

Development of a Survey Instrument to Measure Student Response to Instructional Practices



Matt DeMonbrun & Cynthia Finelli, Ph.D.
University of Michigan

Introduction

- Various calls have been made for instructional reform in STEM
- Many innovations in instructional practices have been used in the classroom
 - Research-based instructional strategies (e.g., active learning)
- Faculty's adoption of these practices has been slow
- Student resistance can be a major barrier to adoption [1]

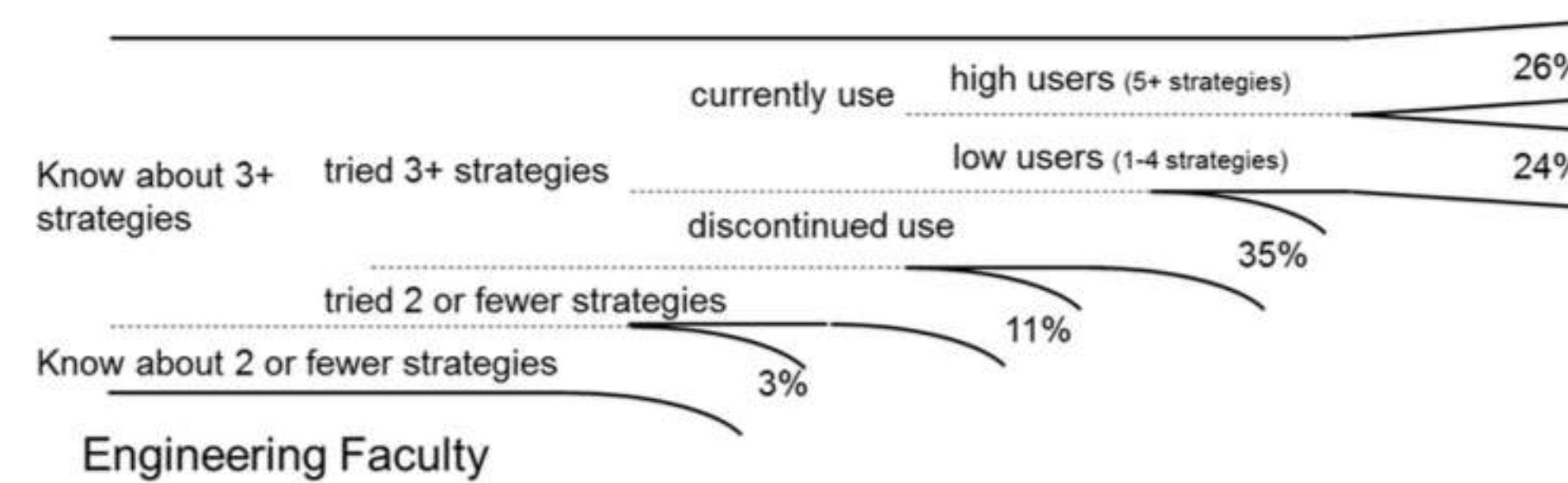


Figure 1. The largest group of faculty (35%) have tried nontraditional teaching methods and then discontinued their use [2]

- New instrument attempts to explain relationship between types of instruction, strategies for using them, and student response

Elements of Our Protocol

Section 1

- Construct of productive engagement [3]
 - Participation (alpha=0.77) vs. Distraction (alpha=0.73) [4]
 - Value (alpha=0.87)
 - Positivity towards instructor/course (alpha=0.72)
 - Overall evaluation of instructor/course (alpha=0.72)

Section 2

- Approaches to reducing student resistance [5, 6, 7]
 - Explanation Strategies (alpha=0.80)
 - Facilitation Strategies (alpha=0.71)

Section 3

- Interactive or dialoguing, Constructive or generating, Active or selecting, and Passive or receiving (ICAP) Model Framework [8]
- Measures of both actual and ideal course experiences (alphas>0.65)

Validation of Protocol

- Reliability and Validity
 - Cognitive interviewing with approximately 15 students at 4 institutions
 - Pilot testing with 362 students at 4 institutions
 - Additional validation through expert review and confirmatory factor analysis

Appendix A: STRIP Student Instrument

STRIP End-of-Term Student Survey

1. In this course, when the instructor asked you to do an in-class activity (e.g., solve problems in a group during class or discuss concepts with classmates), how often did you react in the following ways?

	1. Almost never (< 10% of the time)	2. Seldom (< 30% of the time)	3. Sometimes (< 50% of the time)	4. Often (< 70% of the time)	5. Very Often (> 90% of the time)
a. I did not actually participate.	1	2	3	4	5
b. I gave the activity minimal effort.	1	2	3	4	5
c. I felt positively towards the instructor.	1	2	3	4	5
d. I tried my hardest to do a good job.	1	2	3	4	5
e. I distracted my peers during the activity.	1	2	3	4	5
f. I pretended to participate in the activity.	1	2	3	4	5
g. I felt the effort it took to do the activity was worthwhile.	1	2	3	4	5
h. I participated actively (or attempted to).	1	2	3	4	5
i. I talked with classmates about other topics besides the activity.	1	2	3	4	5
j. I felt the instructor had my best interests in mind.	1	2	3	4	5
k. I saw the value in the activity.	1	2	3	4	5
l. I felt the time used for the activity was beneficial.	1	2	3	4	5
m. I enjoyed the activity.	1	2	3	4	5
n. I surfed the internet, checked social media, or did something else instead of doing the activity.	1	2	3	4	5
o. I rushed through the activity.	1	2	3	4	5

2. In this course, when the instructor asked you to do an in-class activity (e.g., solve problems in a group during class or discuss concepts with classmates), how often did the instructor do the following things?

	1. Almost never (< 10% of the time)	2. Seldom (< 30% of the time)	3. Sometimes (< 50% of the time)	4. Often (< 70% of the time)	5. Very Often (> 90% of the time)
a. Clearly explained what I was expected to do for the activity.	1	2	3	4	5
b. Clearly explained the purpose of the activity.	1	2	3	4	5
c. Discussed how this activity related to my learning.	1	2	3	4	5
d. Solicited my feedback or that of other students about the activity.	1	2	3	4	5
e. Used activities that were the right difficulty level (not too easy, not too difficult).	1	2	3	4	5
f. Walked around the room to assist me or my group with the activity, if needed.	1	2	3	4	5
g. Encouraged students to engage with the activity through his/her demeanor.	1	2	3	4	5
h. Gave me an appropriate amount of time to engage with the activity.	1	2	3	4	5

3. Please rate your level of agreement with the following items.

	1. Strongly disagree	2. Disagree	3. Neutral	4. Agree	5. Strongly agree
a. Overall, this was an excellent course.	1	2	3	4	5
b. Overall, the instructor was an excellent teacher.	1	2	3	4	5
c. I would recommend this instructor to other students.	1	2	3	4	5

4. In how many of your college courses has the instructor asked you to do an in-class activity at least once a week?

Every one of my college courses Almost all of my college courses
 About half of my college courses A few of my college courses None of my college courses

5. For each of the following things, please indicate how often you did each thing in this course and how often you would like to do each in your ideal course.

	In this course, how often did you...					In your ideal course, how often would you like to...				
	1. Never	2. Seldom (5-10 times/semester)	3. Sometimes (once a week)	4. Very often (more than once/week)	5. Much more	1. Much less	2. Slightly less	3. About the same	4. Slightly more	5. Much more
a. Listen to the instructor lecture during class.	1	2	3	4	5	1	2	3	4	5
b. Brainstorm different possible solutions to a given problem.	1	2	3	4	5	1	2	3	4	5
c. Find additional information not provided by the instructor to complete assignments.	1	2	3	4	5	1	2	3	4	5
d. Work in assigned groups to complete homework or other projects.	1	2	3	4	5	1	2	3	4	5
e. Make individual presentations to the class.	1	2	3	4	5	1	2	3	4	5
f. Be graded on my class participation.	1	2	3	4	5	1	2	3	4	5
g. Study course content with classmates outside of class.	1	2	3	4	5	1	2	3	4	5
h. Assume responsibility for learning material on my own.	1	2	3	4	5	1	2	3	4	5
i. Discuss concepts with classmates during class.	1	2	3	4	5	1	2	3	4	5
j. Make and justify assumptions when not enough information is provided.	1	2	3	4	5	1	2	3	4	5
k. Get most of the information needed to solve the homework directly from the instructor.	1	2	3	4	5	1	2	3	4	5
l. Be graded based on the performance of my group.	1	2	3	4	5	1	2	3	4	5
m. Preview concepts before class by reading, watching videos, etc.	1	2	3	4	5	1	2	3	4	5
n. Solve problems in a group during class.	1	2	3	4	5	1	2	3	4	5
o. Solve problems individually during class.	1	2	3	4	5	1	2	3	4	5
p. Answer questions posed by the instructor during class.	1	2	3	4	5	1	2	3	4	5
q. Ask the instructor questions during class.	1	2	3	4	5	1	2	3	4	5
r. Take initiative for identifying what I need to know.	1	2	3	4	5	1	2	3	4	5
s. Watch the instructor demonstrate how to solve problems.	1	2	3	4	5	1	2	3	4	5
t. Solve problems that have more than one correct answer.	1	2	3	4	5	1	2	3	4	5
u. Do hands-on group activities during class.	1	2	3	4	5	1	2	3	4	5

This material is based upon work supported by the National Science Foundation under DUE Awards #1347417, 1347482, 1347580, and 1347718. Any opinions, findings, and conclusions or recommendations expressed are those of the authors and do not necessarily reflect the views of the NSF.

Results

- We have initial results from students' responses to our eight piloted courses
 - Six active learning and two traditional (lecture-based) courses were included

Table 1: Confirmatory Factor Analyses for Ideal Types of Instruction

Instrument item	Standardized factor loadings	Standard error	Item reliability (R ²)	Construct reliability	Average variance extracted		
Factor 1: Interactive							
Solve problems in a group during class	0.72	0.05	0.74	0.80	0.88		
Do hands-on group activities during class	0.63	0.06	0.76				
Discuss concepts with classmates during class	0.64	0.06	0.77				
Work in assigned groups to complete homework or other projects	0.70	0.05	0.75				
Be graded based on the performance of my group	0.44	0.07	0.80				
Study course content with classmates outside of class	0.61	0.06	0.77				
Factor 2: Constructive							
Make and justify assumptions when not enough information is provided	0.51	0.07	0.76			0.77	0.86
Find additional information not provided by the instructor to complete assignments	0.66	0.05	0.72				
Take initiative for identifying what I need to know	0.60	0.06	0.73				
Brainstorm different possible solutions to a given problem	0.50	0.07	0.75				
Assume responsibility for learning material on my own	0.76	0.05	0.69				
Solve problems that have more than one correct answer	0.50	0.07	0.75				
Factor 3: Active							
Make individual presentations to the class	0.43	0.08	0.72	0.73	0.85		
Be graded on my class participation	0.42	0.08	0.73				
Solve problems individually during class	0.55	0.06	0.71				
Answer questions posed by the instructor during class	0.74	0.04	0.67				
Ask the instructor questions during class	0.74	0.04	0.67				
Preview concepts before class by reading, watching videos, etc.	0.56	0.06	0.70				
Factor 4: Passive							
Listen to the instructor lecture during class	0.62	0.09	0.51			0.65	0.80
Watch the instructor demonstrate how to solve problems	0.60	0.08	0.52				
Get most of the information needed to solve the homework directly from the instructor	0.51	0.08	0.63				

Table 2: Confirmatory Factor Analyses for Student Responses to Instruction

Instrument item	Standardized factor loadings	Standard error	Item reliability (R ²)	Construct reliability	Average variance extracted
Factor 1: Value					
I felt the time used for the activity was beneficial	0.71	0.04	0.89	0.87	0.95
I saw the value in the activity	0.84	0.03	0.80		
I felt the effort it took to do the activity was worthwhile	0.89	0.03	0.74		
Factor 2: Positivity					
I felt positively towards the instructor	0.66	0.07	0.64	0.72	0.86
I felt the instructor had my best interests in mind	0.73	0.07	0.53		
I enjoyed the activity	0.57	0.07	0.72		
Factor 3: Participation					
I participated actively (or attempted to)	0.58	0.08	0.70	0.77	0.84
I tried my hardest to do a good job	0.67	0.08	0.72		
I pretended but did not actually participate	0.71	0.07	0.74		
I rushed through the activity, giving minimal effort	0.64	0.09	0.68		
Factor 4: Distraction					
I distracted my peers during the activity	0.58	0.08	0.75	0.73	0.85
I talked with classmates about other topics besides the activity	0.39	0.05	0.68		
I surfed the internet, checked social media, or did something else instead of doing the activity	0.65	0.06	0.65		
Factor 5: Evaluation					
Overall, this was an excellent course	0.82	0.05	0.60	0.72 ^a	0.93
Overall, the instructor was an excellent teacher	0.82	0.05	0.60		

^aStatistic calculated using the Spearman-Brown coefficient (Eisinga et al., 2013)

- We conducted EFA on Fall 2014 data and found five factors for student response
- We conducted CFA with same five factors on Spring 2015 data and found that all five factors had acceptable construct reliability and factor loadings
- Two survey measures loaded strongly on two different factors (Distraction and Participation)
- We split these items into four different questions to address both constructs

References

- Cutler, S., & Borrego, M. (2013). *An analysis of the Fidelity of Implementation of Research-Based Instructional Strategies in the statics classroom*. Paper presented at the ASEE Annual Conference & Exposition.
- Cutler, S., Borrego, M., Henderson, C., Prince, M., & Froyd, J. (2012). *A Comparison of Electrical, Computer, and Chemical Engineering Faculty's Progression through the Innovation-Decision Process*. Paper presented at the Frontiers in Education Conference, Seattle WA.
- Chasteen, S. (2014, November 4). Measuring and improving students' engagement [blog post]. Retrieved February 25, 2015 from <http://blog.sciencegeekgirl.com/2014/11/02/measuring-and-improving-students-engagement/>.
- Weimer, M. (2013). *Leamer-Centered Teaching: Five Key Changes to Practice*. San Francisco: Jossey-Bass.
- Bacon, D., Stewart, K., & Silver, W. (1999). Lessons from the best and worst student team experiences: How a teacher can make the difference. *Journal of Management Education*, 23(5), 467-488.
- Van Barneveld, A., & Strobel, J. (2011). *Reports from teaching practice: experiences and management of tensions encountered with PBL implementations in the early years of undergraduate engineering education*. Paper presented at the Research in Engineering Education Symposium, Madrid, Spain.
- Yadav, A., Lundeberg, M., Subedi, S., & Bunting, C. (2011). Problem-based learning in an undergraduate electrical engineering course. *Journal of Engineering Education*, 100(2), 253-280.
- Chi, M. T. (2009). Active-Constructive-Interactive: A Conceptual Framework for Differentiating Learning Activities. *Topics in Cognitive Science*, 73-105.