

Preliminary Results From A Survey Of Physics Faculty On Use Of Research- Based Instructional Strategies

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AMERICAN INSTITUTE OF PHYSICS



National Science Foundation
WHERE DISCOVERIES BEGIN

Abstract

Although substantial time and money has gone into developing Research-Based Instructional Strategies (RBIS) in physics, little effort has gone into understanding the extent to which these products are used by physics instructors. In Fall 2008, a web survey was delivered to a national sample of physics faculty. This poster will present the preliminary results of the survey based on responses from over 700 physics faculty, roughly evenly divided between three types of institutions: 1) two-year colleges, 2) four-year colleges that offer a B.A. as the highest physics degree, and 3) four-year colleges that offer a graduate degree in physics. Survey participants were asked about their knowledge and use of a selection of currently available RBIS as well as their general attitudes toward teaching.

Survey Design

- Demographic Questions
 - Type of institution, number of years teaching, gender, type of courses taught, etc.
- Familiarity with various research-based instructional strategies.
 - What have they heard about, tried, continue to use, discarded? Why?
- Instructional goals and philosophy.
- Specific classroom behaviors.
 - For example, how often do students talk to one another, how often are open ended questions given on exams.
- Professional Development
 - Frequency of interactions with colleagues about teaching, workshops attended, etc.

Sampling and Response Rates

- Survey administered by AIP Statistical Resource Center (under guidance of Susan White)
- Random sample by institution type
 - Two-Year Colleges
 - Four-Year Colleges with a Bachelors Degree in Physics as the highest physics degree
 - Four-Year Colleges with a Physics Graduate Program
- All faculty at the sampled schools who taught the introductory quantitative physics course in the last two years were invited to complete the survey.
- Response rates
 - Two-Year Colleges: 54%
 - Physics Bachelors Degree: 51%
 - Physics Graduate Degree: 48%

Research-Based Instructional Strategies Included in Survey

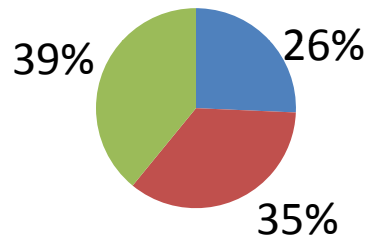
- **Strategies for the Whole Course**
 - Cooperative Group Problem Solving (Heller & Heller)
 - Investigative Science Learning Environment (Etkina & Van Heuvelen)
 - Modeling Physics (Hestenes & Wells)
 - Overview, Case Study Physics (Van Heuvelen)
 - Scale-Up, Studio Physics (Beichner, Wilson)
 - Workbook for Intro. Phys. (Meltzer et. al.)
 - Workshop Physics (Laws)
- **Specific Strategies for Lab**
 - Real Time Physics/Tools for Scientific Thinking Labs (Thornton et. al.)
 - Socratic Dialog Inducing labs (Hake)
 - Video-Based Labs (Beichner et. al.; Zollman et al.)
- **General Strategies for Lecture/Recitation/Homework**
 - Web-based homework/tutoring (e.g., CAPA; Mastering Physics; OWL; UT-Austin; WebAssign)
- **Specific Strategies for Lecture/Recitation/Homework**
 - Activity-Based Physics Tutorials (Cooney et. al.)
 - Active Learning Problem Sheets (Van Heuvelen)
 - Context-Rich Prob. (Heller)
 - Experiment Prob. (Van Heuvelen)
 - Interactive Lecture Demonstrations (Thornton & Sokoloff)
 - Just-In-Time Teaching (Novak et. al.)
 - Open-Source Physics (Christian)
 - Open-Source Tutorials (Elby, Redish, Hammer, Vokos, Rosenberg, Scherr)
 - Peer Instruction (Mazur)
 - Physlets (Christian & Belloni)
 - Ranking Tasks (Maloney et. al.)
 - Research-Based Textbooks: Chabay & Sherwood, Touger, Knight, Moore, Reif, Cummings et. al.
 - Thinking Prob. (Redish)
 - TIPERS (O'Kuma et.al.)
 - Tutorials in Intro. Physics (McDermott)

Respondents

(Useable, n=724)

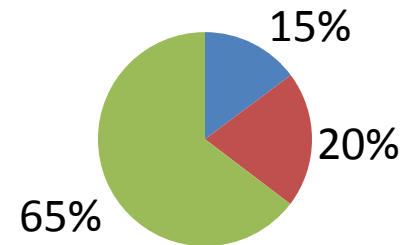
Type of Institution

- Two Year College
- Bachelor Degree Granting
- Graduate Degree Granting

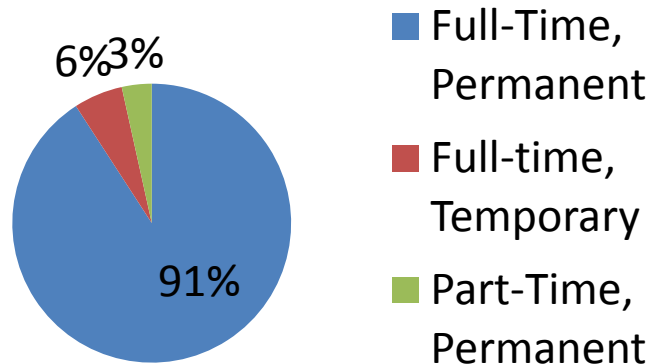


Semesters Teaching Intro Course

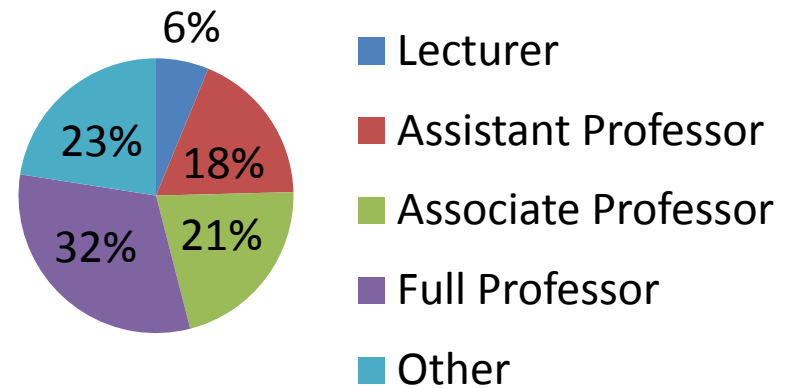
- 1-4 Semesters
- 5-10 Semesters
- More than 10 Semesters



Current Position

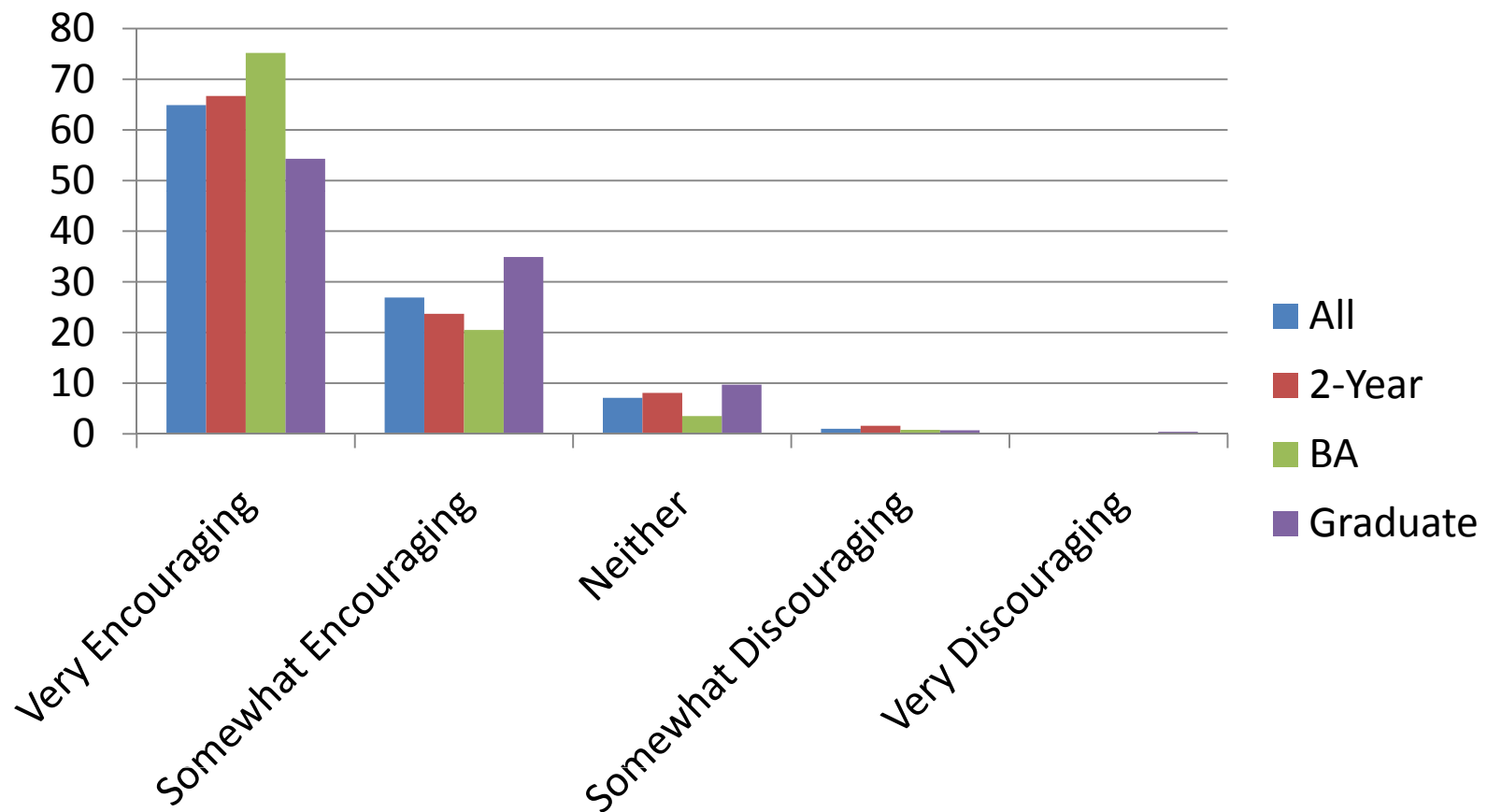


Rank



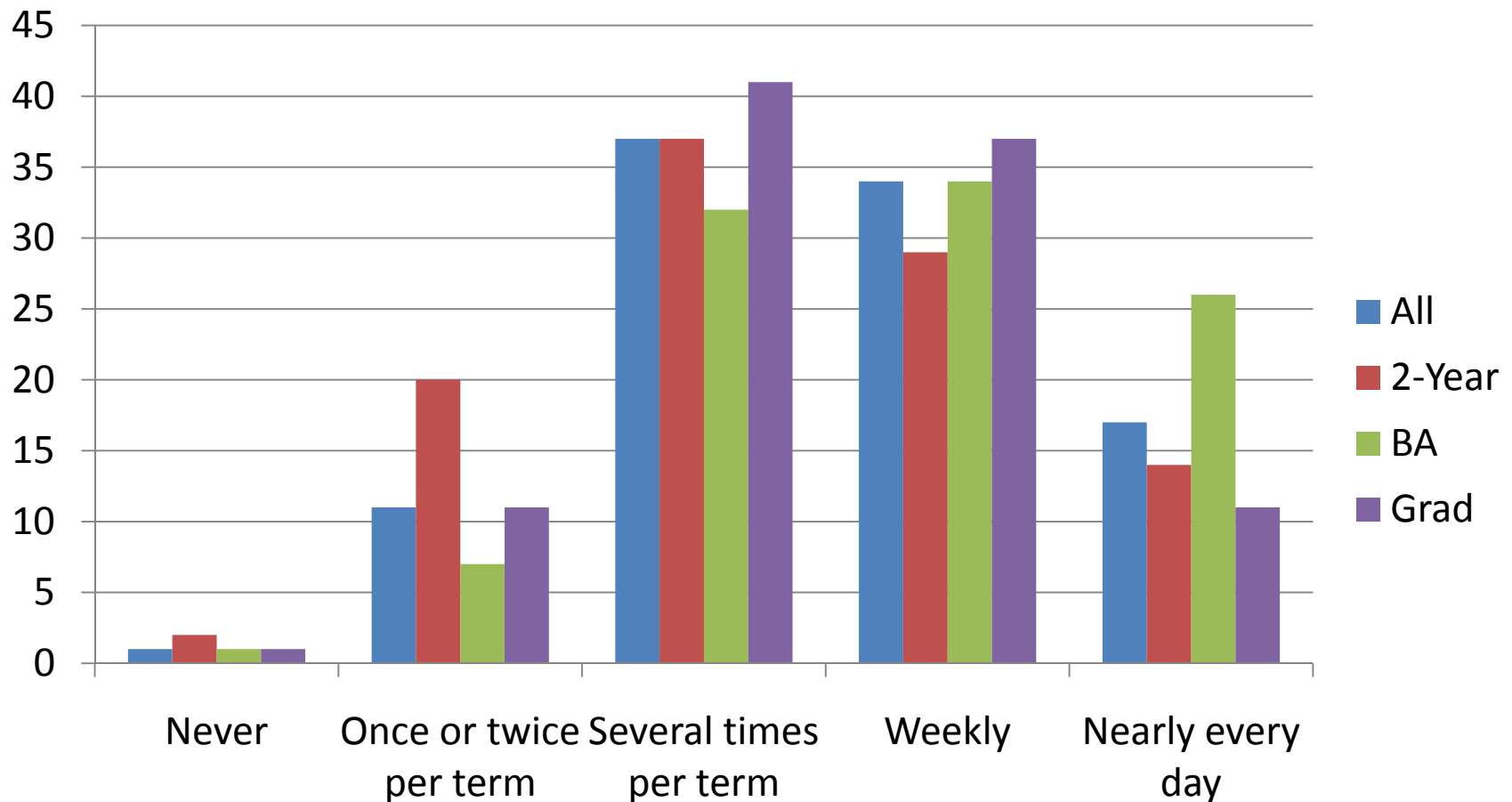
Is your department generally encouraging about efforts to improve instruction?

Reported by % of Respondents



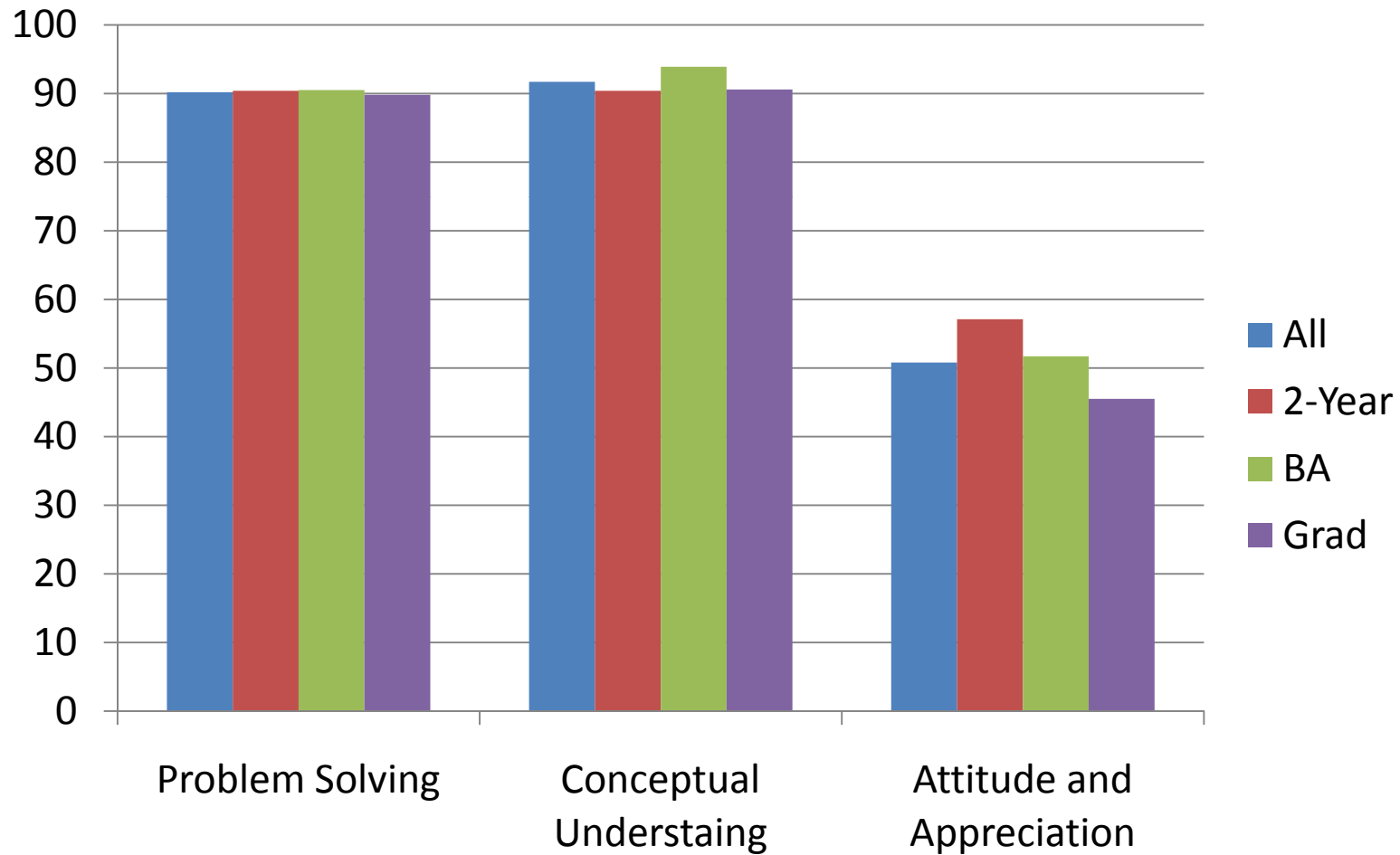
How often did you talk to or correspond with your colleagues about teaching in the last two years?

Reported by % of Respondents



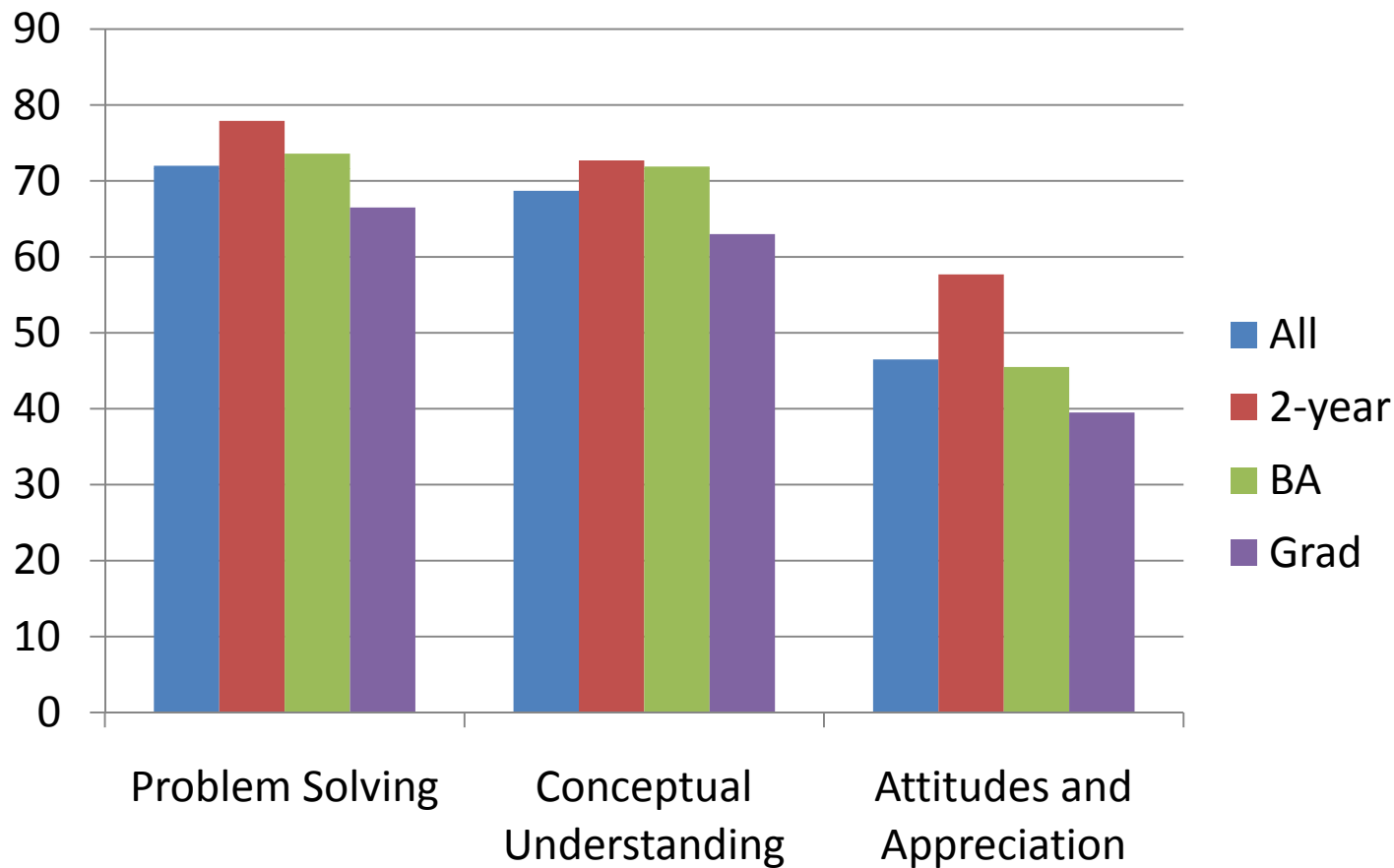
Importance of Instructional Goals

% Rating as "Very Important"



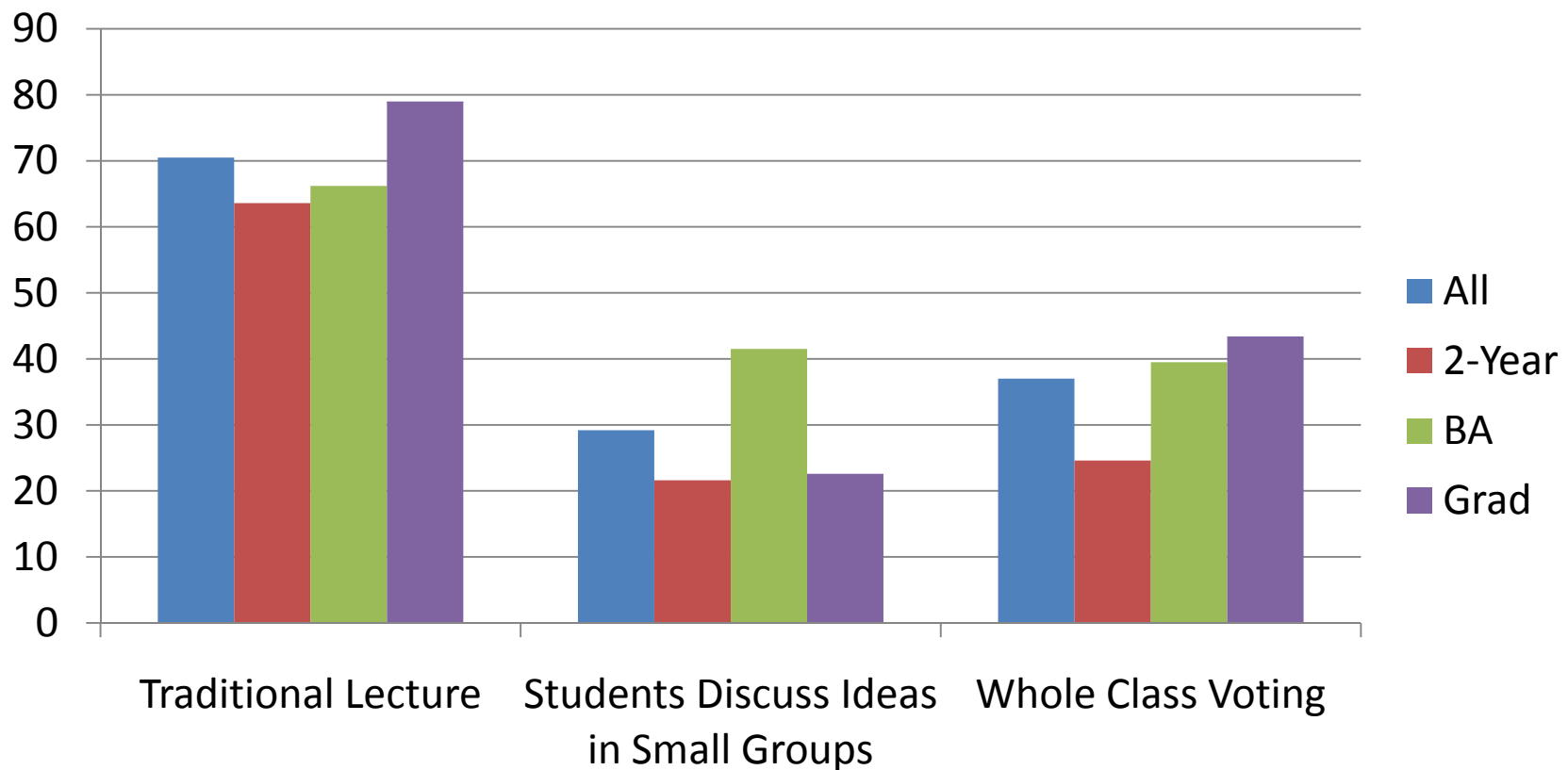
How satisfied are you with the extent to which your students are meeting these goals?

% Rating as “Extremely Satisfied” or “Somewhat Satisfied”



During the lecture portion of your class, how often did you use....

% Reporting "For nearly every class" or "Multiple times every class".



Level of familiarity with each research-based instructional strategy.
% of respondents reporting each category

	Use	Have Used	Familiar, Not Used	Don't Know Much	Never Heard of It
Web-Based Homework	41	12	23	9	15
Peer Instruction	29	14	20	12	25
Ranking Tasks	15	10	13	8	53
Interactive Lecture Demos	14	10	22	16	38
Cooperative Group Problem Solving	14	16	20	15	35
Research-Based Texts	14	10	31	18	29
Physlets	13	15	28	14	29
Just in Time Teaching	8	9	30	17	35
Context Rich Problems	8	7	16	15	55
Tutorials in Intro Physics	8	12	27	15	38
Real Time Physics Lab	7	6	20	19	48

	Use	Have Used	Familiar, Not Used	Don't Know Much	Never Heard of it
Workshop Physics	7	12	30	14	37
TIPERS	7	3	12	10	69
Activity Based Phys Tutorials	6	9	28	18	39
Active Learning Problem Sheets	6	5	23	17	49
Experiment Problems	4	3	11	15	67
Scale-up	3	5	26	16	49
Modeling	3	8	22	20	47
Video Based Lab	3	2	14	14	67
Open Source Physics	2	2	18	17	62
Socratic Dialogue Ind. Lab	2	2	13	15	69
Overview Case Study Physics	2	5	18	19	56
Open Source Tutorials	2	3	16	18	61
Investigative Science Learning Environment	2	4	16	17	62
Thinking Problems	1	2	12	16	69
Workbook for Intro Physics	1	4	14	15	66

How likely are they to use a strategy if familiar with it?

Strategy	% Familiar with Strategy and		Strategy	% Familiar with Strategy and	
	Use it	Have Used it		Use it	Have Used it
Web-Based HW	54	15	Active Learning Prob.	17	16
Peer Instruction	46	22	Video Based Lab	16	12
Ranking Tasks	40	26	Workshop Physics	14	25
TIPERS	32	12	Activity Based Phy T.	14	21
Inter. Lecture Demos	31	22	Socratic Diag. In. Lab	11	11
Coop Gr Prob Solving	28	33	Modeling	10	24
Context Rich Probs	27	21	Scale-up	10	16
Research Based Texts	25	18	Open Source Tutorial	9	11
Physlets	23	27	Open Source Physics	9	11
Real Time Phys. Lab	23	17	ISLE	8	19
Experiment Probs	23	16	Overview Case Study	7	21
Just In Time Teaching	18	19	Thinking Problems	7	10
Tutorials in Intro Phy	17	26	Workbook for Intro	5	19

Significant Variation by Institution Type

Example from Two Instructional Strategies					
	Use	Have Used	Familiar	Don't Know Much	Never Heard of it
Peer Instruction	29.2%	13.9%	20.4%	11.8%	24.7%
Ranking Tasks	15.4	10.0	13.3	8.0	53.4
Two-Year College (N=184)					
Peer Instruction	19.0	7.5	20.1	12.6	40.8
Ranking Tasks	25.1	9.9	10.5	7.6	46.8
Four-Year College with Physics B.A. (N=255)					
Peer Instruction	37.6	16.9	19.0	12.2	14.3
Ranking Tasks	15.2	13.0	17.0	9.4	45.3
Four-Year College with Physics Graduate Degree (N=281)					
Peer Instruction	28.4	15.6	21.8	10.9	23.3
Ranking Tasks	8.9	7.3	11.7	6.9	65.2

Likelihood of using and knowing about innovations by type of school.

% of Respondents Using	All	2-Year	BA	Grad
0 Strategies	38	43	33	40
1-2 Strategies	33	26	34	42
3-5 Strategies	19	20	21	13
5+ Strategies	10	11	11	5
% of Respondents Familiar*	All	2-Year	BA	Grad
0 Strategies	10	12	9	10
1-2 Strategies	16	14	18	16
3-5 Strategies	18	16	17	25
6-10 Strategies	21	20	20	26
10+ Strategies	35	38	36	23

- Strategy use highest among BA instructors.
- Graduate instructors report less familiarity with multiple strategies.

* Includes users, past users and familiar but never used.

Use of At Least One PER-Based Instructional Strategy

51.2% of faculty say that they use at least one of the PER-based instructional strategies we asked about*.

43.1% at two-year colleges

60.1% at four-year colleges w/ B.A.

44.2% at four-year colleges w/grad.

*Excluding Web-Based Homework and Research-Based Text

Use Results with Caution

Peer Instruction **(as described by Mazur)**

- Each class session broken into several segments
 - In each segment
 - Short lecture (7-10 min)
 - ConcepTest (5-6 min)
 - Short conceptual question posed. Students think and record answer.
 - Students convince neighbor
 - Tally of answers
- Must use conceptual questions on exams

Peer Instruction Users **(as described by self-report users)**

- Use instructional activity multiple times every class:
 - Students solve/discuss qualitative/conceptual questions (27.5%)
 - Students discuss ideas in small groups (27.9%)
 - Whole class voting (instructor poses questions that are answered simultaneously by the entire class) (38.9%)
- Use conceptual questions on all tests (65.3%)

Only 12.8% of Peer Instruction Users Report Instructional Activities Consistent with Peer Instruction

Are you interested in using more of the kinds of instructional strategies addressed in the previous questions?

% of Respondents	All	2-Year	BA	Grad
Yes	70	73	77	62



If respondents answered yes, they were asked what prevented them from using more.

Barriers to Use of Physics Education Research

		2YC	BA	Grad
		N=119	N=163	N=144
•Time				
	—General time limitations to learn, develop and implement	50%	61%	50%
	–Limited time in class/content coverage concerns	9	8	10
	–Can't try everything at once	7	6	8
•Resources				
	–Lack knowledge of innovations	25	18	22
	–Lack curricular materials	8	2	3
	–Lack infrastructure and/or funds	13	10	12
	–Lack support of colleagues	3	2	4
•Motivation				
	–I have my own style, prefer to modify	9	7	6
	–Not sure it will work or was unsuccessful in past attempts	5	6	7
•Student Resistance		1	3	1
•Lack control over all aspects of course		0	5	8
•Cost to Students		3	0	0

Summary of Findings: Differences in Institutions

- Instructors at graduate degree granting institutions
 - Report less encouragement to improve instruction
 - Are less likely to rate positive attitudes and appreciation of physics as important goals
 - Are more likely to use lecture and whole class voting methods, while being less likely to use group discussion.
 - Are less likely to be interested in innovations and have knowledge of innovations and less likely to try an innovation when they have knowledge of it.

Summary of Findings: General

- Overall, instructors report their department encourages improved instruction.
- Instructors highly value the goals of developing problem solving skills and conceptual understanding and feel they are generally meeting these goals.
- Most instructors are interested in using more research-based innovations.
- Time to learn about, develop, and implement innovations is the biggest obstacle instructors report.