggestions for future teaching practices are provided.

DATA COLLECTED BY:
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REPORT PRESENTED ON 2/15/15

[NOTE: THIS IS AN ACTUAL REPORT W/IDENTIFYING INFORMATION REMOVED]

Wisconsin Center for Education Research
UNIVERSITY OF WISCONSIN–MADISON

Information about the observed class

Course name: Genetics (BIO 101)

Course details: Upper-division course; ~249 registered students

Observation: Thursday January, 15th, 2015 (10:00 am class session)

Planned activities for 1/25/15 : The plan for the day's class was to review the previous lecture's material to ensure students understood it, and to begin discussing dosage compensations, sex determination, and types of mutations. Since the midterm is the following week, you noted that you'd like to cover these topics in this lecture so the next class could focus on review.

Goals/expectations for students' in-class experience: You noted that you emphasize the logic of memorization, which is told to students numerous times. This is because when students see topics in a new context they need to be able to apply logic/reasoning to these new situations. Memorizing a bunch of facts and formulas will not be sufficient in the long run. So a goal is to really understand the logic of the material, problem-solving and analytical skills.

Section I: Classroom Observation Results

These data were collected during your class on 1/15/15 by an observer trained in the use of the Teaching Dimensions Observation Protocol (TDOP). All data in the table below indicate the proportion of times a particular code was observed relative to all 2-minute intervals within the class period. *It is important to remember that these data do not reflect the quality of instruction or the depth of student learning, but instead capture important features of the learning environment.*

The TDOP was developed at UW-Madison in 2008 to provide robust, fine-grained descriptions of teaching (see Hora & Ferrare, 2013). Thus, the TDOP is a descriptive research tool rather than one that evaluates the quality of teaching, based on two assumptions: (a) the field of educational research needs more structured tools for studying teaching at a fine grain size, and (b) the "quality" of a given class is very difficult to measure and can vary considerably according to raters, situations, and disciplines.

The codes are organized into six categories that capture different aspects of the classroom (teaching methods, student-instructor interactions, instructional technology, student cognitive demand, pedagogical strategies, and student engagement). To shed light on a set of practices known as "active learning" that research in the learning sciences has associated with improved student learning, we also report data that indicate three distinct modes of active learning (in ascending order of efficacy): students being actively engaged, students constructing new ideas/products, and students constructing new ideas/products with one another (see Chi & Wylie, 2014). For more information about the TDOP codes see http://tdop.wceruw.org.

	Code	YOUR DATA	Institutional Peers*	National Dataset**
# of Instructors		1	10	59
# of 2-minute Intervals		32	422	2,514
Teaching Methods				
Lecturing	L	.34	.13	.06
Lecturing w/pre-made visuals	LVIS	.60	.63	.64
Lecturing while writing	LW	.60	.42	.27
Socratic/Interactive lecturea	SOC-L	.00	.01	.03
Working through problems	WP	.00	.19	.08
Small group work	SGW	.06	.07	.11
Desk work	DW	.00	.07	.07
Assessment	A	.00	.02	.11
Multimedia (e.g., Youtube movie)	MM	.04	.03	.03
Pedagogical Moves				
Humor	HUM	.00	.15	.10
Illustration or anecdote	ANEX	.22	.14	.22
Organization	ORG	.00	.03	.10
Emphasis	EMP	.00	.02	.05
Teacher-Student Interactions				
Instructor display question (i.e., seeking new information)	IDQ	.32	.37	.36
Student question	SQ	.34	.25	See below[1]
Student response	SR	.18	.33	.28

	Code	YOUR DATA	Institutional Peers*	National Dataset**
Student peer interactions	PI	.06	.10	.11
Student cognitive demand[2]				
Problem-solving	PS	.06	.10	.15
Creating	CR	.00	.06	.02
Connecting to real-world	CN	.22	.14	.25
Instructional Technology				
Chalkboard	CB	.00	.08	.19
Overhead projector	OP	.60	.20	.08
PowerPoint	PP	.60	.54	.57
Clickers	CL	.16	.05	.10
Demonstrations	D	.00	.00	.02
Digital tablet/Document camera	DT	.00	.19	.10
Websites	WEB	.04	.19	.04
Student Engagement[3]				
Very high (>75% paying attention)	VHI	.46	.50	.63
High (>50% paying attention)	HI	.32	.30	.24
Medium (>25% paying attention)	MED	.16	.14	.07
Low (<25% paying attention)	LO	.00	.02	.01
Code Combinations for "Active Learning" (DOLA framework)				
Being active[4]	SR or PS or PI	See Above	See Above	See Above
Being constructive	SQ or CR	See Above	See Above	See Above
Being interactive	PI & CR	.00	.06	.02

* The dataset of your peers includes instructors from chemistry, two biology departments, physics, and earth sciences.

** The national dataset included in this table is from fieldwork our group conducted in the spring of 2013 at three large, public research universities in the U.S. and Canada. These data include instructors from biology, geology, physics, and mechanical engineering.

1 During the 2013 data collection we used two different codes for student questioning: student novel questions (i.e., seeking new information) which was observed in 4% of all two-minute intervals, and student comprehension questions (i.e., questions asking for clarification) which was observed in 11% of all intervals. We collapsed these codes into a single code for ease of in-class coding.

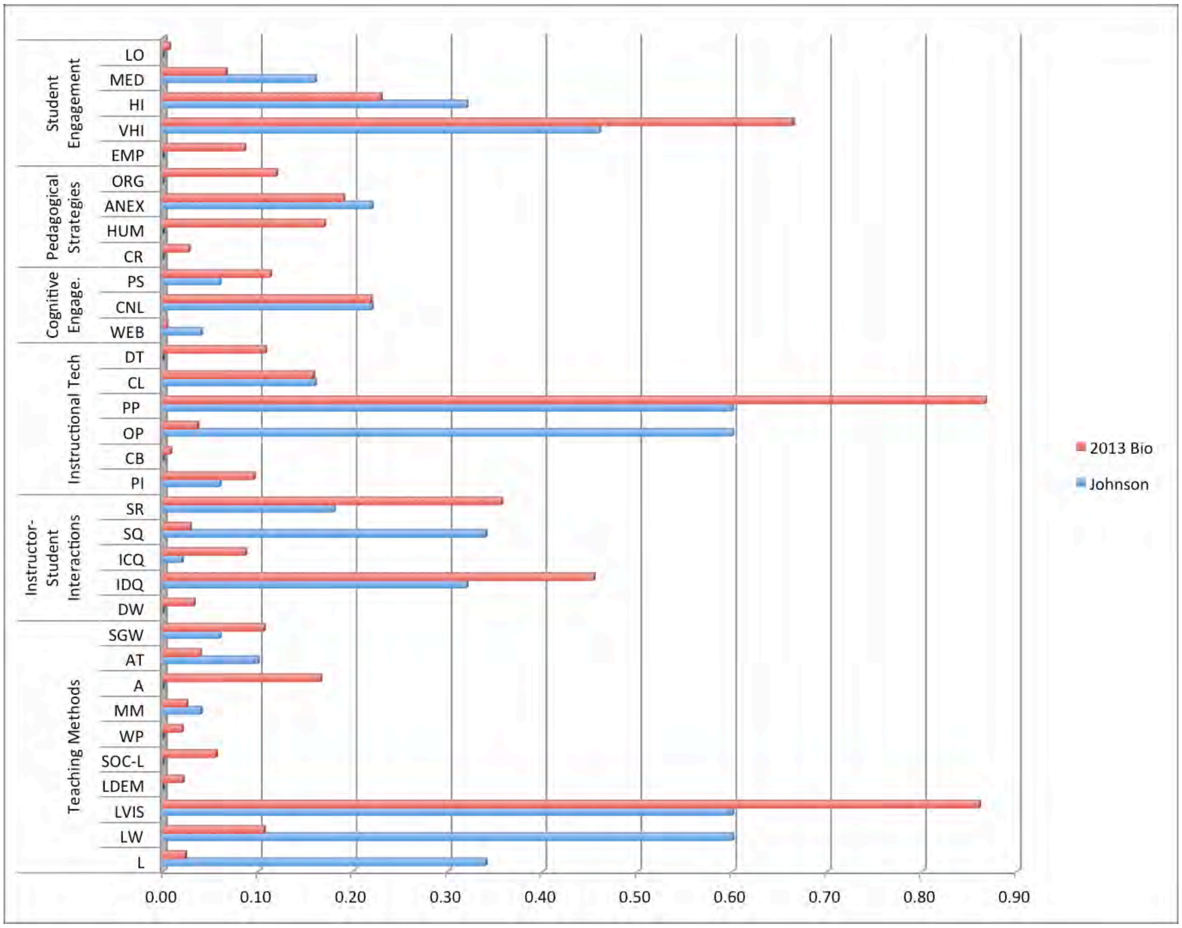
2 Student cognitive demand refers to the possible types of cognitive demands students may be experiencing in the classroom, as inferred by analyst observations of the tasks and activities that instructors ask students to perform.

3 Student engagement refers to the degree to which a selected group (i.e., 8 or 12) of students in the classroom are paying attention to the lesson, as evidenced by their (a) taking notes and/or (b) watching the instructor. As such, this category is a very coarse and selective measure of the degree to which your students are "engaged" in the class.

4 The Differentiated Overt Learning Activities (DOLA) framework was advanced by cognitive scientist Micheline Chi as a way to better understand the possible types of cognitive activity students experience in the classroom (see Chi & Wylie, 2014). In their framework, there are three distinct categories of student cognitive engagement, each of which is successively more effective in facilitating student learning: being active (students are visibly engaged in activities that activate their own knowledge about course content), being constructive (students are visibly engaged in activities where they generate their own knowledge/products), and being interactive (two or more students are visibly engaged in activities where they generate their own knowledge/products). To capture aspects of these categories, we have mapped certain TDOP codes onto the DOLA framework as a way to capture the prevalence of active learning modalities in the classroom.

Classroom Observation Results: Comparing your data to disciplinary peers

On this page your observation data are depicted alongside the data of 18 biologists who our research team studied in the spring of 2013. It is important to note that this group was a self-selected sample from only 3 research universities in the U.S. and Canada and included both upper- and lower-division courses. This comparison may be interesting to you as you can see, in general terms, how your instructional approach compares to a group of disciplinary peers.



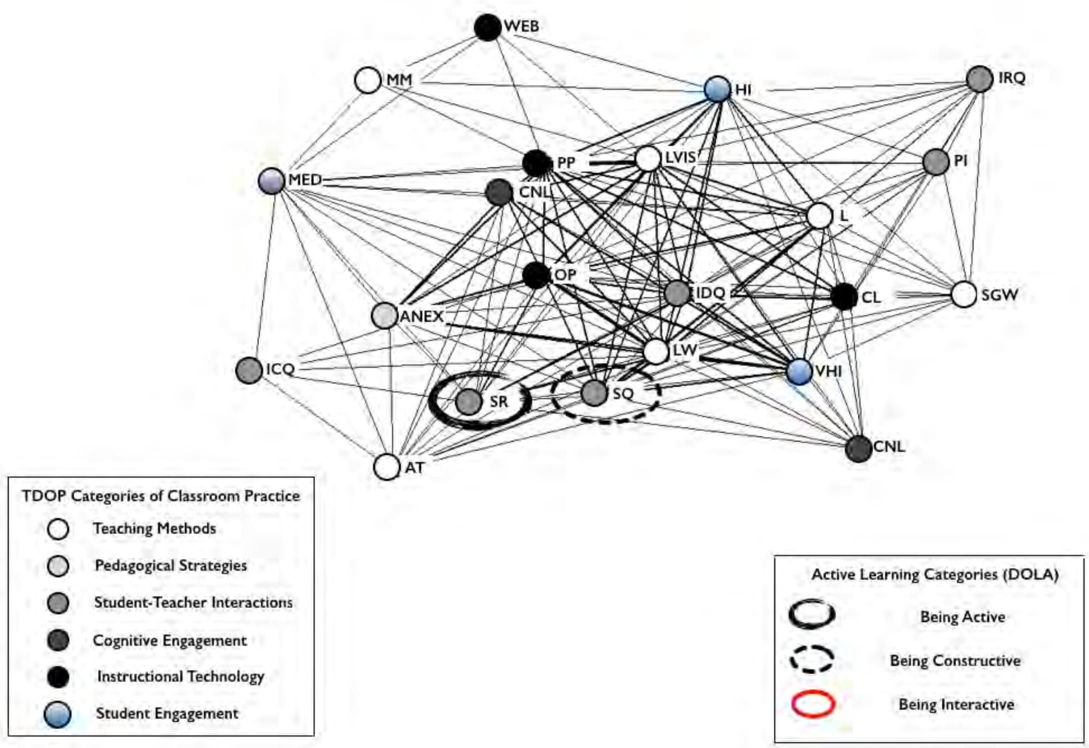
This graphic indicates that your teaching practices are similar in many ways to this group of 18 biologists, including the use of examples and illustrations (ANEX) and the corresponding cognitive demand of making connections (CNL), and the use of clickers (CL).

In other cases, however, your teaching varies from this group in the degree to which Powerpoints (PP) and lecturing with visuals (LVIS) were observed, student questions (SQ), lecturing with writing (LW) and so on.

Classroom Observation Results: Social Network Analysis Graph

This page includes a graph that depicts all of your observation data at once in a social network affiliation graph. The codes that are located towards the center of the graph and that are connected by thicker, darker lines, are those that were observed most frequently. Thus, these clusters of codes represent your primary teaching practices for the observed class.

We report graphs using social network analysis in order to highlight the fact that particular teaching behaviors (e.g., lecturing) do not occur in isolation, but instead are utilized in conjunction with other teaching strategies, student-teacher interactions, and types of instructional technology.



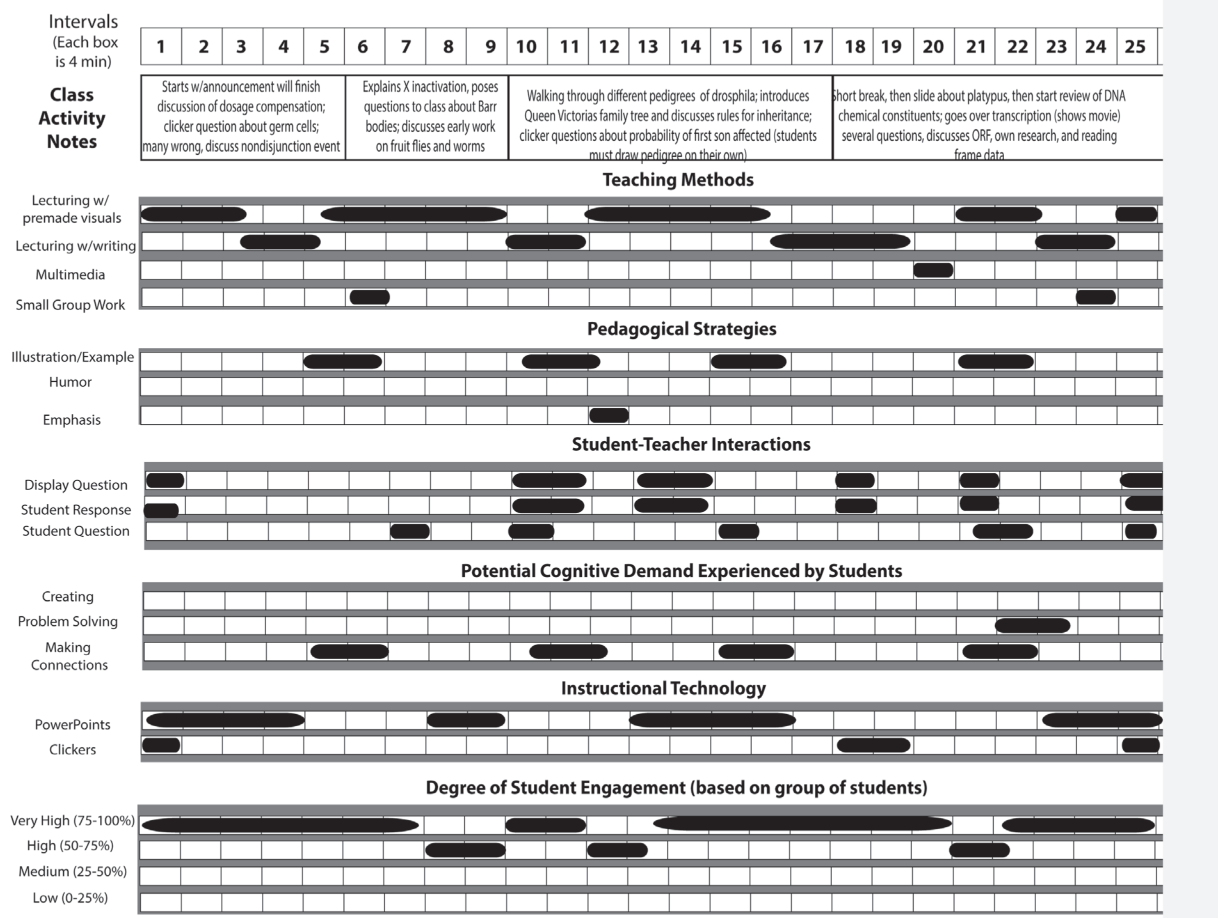
This graph indicates that your primary "teaching repertoire" for this class period was comprised of lecturing with visuals (LVIS) including projected PowerPoint slides (PP/OP) and also writing on them (LW), while also posing questions (IDQ) verbally and with clickers (CL), allowing for student responses (SR), all of which were associated with very high student engagement (VHI). Codes that were still regularly observed but with slightly less frequency include students asking questions (SQ), small group work (SGW) and so on. Codes that are located on the outside of the graph, while still observed with some regularity, can be considered more peripheral to your primary repertoire.

Your teaching also included two indicators of active learning categories: being active (SR) and being constructive (SQ).

Classroom Observation Results: Time series

Here you will see a graph of your data that depicts how your teaching unfolded over time in terms of: (a) specific instructional episodes or topics, (b) actual teaching methods, pedagogical strategies, student-teacher interactions, and cognitive demands used, and (c) student engagement. This graph is intended to provide you with an indication of the degree to which students were paying attention during different portions of your class.

Given space limitations we cannot represent the entirety of what you covered or discussed in the class, and so the notes at the top are meant to remind you about the sequence with which you discussed topics that day. It is also important to note that our measure of student engagement is necessarily limited to those 8-10 students who were seated in the area near our observer.



Engagement is measured by the % of students (in the group of 10) who are visibly paying attention to the instructor and/or task at hand

Your students were very engaged throughout the class period, particularly during clicker questions and when you were actively writing notes on the slides. In terms of students being asked and answering questions, the class period was rather interactive as is evident in the graph.

Section II: Student Survey Results

Next we provide results from the student evaluation surveys that we administered to your students immediately after the observed class. The survey includes questions about (a) what students did in the classroom while you were teaching, (b) what they thought they *should* be doing in class, (c) open-ended questions about what they feel are the most and least helpful aspects of the class so far, and (d) students' study habits.

Unfortunately, there was a very low response rate to the survey. 11 students out of the approximately 249 registered for the course responded, which translates into a 4.4% response rate. As a result, the results are certainly not representative of all of the students in this course. To improve response rates our research team could have offered cash incentives or a raffle, which the literature on survey administration shows will raise response rates on web-based surveys. However, a more feasible and cost-effective approach to get a non-biased, representative sample of these data would be to administer the survey during class (in hard copy form) or as part of a course requirement (in online form).

It is also worth noting the low response rates such as this are being experienced across your institution with the new online end-of-term student evaluation system, for which some faculty report receiving less than 20% responses from their class. This trend of low response rates highlights the importance of securing high-quality formative feedback from students using other means, including in-class questions, office hour visits, and so on.

Responses to questions about student behaviors in class

These items capture what students actually did during your class on 1/15/2015. In addition, we also asked what students think they need to do to succeed in the course. These questions were asked in order to get a sense of similarities and differences between what students actually do in class (as far as they can accurately self-report) and what they perceive to be important in-class behaviors to succeed in the course.

	n=11
	Mean
How would you characterize your experience in BIO 101 on Thursday, January 15th? (1=Very Often, 2=Often, 3=Sometimes, 4=Rarely, 5=Never)	
I paid close attention to the instructor and course material	1.6
I applied course concepts to solve problems	1.7
I was actively attempting to make sense of new ideas	1.4
I tried to understand solutions, concepts, and theories	1.4
I focused on remembering and retaining most of the material	1.7
I demonstrated how a theory or idea could be applied to an actual problem	2.2
I recorded key information from the class (e.g., note-taking)	1
I made connections between course content and my own life and/or the world around me	2.3
I did not pay attention and was engaged in other activities	4.4
To be successful in this course, what do you think you need to be doing during class in BIO 101? (1=Very Often, 2=Often, 3=Sometimes, 4=Rarely, 5=Never)	
I should pay close attention to the instructor and course material	1
I should apply course concepts to solve problems	1.1
I should actively attempt to make sense of new ideas	1
I should try to understand solutions, concepts, and theories	1
I should focus on remembering and retaining most of the material	1
I should demonstrate how a theory or idea could be applied to an actual problem	1.25
I should record key information from the class (e.g., note-taking)	1.1
I should make connections between course content and my own life and/or the world around me	1.5
I should not pay attention and be engaged in other activities	2.5

The most common in-class behaviors students reported include note-taking, trying to understand material, focusing on retaining material, and actively making sense of new ideas. In general terms, these are consistent with our observation of the class, where fewer instances of other experiences listed here (e.g., demonstrating how theories can be applied) were observed.

In terms of what students think they should be doing, it appears that they feel that all of the listed items are important. Thus, the question is: which of these "important" behaviors are students actually engaging in during class? The answer is many of them, with the exception of making connections to their own lives (though this cognitive demand was observed) and demonstrating how theories can be applied in practice.

Responses to open-ended question about **most** useful part of class

Here we provide a selection of open-ended responses that students provided in response to the following question: **"What was the most useful part of BIO 101 on Thursday, January 15 in terms of helping you learn the material."** After this question we also asked students about which aspects of the course in general they found most helpful. Responses to both questions were selected for their detailed and constructive nature.

Resources provides to students for self-directed learning

"Making use of his teaching/research experience to create an outline for students to follow and give those students access to those resources. It leaves us with no excuse not to be able to learn the material if we have someone who is actively trying to help us out."
"The ease of access to materials - outlines, notes, webcases, practice problems are all easily accessible."
"Webcast."

Clicker questions and discussion

"The clicker questions and solutions reviewed (by the instructor)." (1/15/15)

Outlines provided to students

"The outlines in class and the homework aren't too long, but still have most of the topics we need to know." (1/15/15)
"The way he teaches through the outlines."
"Having key points from the PowerPoints in our note outline completed for us. It makes for better use of our time trying to follow the teacher, and trying to process what she is saying and not having to worry if we got every word down." (1/15/15)

Going through examples in class

"When Professor Johnson went through the examples." (1/15/15)

In-class problem solving

"When we do examples and solve problems in class together with the teacher (as he shows how to do it step by step).""In-class worksheets; short and informative homework."
"In-class examples and working through problems."
"In class problems that we try and solve ourselves, and then work out together." (1/15/15)

Instructional style and demeanor

"Dr. Johnson is very specific about what we need to read for the next class." (1/15/15)
"Having a professor who likes to engage with his students."
"The clarity and consistent information being taught by the instructor."

Responses to open-ended question about **least** useful part of class

Here we provide a selection of open-ended responses that students provided in response to the following question: **"Which aspects of the course, if any, are the least helpful in terms of helping you learn the material?"** These responses were selected for the detailed and constructive nature.

Note-taking and speed of class

"When we have to write too many things down and the instructor goes too fast."

"Taking notes - you should be understanding and writing what you think."

Challenging problems

"Sometimes extra credit problems can be too advanced for me to answer with confidence."

Miscellaneous comments

"Nothing"
"None - I love this course and Dr. Johnson"
"N/A"
"None"

Topics that students are currently struggling with (as of 1/15/15)

Chromosomes (2 students) **ORFs (1 student)**

Sex determination and pseudoautosomal region (1 student)

Two genes on one chromosomes that display different phenotypes and pedigrees (1 student)

Responses to questions about student preferences for teaching

These items capture student preferences for teaching. We chose to focus students' attention on an "ideal course" in your discipline, rather than ask for generalized preferences for teaching. Answers to these questions may shed light on the types of instruction that your students are accustomed to, prefer, or even expect.

In the literature a distinction is made between two types of students' approaches to their own learning (and corresponding preferences for teaching): "deep approaches " where students seek to gain an in-depth understanding of the material and its meaning, and "surface approaches" where students seek to memorize and retain material (e.g., Entwistle & Tait, 1990). While we did not ask questions about these approaches, some of the preferences below can be associated with a deep or a surface approach. For example, solving problems in-class, working with classmates, and doing hands-on activities can be thought of as reflective of a deep approach to learning.

In addition to questions about preferences for teaching, we also asked a question about students willingness to raise their hands in class to ask questions. Answers to this question may indicate the willingness of students in this course to take risks and/or ownership of their own learning by ensuring that they understand the material being discussed in class.

	n=11
	Mean
For each of the following things, please indicate how often you would like to do in your ideal biology course (1=Very Often, 2=Often, 3=Sometimes, 4=Rarely, 5=Never)	
Listen to the instructor lecture during class	1
Solve problems with a single correct answer (i.e., closed-ended problems)	1
Answer questions posed by the instructor during class	1.25
Be encouraged by the instructor to ask questions during class	1.1
Solve problems with multiple correct answers	1.5
Work with my classmates on problems and activities	1.4
Do hands-on activities during class	1.4
Please read the following statement about raising your hand in class and asking questions (1=Always, 2=Very Likely, 3=Somewhat Likely, 4=Unlikely, 5=Never)	
If you don't understand something in class, how likely are you to raise your hand and ask the instructor to explain the topic again?	3.5

Students in your course appear to be open to many different types of instruction, but with preferences for lecturing and answering closed-ended questions. While they report being amenable to asking questions during class, they also appear rather unlikely to ask you a question in-class if they did not understand the material.

This response is rather common among undergraduate students, and while preferences for teaching cannot be altered in a short time frame, if you would like students to be more assertive in asking questions in class, one or two announcements to this effect may encourage more students to ask questions (either during or after class) when they truly do not understand the material.

Responses to questions about student study habits

These items capture student study habits, including the total number of hours spent studying for this course on a weekly basis, as well as their use of specific study strategies. Research in cognitive psychology and the learning sciences is accumulating in regards to which strategies are effective for learning.

For example, in an extensive review of the literature, Dunlosky and colleagues (2013) found that the common practices of re-reading text and highlighting text are considered low-utility (little empirical evidence and generalizability across situations), and that conducting practices tests spread out over time (and across topics) are high-utility (considerable empirical evidence and generalizable across situations). Thus, it is important to ascertain which types of study strategies your students are using.

In the table below, high-utility practices as identified by Dunlosky et al (2013) are indicated by (*).

	n=11
	Mean
How often do you engage in the following activities when you study for BIO 101? (1=Very Often, 2=Often, 3=Sometimes, 4=Rarely, 5=Never)	
Take self-initiated practice tests for course *	2.3
Establish a schedule of practice tests or other study strategies on the same topic that are spread out over time *	2.3
Establish a schedule of practice tests or other study strategies on different but related topics that are spread out over time *	2.8
Attempt to explain a phenomenon, solution, or concept in your own words	2.1
Re-read the material again after the initial reading	2.1
Highlight key passages and ideas in the textbook or other course materials	2.2
Use mental imagery (e.g., mnemonics) to memorize key concepts and facts	2.4
Do assigned homework and related activities (e.g., problem sets)	1.2
In a typical 7-day week, how many hours do you spend studying for BIO 101?	5 hours

The students in your course appear to lean heavily on re-reading course materials, explaning concepts in their own words, highlighting, and doing assigned activities as their primary study strategies. While these strategies certainly can be effective for many learners, it may be worthwhile to suggest to students at the beginning of a course that other study strategies are known to be highly effective, particularly taking practice tests distributed over time and across topics.

Another approach some instructors take to encourage (or force) such study habits, is to regularly administer short quizzes, though unless digitized, the grading of these assessments can be onerous.

Conclusions and Recommendations

Thinking back on the goals you had articulated for this class (e.g., having students understand the logic of scientific reasoning as opposed to memorizing a bunch of facts/formulas), we saw evidence in the classroom observation and student survey that they are being realized to a large extent. Besides observing relatively high degrees of student engagement (very high), we also observed students taking careful notes as you walked through how to read genetic pedigrees and understand gene sequence output.

Students also seem to appreciate your use of the slide outlines as a way to organize the course but also as a way to take notes in-class. They also appreciated the detailed examples you gave throughout the lecture, and your walking through reasoning processes for the pedigrees and sequence data.

As we have conducted our research on the types of formative feedback data most useful to instructors, one of the most valuable types of information is student's being vocal about which topics they do not understand. This information can be conveyed using high-tech (e.g., in-class clickers, email) or low-tech (e.g., hand-raising, office hour visits) methods. If you want this type of feedback, however, the key is to communicate with your students that they should feel comfortable in approaching you with questions. Otherwise, many students will likely stay quiet and keep their misconceptions to themselves until the mid-term or the final exam.

While the few students answering the survey indicated that they are somewhat unlikely to ask questions in class, based on the observation it is clear that a classroom culture has been established where students feel comfortable with taking class time to ask questions. While being an important source of formative feedback for you as an instructor, providing students with the opportunity to check their own understanding is also a critical aspect of their learning process.

Finally, as you may notice, we do not offer any evaluative judgments regarding the "quality" of your teaching, based in large part on the lack of data on student learning outcomes. In addition, we subscribe to the view that effective teaching can take many forms and are not limited to the sole use of specific methods such as "active learning" (see Hora & Ferrare, 2013; Hora, 2014; Freeman et al, 2014).

Instead, we intend for these reports to provide a "snapshot" of teaching and learning dynamics within your classroom that can be used to reflect upon your work as an instructor. While we offer no insights about the pros and cons about the way that you taught circulation, we hope that these data about the mechanics of your teaching, your students experiences in the classroom, and their own approaches to studying will prove to be helpful in your work.

Next Steps

Thank you again for participating in this field-testing of the ISOP framework for providing faculty formative feedback about their teaching. After completing the field-test, we anticipate updating the TDOP website to include the capacity to administer student surveys such as the one included in this report. In addition, we hope to develop the website to serve as a resource for administrators, researchers, and faculty who are interested in improving the types of data collected for formative and summative assessment of teaching.

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Contact Information and Acknowledgements

For more information about this study see http://tpdm.wceruw.edu, or contact Matthew Hora at hora@wisc.edu or Jana Bouwma-Gearhart at jana.bouwma-gearhart@oregonstate.edu. The TDOP can be used free-of-charge at http://tdop.wceruw.org.

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