Will my student evaluations decrease if I adopt an active learning instructional strategy?

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Will my student evaluations decrease if I adopt an active learning instructional strategy?

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College instructors are often afraid to use active learning instructional strategies because they fear that students may complain and/or give them lower evaluations of teaching. In this paper, we present data from a survey of 431 physics instructors who had attended the Physics and Astronomy New Faculty Workshop and who attempted to incorporate active learning into their introductory course. Nearly half of respondents (48%) felt that their student evaluations increased, one-third (32%) felt that their student evaluations had not been impacted, and one-fifth (20%) felt that their student evaluations decreased. Thus, contrary to common fears, for these instructors the most likely result from the incorporation of active learning was an increase in student evaluations. © 2018 American Association of Physics Teachers.

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I. INTRODUCTION

During the last several decades researchers in science, technology, and mathematics (STEM) education have developed and demonstrated the efficacy of a variety of instructional strategies based on active learning.1 Many instructors know about these instructional strategies and are interested in implementing these strategies more frequently.2,3 Decisions about whether or not to use active learning instructional strategies are most commonly made by individual course instructors. Prior research has identified a wide variety of reasons why instructors might decide not to adopt active learning strategies. These include concerns about the efficacy of active learning instruction, the amount of time it would take to learn about active learning and to redesign a course, the amount of ongoing preparation required, the ability to cover necessary course content, and student resistance to active learning.3–5

The possibility of student resistance to active learning instruction is particularly important because the primary or sole method by which most instructors are evaluated is via end of course student evaluations.6,7 Thus, the possibility of decreased student evaluations is a significant deterrent.

Even though many instructors are concerned that adopting active learning instruction might decrease their student evaluations, we are not aware of any significant data set about what actually happens to student evaluations for instructors who adopt active learning. The purpose of this paper is to present such a data set so that instructors can better judge the relative risk of adopting active learning instructional strategies.

II. WHAT DO WE KNOW ABOUT STUDENT EVALUATIONS AS A MEASURE OF TEACHING QUALITY?

Before delving into a discussion about the impact of teaching styles on student evaluations, we feel that it is important to talk a little about the data related to the use of student evaluations as the sole measure of teaching quality and to be clear that we do not advocate such use of student evaluations. The body of research around student evaluations is extensive and beyond our ability to fully summarize. Here we make two important claims about student evaluations. First, student evaluations are a poor proxy for the quality of instruction. Second, student evaluations are influenced by personal characteristics of the instructor.

There is significant controversy in the literature about what it is that student evaluations actually measure. Yet, there is a reasonable consensus that student evaluations do not directly measure the quality of instruction.8–11 Thus, student evaluations are probably best thought of as an indication of how happy the students are with the course. Student satisfaction is, of course, important. While it is certainly desirable and possible for a course to have high quality instruction as well as highly satisfied students, student evaluation scores cannot be used to make such a determination.

In addition to their failure to measure instructional quality student evaluations are known to be correlated with instructor personal characteristics unrelated to teaching, such as race, gender, and attractiveness.12,13 Some studies indicate that these personal characteristics may be more of an influence than teaching behavior.9 When used as the basis for important hiring and promotion decisions, student evaluations therefore serve to promote employment discrimination.

Given that student evaluations do not directly measure instructional quality and that they are frequently influenced by irrelevant personal characteristics of the instructor, student evaluations should be used with caution. In another paper, we argue that teaching should be evaluated using multiple methods.7 However, it is clear that the majority of instructors must give great attention to their student evaluations, despite the problematic nature of doing so, due to the widespread use of such evaluations by institutions in evaluating instruction.7

III. DATA COLLECTION

The data presented in this study come from surveys conducted with physics faculty after they have attended the Physics and Astronomy New Faculty Workshop (NFW). Physics instructors at all types of four-year colleges in the US are eligible to attend the NFW and currently approximately 40% of new physics and astronomy faculty attend.14
The workshop targets faculty in their first two years of their first tenure-track appointment. The four-day immersive workshop focuses on introducing new faculty to active learning instructional strategies and includes presentations by leading curriculum developers in physics. Topics covered include ways to address difficulties students encounter with physics concepts, ways to address teaching problem solving, and ways to use interactive teaching and peer instruction in a formal classroom setting. Although the NFW introduces participants to many different instructional strategies, there is strong advocacy for decreasing the amount of lecturing and increasing the use of instruction that incorporates active learning and student-student interaction.

For example, one longstanding NFW presenter is the developer of Peer Instruction, Eric Mazur. In a class using Peer Instruction the instructor gives a mini-lecture on a particular topic and then poses a multiple choice question for the students to answer using clickers. After answering individually, students discuss their responses with other students sitting nearby. Students then answer the question again. After a whole-class discussion about the topic the instructor then decides whether more time is needed on the current topic or whether the class is ready to continue to the next topic. Other active learning instructional strategies presented at the NFW include Cooperative Group Problem Solving, Just-in-Time Teaching, and Tutorials in Introductory Physics.

Our web survey was sent to 1306 New Faculty Workshop (NFW) attendees. This represents all attendees, from the first workshop in 1996 until early summer 2013, who could be located and were still in academia. Survey participants were invited to participate via email, and up to three email reminders were sent to non-respondents. We received 547 responses (42% response rate). Of these, 116 were not used in the analysis. Some (n = 16) did not provide consent to participate in the study, which was required by our Human Subjects protocol; some (n = 54) had never taught an introductory quantitative physics course, which was the target course for this study; and some (n = 46) did not respond to questions related to change in students course evaluations, which is the primary outcome variable reported in this study. The remaining data set of 431 respondents was used in the analysis reported here.

IV. RESULTS

In this section, we first describe the survey respondents and their self-reported instructional strategies. We then discuss their perceptions of how students responded to their use of active learning instruction.

Of the 431 survey respondents, 71% were male and 27% were female; 10 (2%) did not respond to the gender question or indicated that they preferred to not disclose their gender.
The American Institute of Physics reports that in the 2009–2010 academic year (most recent data available) 14% of physics instructors in physics degree granting departments were female. Thus our sample has a higher representation of female instructors than the overall population. English was the native language for 68% of the respondents, while 30% reported a different native language. We are not aware of any comparison data for the native language for the population of physics instructors.

During the survey, respondents were asked to think about the most recent quantitative (algebra- or calculus-based) physics class they taught. Approximately two-third (64%) of them indicated that the course was calculus-based, and one-third (33%) of them indicated that this was algebra-based.

A. Almost all of the NFW participants use at least some active-learning-based instructional strategies

As expected, based on prior studies of NFW attendees, almost all of the NFW participants use at least some non-traditional, active-learning-based instructional strategies. As discussed in this section, nearly all respondents report using at least some alternative instructional features (Fig. 1), frequently think of themselves as having a more alternative teaching style than their colleagues (Fig. 2), and describe using significant percentages of class time for activities other than lecture (Fig. 3).

The instructors surveyed tended to use alternative instructional techniques as advocated by the NFW. Instructors were asked to rate their overall teaching style (Fig. 1). Most (63%) instructors considered themselves to be mostly traditional with some alternative features.

Instructors were also asked to rate their style compared to their colleagues (Fig. 2). Most (61%) rated themselves as more alternative than their colleagues.

During the survey, instructors were asked to estimate the percentage of class time that they spent using each of the following instructional activities: Traditional Lecture, Whole Class Discussion, Small Group Work/Discussion, Individual Student Work, Student Presentation. Figure 3 shows the class time used in each activity. These terms were not defined on the survey, so instructors may have interpreted them differently. Figure 3 is a box and whisker chart showing the distribution of the percentage of time instructors reported using each of the instructional activities. Overall, instructors reported using a mean 56% [±24%] of their class time in lectures. This can be compared to results of a recent observational study of 548 faculty in a variety of Science, Technology, Engineering, and Mathematics (STEM) disciplines. That study found that, on average, STEM faculty engaged in lecture in 75% of the 2-minute class intervals observed. The NFW sample appears to engage in somewhat less lecturing than the more representative sample of STEM faculty. This is what we would expect given the influence of the NFW and the data presented in Fig. 2 where instructors indicated that they felt their teaching was somewhat more alternative than their colleagues.

As a consistency check, we compared instructors’ perceptions of their overall teaching style to their reports of the way that they used class time. As expected, self-reported instructional style was strongly correlated with percentage of class time spent in lecture (Fig. 4).

Comparisons of the percentage of class time spent by instructors in lecture were performed using one-way ANOVAs to test if differences in average lecture time differ based on instructors’ gender, native language, and the basis of the courses they taught. Descriptive statistics are presented in Table I. Based on separate one-way ANOVAs, male instructors report spending more time in lecture than female instructors ($p = 0.02$) and instructors of algebra-based courses report spending more time on lecture than those in calculus-based courses ($p < 0.001$). There was no statistically significant difference between instructors whose native language was English vs. non-English ($p = 0.342$).

B. Respondents reported increased student evaluations more frequently than other outcomes when they implemented active learning

As discussed in Sec. IV A, almost all of the NFW participants use at least some non-traditional, active-learning-based instructional strategies.

Table I. Summary statistics for means of percentage of class times instructors reported spending in lectures.

| Percentage of class time instructors report spending in lectures |
|---|---|---|---|---|---|
| | Gender | Native language | Course type |
| | Female | Male | English | Non-English | Calculus-based | Algebra-based |
| Average (%) | 52.55 | 61.40 | 56.16 | 57.78 | 51.12 | 62.82 |
| Std. Error | ±2.45 | ±1.64 | ±1.69 | ±2.42 | ±1.72 | ±2.40 |

*Statistically significant at $p = 0.05$ level.
instructional strategies. On the survey, we asked instructors whether they felt that the use of these active-learning-based instructional strategies had ever impacted their student evaluations (see Fig. 5). Nearly half of respondents (48%) felt that their student evaluations increased, one-third (32%) felt that their student evaluations had never been impacted, and one-fifth (20%) felt that their student evaluations decreased. Thus, contrary to common fears, for these instructors the most likely result from the incorporation of active learning was an increase in student evaluations. A Pearson Chi-square test found no statistically significant difference in reported changes in student evaluations based on instructors’ gender ($p = 0.358$) or native language ($p = 0.194$).

As discussed earlier, student evaluations are often very high stakes for instructors. Thus, even if student evaluations are likely to increase upon adoption of active learning, a small possibility of decreasing student evaluations (estimated here at 20%) might be enough to prevent an instructor from considering the use of active learning. Because of this, we sought to understand trends in student evaluations in more depth from the data we had available in the survey.

One trend that we noticed was that self-reported changes in student evaluations appeared to be correlated with how much lecturing instructors reported using. As shown in Table II, instructors who reported a decrease in student evaluations reported a lower percentage of lecture (47% ± 2.8) than instructors who reported an increase in student evaluations (55% ± 1.6). Those who report no change in student evaluations reported the highest percentage of lecture (65% ± 2.0). The differences between these three groups are statistically significant (1-factor ANOVA, $p < .001$).

C. Give extra attention to student reactions when reducing lecture to less than 20% of class time

To better understand this pattern, we binned instructors by the amount of class time allocated to lecture and created Fig. 6 to show the percentage of the three student evaluation outcomes for every 10%-wide bin of lecture time. Figure 6 shows between 20% lecture and 60% lecture, the most likely

![Fig. 5. Instructors’ perception of the how using active learning affected their student evaluations.](image)

![Tab. II. Descriptive statistics for class-time spent in lectures by instructors who reported three different changes in their student evaluation: decrease, increase, and no changes.](table)

<table>
<thead>
<tr>
<th>Percentage of class time spent in lecture</th>
<th>Average %</th>
<th>N</th>
<th>Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in student evaluations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decrease</td>
<td>46.92</td>
<td>86</td>
<td>2.78</td>
</tr>
<tr>
<td>Increase</td>
<td>54.92</td>
<td>208</td>
<td>1.60</td>
</tr>
<tr>
<td>No change</td>
<td>64.69</td>
<td>137</td>
<td>2.02</td>
</tr>
<tr>
<td>All instructors</td>
<td>56.43</td>
<td>431</td>
<td>1.18</td>
</tr>
</tbody>
</table>
outcome of incorporating active learning is that student evaluations will increase. As the time spent lecturing increased above 60% there were more reports of no changes in student evaluations. We hypothesize that this is because these instructors probably have not changed their instruction very much, so there is no reason to expect a change in student evaluations. Conversely as the time spent lecturing dropped below 20% there was a greater likelihood of decreasing evaluations.

In addition to receiving lower end-of-semester course evaluations, instructors are often also sensitive to student complaints. In the survey, we also asked instructors to respond to the statement: “When I have tried to integrate interactive techniques, such as those presented at the NFW, many students complained.” Note that “many” was not defined, so instructors may have interpreted this question differently. Possible responses were: strongly agree, agree, disagree, and strongly disagree. The most likely outcome of trying to integrate active learning is that many students do not complain (Fig. 7). The majority of instructors, 77%, disagreed (disagree or strongly disagree) that many students complained. Only 23% agreed that many students complained. Figure 8 shows a trend in complaints similar to the one found for end-of-semester evaluations; namely, that student complaints tend to increase as the percentage of lecture decreases. Complaints become the most likely outcome when the percentage of lecture drops below 20%.

D. Open-ended comments

In the survey, after a respondent answered the forced-choice question about whether their student evaluations changed, those who reported changes (N = 294) were asked to respond to the open-ended question; “Please explain briefly why you feel that your ratings on end-of-semester student evaluations have ever been impacted by your use of interactive instructional techniques, such as those presented at the NFW.” Because the question was ambiguously worded, some of these responses [N = 68, 23%] were related to instructors identifying the source of evidence behind their belief that evaluations had been impacted. For example, “Year-to-year comparison of numerical results, plus just reading the comments.” The remainder of responses [N = 226] identified the underlying reasons for the reported change in student evaluations. Of these, 156 instructors reported an increase and 70 reported a decrease. An example of a reason given for an increase was “The written comments have specifically pointed out that students enjoyed clicker questions as well as JITT components.”

The open-ended comments that contained reasons for increases or decreases in student evaluations were coded

![Fig. 7. Percentage of instructors reporting many student complaints when implementing active learning instruction.](image1)

![Fig. 8. Reports of student complaints when implementing active learning instruction compared to the percentage of class time spent in lecture. Student complaints become more likely when the percentage of class time spent in lecture drops below 20%.](image2)
qualitatively using standard techniques for developing emergent categories. This process began by reading all of the comments and grouping them into themes. These themes were then combined iteratively to form categories. The comments in each category were then read for consistency, and the category descriptions were adjusted to better fit the comments. This process continued until a stable set of categories was developed. A final coding was then done to place each comment into one or more of the categories. These are summarized in Tables III and IV.

1. Reasons instructors think active learning increased their students’ evaluations

Tables III identifies the main categories of reasons instructors reported for increases in their students’ evaluations. The top four most common reasons are discussed in more detail below.

   a. Theme 1: Students believe active learning helps them learn better. The most common reason why instructors felt that their student evaluations increased with the use of active learning is that students felt they were learning more in these classes. Approximately 30% (46/156) of the instructors with increased student evaluations reported this reason. Despite potential initial resistance/discomfort, students are likely to comprehend the benefits of use of active learning features once they start to notice that those features help them learn better. This is indicated by quotes such as “Although many [students] comment that my class requires more work than other instructors in the department, they [students] felt like they understood the material better,” or “In the start, students complain but eventually they understand better and learn more and hence most students like the interactive techniques at the end.”

   b. Theme 2: Students find active learning classes enjoyable. Another reason instructors reported for increased student evaluations is that they believe students find these classes more enjoyable. Comments from 45 of the 156 instructors [29%] with increased student evaluation reported students’ enjoyment of their class is one of the prime reasons behind their increased student evaluations. An example of such a comment is “When students enjoy being in the classroom because they have fun while learning, they tend to carry that feeling over to the evaluations.” Quotes such as “Interactive techniques keep the students more alert. They tend to enjoy the activities,” indicate that interactive techniques associated with active learning features help students enjoy their time while learning in class.

   c. Theme 3: Students like to interact with other students. Many instructors believe that students like active learning because it allows them to interact with fellow classmates as well as with the instructor. Comments from 37 of the 156 instructors [24%] with increased student evaluations indicate that students are more likely to be satisfied by interactive teaching practices because students enjoy participating in the interactive features required by such practices. Quotes such as “The students liked the fact that they were made to discuss some questions with their neighbors,” and “It is obvious to anyone that they [students] enjoy being interactive… The more interactive things I do, the better rating I get,” indicates that allowing students to interact with each other can directly contribute to increased student evaluation.

   d. Theme 4: Students like to use technology. Instructors also think that students enjoy the use of technology in the classroom; a common aspect of active learning instruction. Comments from 33 of the 156 instructors [21%] who had increased student evaluations indicated that students liked many uses of technology such as online activities, lecture, quizzes, etc. A majority of these instructors [25 out of 33] mentioned students’ comfort and enjoyment with the use of clickers. Therefore, it appears that appropriate use of technological features are likely to contribute to student satisfaction. Instructors referred to the use of clickers, online

Table III. Instructor-reported reasons for increases in student evaluations.

<table>
<thead>
<tr>
<th>Reason given for increase in student evaluations</th>
<th>N[% out of N = 156]</th>
<th>Example quote</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students felt they were learning more</td>
<td>46 [30%]</td>
<td>“They [students] are responding to the fact that they are actually learning and being engaged.”</td>
</tr>
<tr>
<td>Students found the class more enjoyable</td>
<td>45 [29%]</td>
<td>“When students enjoy being in the classroom because they have fun while learning, they tend to carry that feeling over to the evaluations.”</td>
</tr>
<tr>
<td>Students liked to interact with others</td>
<td>37 [24%]</td>
<td>“Students do like participation in interactive activities for most part and do see these befitting their learning, so that also increases my evaluations.”</td>
</tr>
<tr>
<td>Students liked use of technology</td>
<td>33 [21%]</td>
<td>“Responses to the question in the end-of-term evaluation questionnaire [related to technology] were significantly more positive for my classes than for my institution as a whole. Last offering: 4.8/5 for my class; 4.0/5 for institution as a whole. The technology employed was really just online reading quizzes before every class, and clickers during class.”</td>
</tr>
<tr>
<td>Students felt instructors cared for their learning</td>
<td>15 [10%]</td>
<td>“When they [students] understand that I am interested in their learning and not in covering material, they are more open-minded to a less-structured, more interactive classroom.”</td>
</tr>
<tr>
<td>Instructors broke up the lecture</td>
<td>8 [5%]</td>
<td>“The clicker questions really help the students realize how they’re doing; they break up the time in lecture, it allows discussion and targeted feedback from me.”</td>
</tr>
<tr>
<td>Students liked problem solving</td>
<td>6 [4%]</td>
<td>“I feel that students appreciate the opportunity it gives them to practice examples before the homework. I feel that it helps bridge the gap between learning a physics concept, and being able to apply that concept in solving a problem.”</td>
</tr>
</tbody>
</table>
quizzes, just-in-time teaching [JITT] components, laboratory simulations software, etc. as examples of the use of technology in instruction. For instance, one instructor quoted, “The written comments [of my student evaluations] have specifically pointed out that students enjoyed clicker questions as well as JITT components.”

2. Reasons instructors think active learning decreased their students’ evaluations

Tables IV identifies the main categories of reported reasons for decreases in their students’ evaluations. The top four most common reasons are discussed in more detail below. It is important to note that many instructors who experienced a decrease in student evaluations still had positive things to say about active learning instructional strategies. Some of these instructors (N = 7, 10% of those experiencing a decrease in student evaluations) explicitly said that they weighed the benefits of active learning more than the costs of decreased student evaluations. For example, “I am an engaging lecturer and asking students to work in class is counter to their experiences in other classes, so there is some push back. But I don’t really care. I can demonstrate they learn more, so that’s all that matters to me!” Thus, student attitudes are only one of the considerations that shape an instructor’s use of active learning.

a. Theme 1: Students do not feel that they are being “taught” when instructors use active learning strategies. When the instructors who used active learning in their classroom were asked why their student evaluations decreased, an important reason they identified was that students often felt burdened by active learning and blamed teachers for “not teaching.” Approximately 43% (30/70) of instructors gave this reason. In many cases, these instructors blamed themselves for not being able to successfully “sell” students on active learning: “it ends up being a salesmanship job by the instructor. I’m not a good salesman, therefore, my SEI’s suffer.”

b. Theme 2: Students do not want to work actively during class time. Approximately 37% (26/70) of instructors felt that student evaluations decreased because students prefer to be passive during class time. Instructors said that “they [students] want to be spoon fed, not think,” “students want more direction… less open-ended activity.” Another said, “When I have tried to integrate more interactive techniques in my course, such as those presented at the NFW in my course, I found it difficult to get students to engage in the activities.” These instructors feel that students who are “forced” to engage in class activities against their will become the contributors to decreased student evaluations.

c. Theme 3: Students do not know what to expect in an active learning class. Some instructors who reported decreased student evaluations (12/70 = 17%) indicated that active learning creates uncertainty for students because they do not know what to expect. For example, one instructor commented, “Students tend to give higher evaluations when courses match their expectations.” Comments pertaining to this reason indicate a lack of adequate communication and understanding between the instructor and the students. For example, “Particular approaches like focusing on setting up problems without working them through in detail made many students uncomfortable, led to complaints, and lowered evaluation scores.” These instructors felt that students were uncomfortable about not knowing what to expect in the course and, thus, were more likely to give lower evaluations.

d. Theme 4: Students do not like to interact with other students and/or with the instructor. A few instructors (8/70 = 11%) felt that student evaluations decreased because students do not want to interact with others during class. Quotes such as “They [students] are resistant to interactive learning with me [instructor] or with their colleagues,” and “some students strongly oppose a class model in which they have to be more active and participate. They do not appreciate that their grade may be dependent on such participation” suggest that students may not enjoy interacting with other students or the instructor in the classroom.

V. LIMITATIONS

The primary goal of this study was to seek evidence to support or refute the common untested belief that use of active learning instructional strategies will lead to decreased student evaluations. While our results suggest that this belief is incorrect, our study has several limitations that demonstrate the need for more rigorous research on this topic. Study limitations have to do with the nature of self-reported
data as well as possible different interpretations of survey terms such as “traditional lecture,” “alternative instruction,” and “many students complained.” It is also the case that, on the survey, there is no good way for instructors to indicate changes in student evaluations over time. Such as, for example, if student evaluations initially decreased and then later increased. These issues should be addressed in future research.

VI. CONCLUSIONS

This study sought to empirically document changes in student evaluations of teaching when instructors adopt active learning instructional strategies. Although many instructors fear drops in student evaluations due to the use of active learning, we are not aware of any prior study of this phenomenon. Using a survey of 431 attendees of the Physics and Astronomy New Faculty Workshop we found that the most common change in end-of-semester student evaluations of teaching was an increase: 48% of respondents reported an increase, 32% reported no change, and 20% reported a decrease. There was no difference between male and female instructors or between native vs. non-native English speakers.

Taking a more nuanced look at the results, we also noticed that student reactions appeared to be related to the amount of class time spent in lectures. Increases in student evaluations were the most common outcome reported by instructors when time spent in lectures in the active learning class was between 20 and 60 percent of the total class time. As the time spent lecturing increased above 60% there were more reports of no changes in student evaluations. Conversely as the time spent lecturing dropped below 20% there was a greater likelihood of decreasing evaluations.

Qualitative analysis of reasons instructors gave for changes in student evaluations also provide some information about the strengths and weaknesses of active learning from the student perspective. Instructors report that many students prefer active learning classes over traditional classes. They think students feel that they learn more in an active learning class, enjoy the classroom environment, like to interact with other students, and enjoy the use of technology.

Instructors also provided reasons for why they think some students do not like active learning classes. They indicated that some students do not feel that they are being taught, do not want to work during class time, do not know what to expect, and do not like to interact during class. Consistent with previous suggestions for successful implementation of active learning, these findings suggest that it is important to clearly explain to students why active learning is being used and what will be expected of the students. Frequent feedback can also be used to help students see that they are learning more.

As mentioned above, there is no clear correlation between student evaluations and student learning. In addition, many research studies suggest that a low lecture, high engagement environment is associated with the highest learning gains. For example, Redish reports result from three different instructional strategies: traditional course (high lecture), Peer Instruction (moderate lecture), and Workshop Physics (low lecture). He showed that, while gains on the Force Concept Inventory were higher for Peer Instruction than for traditional instruction, they were highest with the very low lecture Workshop Physics course. Therefore, it is important not to use our data to conclude that one should lecture at least 20% of the time. We note that some instructors who reported lecturing less than 20% also in reported increased student evaluations. Therefore, it is possible to use high levels of student engagement (associated with higher learning) and maintain high student satisfaction.

We also note that our data do not allow us to investigate the departmental and institutional context in which instructors implemented a very low lecture approach. Context is likely to influence student satisfaction. For example, we hypothesize that when implementing a very low lecture approach in an environment that is built into the structure of the department and supported across the department, student satisfaction is more likely to be positive than when done by a single individual in an otherwise high lecture department.

In summary, while instructors are concerned that implementing active learning techniques will negatively impact their student evaluations, our data suggest that for the majority of faculty, starting with moderate changes, the most likely result is that student satisfaction will increase. Instructors utilizing a very high engagement approach (less than 20% lecture) should take extra care to be attentive to issues of student satisfaction. Our overall recommendation is that instructors should not use fear of negative student reactions as a reason to avoid implementing active learning strategies.

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