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Problem

The last 30 years has seen the development and dissemination of many **Research-Based Instructional Strategies (RBIS)** for use in introductory college-level physics courses. Although substantial time and money has gone into developing these RBIS, little effort has gone into understanding whether typical physics instructors use or even know about these products. In this poster we describe and present the results of a web survey designed to document the degree to which Physics Education Research (PER) has impacted the teaching of introductory physics.

Research Questions

1. Which RBIS do faculty know about?
2. Which RBIS do faculty use?
3. To what extent are RBIS modified during use?

This study was focused on college-level quantitative physics. By quantitative physics we are referring to the algebra- or calculus-based introductory physics classes that often go by the names of "college physics" or "university physics".

Methods

A web-based survey was developed by the authors in consultation with researchers at the American Institute of Physics Statistical Research Center (SRC). One part of the web survey asked faculty to rate their level of knowledge and/or use of 24 specific RBIS. The following five categories were used: 1) I currently use all or part of it (current user), 2) I have used all or part of it in the past (former user), 3) I am familiar with it, but have never used it (knowledgeable nonuser), 4) I've heard the name, but do not know much else about it (little knowledge), 5) I have never heard of it (no knowledge).

The survey was administered in Fall 2008 by SRC. Sampling was done at three types of institutions: 1) two year colleges, 2) four year colleges that offer a physics bachelor's degree as the highest physics degree, and 3) four year colleges that offer a graduate degree in physics. SRC staff randomly selected institutions within each of the three types. Once selected, SRC staff asked department chairs to identify faculty who were likely to meet the selection criteria for the survey. Faculty were eligible for the survey if they had taught an introductory quantitative course in the last two years and were full time or permanent employees (i.e., part time, temporary faculty were not eligible).

Table 1 shows the number of institutions and faculty in the population and sample, the web survey response rate, and the number of faculty who responded to the survey. **The overall response rate was 50.3%** resulting in 722 useable responses.

| | Population Estimates | | Response Rate | Useable Responses | |
|--|----------------------|--------------|---------------|-------------------|--------------|
| | # of Colleges | # of Faculty | % of faculty | # of Colleges | # of Faculty |
| Two-Year College | 1072 | 2560 | 53.7% | 128 | 186 |
| Four-Year College w/ Physics Bachelor Degree | 511 | 2700 | 50.6% | 128 | 255 |
| Four-Year College w/ Physics Graduate Degree | 252 | 6300 | 48.2% | 89 | 281 |

TABLE 1. Overview of population and web survey sample for faculty in each type of institution. Population estimates are from reports published by the AIP.

Results: Knowledge

- 87.3% of faculty report that they know about 1 or more RBIS.
- 50.3% know about six or more.
- In general, faculty knowledge at B.A. institutions is higher than that at two year colleges or Grad institutions.

Faculty Knowledge

| RBIS | All Faculty |
|--|-------------|
| Peer Instruction | 63.5% |
| Physlets | 56.3 |
| Cooperative Group Problem Solving | 49.3 |
| Workshop Physics | 48.2 |
| Just in Time Teaching | 47.7 |
| Tutorials in Introductory Physics | 47.0 |
| Interactive Lecture Demonstrations | 45.4 |
| Activity Based Problem Tutorials | 43.0 |
| Ranking Tasks | 38.7 |
| SCALE-UP | 34.5 |
| Active Learning Problem Sheets | 34.3 |
| Modeling | 32.7 |
| Real Time Physics Labs | 32.4 |
| Context Rich Problems | 30.4 |
| Overview Case Study Physics | 24.7 |
| Open Source Physics | 21.8 |
| Investigative Science Learning Environment | 21.1 |
| TIPERS: Tasks Inspired by Physics Education Research | 20.9 |
| Open Source Tutorials | 20.8 |
| Video Lab | 18.8 |
| Workbook for Introductory Physics | 18.5 |
| Experiment Problems | 17.3 |
| Socratic Dialog Inducing Labs | 16.3 |
| Thinking Problems | 15.1 |

TABLE 2: Ranking of the 24 RBIS according to level of Knowledge (percentage of faculty who indicate that they are current users, former users, or knowledgeable nonusers of the RBIS).

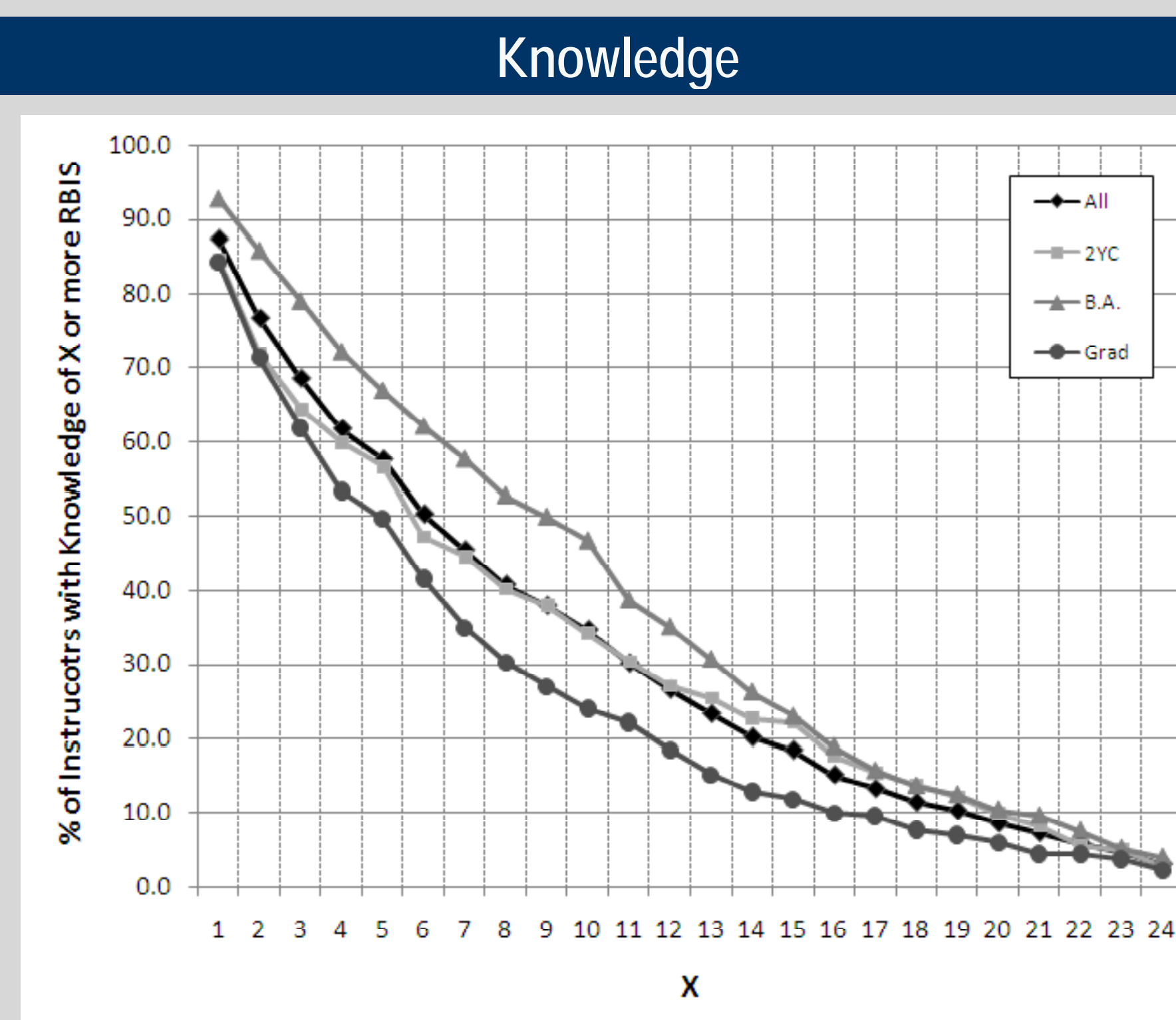


FIGURE 1. Percentage of instructors who report knowing about X or more RBIS.

Results: Use

- 48.1% of faculty say that they use 1 or more RBIS
- In general, faculty use at B.A. institutions is higher than that at two year colleges or Grad institutions.

Faculty Use

| RBIS | All Faculty |
|--|-------------|
| Peer Instruction | 29.2% |
| Ranking Tasks | 15.4 |
| Interactive Lecture Demonstrations | 13.9 |
| Cooperative Group Problem Solving | 13.7 |
| Physlets | 13.0 |
| Just in Time Teaching | 8.4 |
| Context Rich Problems | 8.3 |
| Tutorials in Introductory Physics | 7.9 |
| Real Time Physics Labs | 7.3 |
| Workshop Physics | 6.7 |
| TIPERS: Tasks Inspired by Physics Education Research | 6.6 |
| Activity Based Problem Tutorials | 6.0 |
| Active Learning Problem Sheets | 5.9 |
| Experiment Problems | 4.0 |
| SCALE-UP | 3.3 |
| Modeling | 3.2 |
| Video Lab | 3.1 |
| Open Source Physics | 1.9 |
| Socratic Dialog Inducing Labs | 1.9 |
| Overview Case Study Physics | 1.7 |
| Open Source Tutorials | 1.7 |
| Investigative Science Learning Environment | 1.6 |
| Thinking Problems | 1.1 |
| Workbook for Introductory Physics | 0.9 |

TABLE 3: Ranking of the 24 RBIS according to level of Use (percentage of faculty who indicate that they currently use the RBIS).

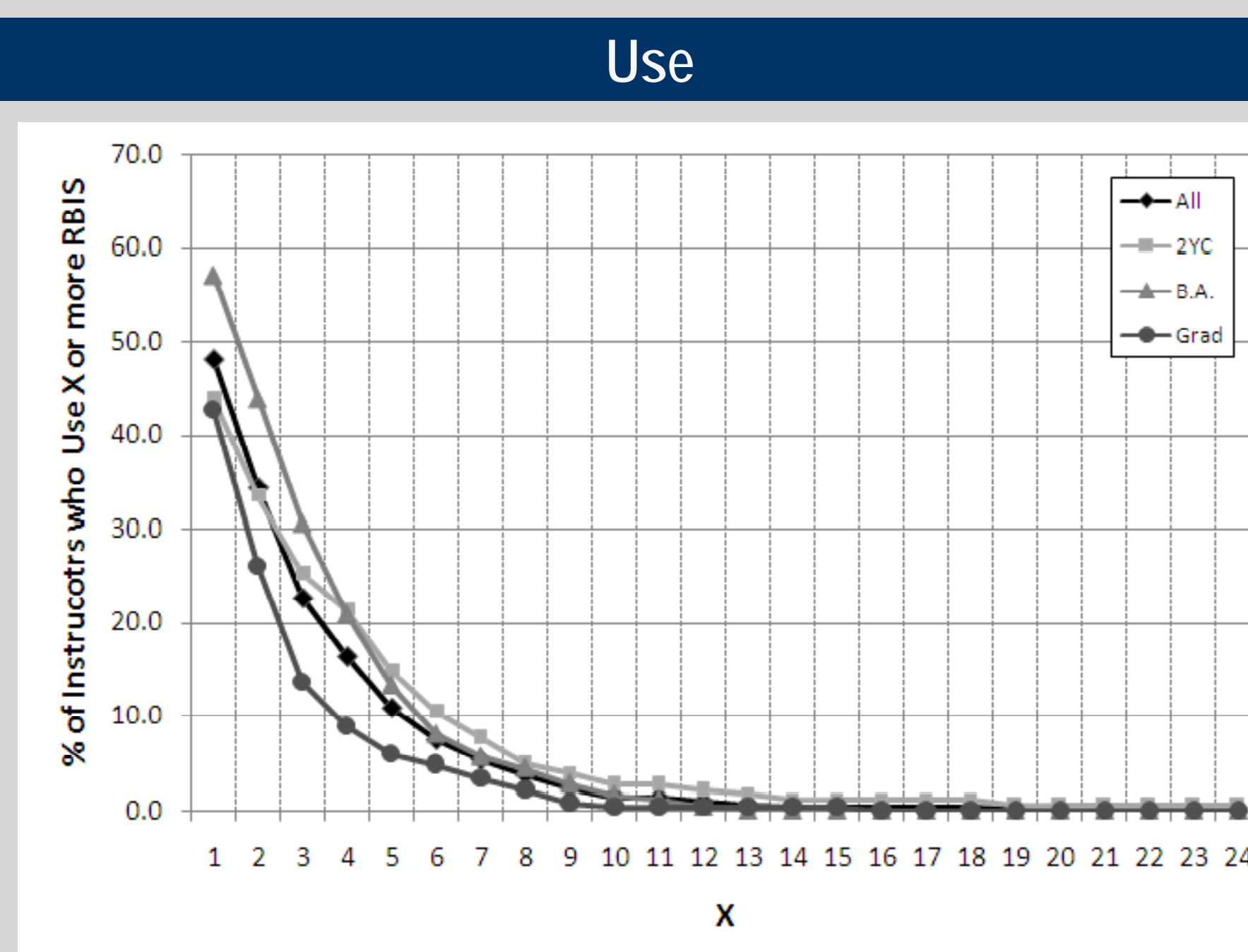


FIGURE 2. Percentage of instructors who report using X or more RBIS.

Conclusions

- Dissemination efforts have impacted the knowledge and practice of many faculty, but there is room for improvement.
- Faculty knowledge of RBIS appears to be relatively widespread.
- RBIS are typically not used as recommended by the developer and faculty do not always realize the extent of modification they have made. Additional work is needed to understand more about why and how faculty make these modifications and the extent to which modifications are typically constructive or destructive.
- Because of the high level of modifications, change agents may be more successful if they provide flexible curricula and substantial support and guidance during the implementation and customization process.

Results: Modifications

- RBIS are not typically used as recommended by the developer.
- faculty do not always realize the extent of modification they have made.

Faculty Self-Reported Modifications

| | PI (N=195) | RT (N=99) | CGPS (N=96) | RTPL (N=47) |
|---|------------|-----------|-------------|-------------|
| I used it basically as described by the developer. | 16.9% | 33.3% | 8.3% | 25.5% |
| I made some relatively minor modifications | 35.9 | 38.4 | 16.7 | 53.2 |
| I used some of the ideas, but made significant modifications | 41.0 | 21.2 | 47.9 | 21.3 |
| I am not familiar enough with the developer's description to answer this question | 6.2 | 7.1 | 27.1 | 0.0 |
| All Users | 100 | 100 | 100 | 100 |

TABLE 4: Extent of modification identified by self-reported users of all or part of each of four RBIS: Peer Instruction (PI), Ranking Tasks (RT), Cooperative Group Problem Solving (CGPS), and Real Time Physics Labs (RTPL). The percentages listed are the percentage of users within each of the RBIS categories who answered the question.

Self-Reported Use of Peer Instruction

- Only 6.2% of faculty use five components of Peer Instruction. Results from Cooperative Group Problem Solving are similarly small (1.0%).

| | Components of Peer Instruction | | | | | | | | |
|---|--|---|--|---|--|-----------------------|----------------------------|----------------------------|-------|
| | Traditional Lecture (for nearly Every Class or multiple times every class) | Students discuss ideas in small groups (multiple times every class) | Students solve/discuss qualitative/conceptual problem (multiple times every class) | Whole class voting (multiple times every class) | Conceptual questions (used on all tests) | Uses all 5 components | Uses 4 of the 5 components | Uses 3 of the 5 components | |
| 1. I used it basically as described by developer | 16.9% | 53.1% | 28.1% | 25.0% | 50.0% | 68.8% | 6.3% | 18.8% | 18.8% |
| 2. I made some relatively minor modifications | 35.9 | 47.8 | 33.3 | 30.4 | 40.6 | 69.6 | 7.2 | 14.5 | 14.5 |
| 3. I used some of the ideas, but made significant modifications | 41.0 | 62.0 | 24.1 | 27.8 | 36.7 | 63.3 | 6.3 | 15.2 | 13.9 |
| 4. I am not familiar enough with the developer's description to answer the question | 6.2 | 72.7 | 18.2 | 9.1 | 9.1 | 36.4 | 0.0 | 9.1 | 0.0 |
| All Peer Instruction Users | 100.0 | 54.9 | 27.2 | 26.7 | 37.9 | 63.6 | 6.2 | 14.9 | 13.8 |

TABLE 5: Instructor use of developer-recommended aspects of Peer Instruction. Table represents all self-described users of Peer Instruction. Respondents are broken into four categories based on their self-described degree of modification of Peer Instruction. Percentages reported are the percentage of respondents within a particular category.

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