







Five students who initially had negative affect toward the “individual effort” factor shifted to a more positive affect, two did not take the survey at the end of the semester, and 12 remained in the negative affect group; 44% of the members of the negative affect group in week 14 were in that group at week 2. Five students who disliked at least one activity in the “working with classmates” factor shifted into the positive affect group, while four remained the negative affect group. Therefore, most of the students in the negative affect group in week 14 were not in that group in week 2 for either factor. We therefore conclude that while some students may have been predisposed against certain activities, that predisposition did not solely determine their affect at the end of the semester. For example, further investigation revealed that an overwhelming majority (85%) of students who reported dislike for at least one item in the “working with classmates” factor disliked the laboratory activities that were done in class. Apparently, many students learned to dislike performing laboratory activities over the semester.

We then compared students with a negative affect in each factor to the rest of the sample. Specifically, we were testing the null hypothesis that there would be no difference between those two groups in the importance students placed on each of three priorities for the course during week 14: earning a good grade, learning physics, and enjoying in-class time. We rejected the null hypothesis for two cases. Students who held a negative affect regarding individual effort rated “learning physics” as less important compared to their peers,  $t(36.51) = -3.99, p < .001$ . Similarly, students who disliked working with classmates rated “enjoying my time in class” as less important compared to their peers,  $t(102) = -2.02, p < .05$ .

We also tested the null hypothesis that there was no gender difference between students with a negative affect in each factor and their classmates. We rejected the hypothesis only for one case: students who held a negative affect towards individual effort at week 14 were more likely to be female than their peers,  $z = -2.23, p < .05$ . No other gender differences emerged.

## V. CONCLUSIONS

Our ongoing goal for this study has been to understand factors that are related to student satisfaction in active

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learning physics classes in order to provide insight and advice to instructors of such classes who face pushback. To that end, some details are coming into focus regarding students who are more likely to give such pushback.

Students who experienced more instructor-related activities were more pleased with the course, and students generally had a positive affect toward instructor-related activities. However, that factor included both traditional activities, such as introducing new material in lecture, and instructor support, such as providing feedback and encouragement. In this way, instructors face a challenge: they are likely to receive better course evaluations if they do more traditional behaviors, although doing so would undermine the active-learning philosophy of such a course.

Additionally, students who did not enjoy individual effort, and who did not enjoy working with classmates (most dramatically on in-class laboratory activities) at the end of the course were more likely to report low course satisfaction scores. Unfortunately, from our preliminary analysis, we were unable to uncover a way to predict which students would end up with a negative affect towards “individual effort” or “working with classmates” at the end of the semester. One interpretation of that finding is that while some students may have been predisposed against certain activities, other students develop a negative attitude toward activities in class. We speculate that a possible reason for that attitude shift is that they do not see tangible benefits from those activities. For example, because students who had negative affect toward individual effort tended to value learning physics less than their classmates, we might hypothesize that such students do not value the reward of learning that comes from individual struggle, especially if they do not see a benefit in their grade.

However, it is students’ actual experiences and interactions that seem to shape their satisfaction in the class, not a particular predisposition, suggesting that instructors do have an element of control over student satisfaction. Therefore, any framing or affective maintenance that instructors do early in the semester should be supported and continued throughout the course. Such maintenance may reinforce the importance of struggle while connecting the value of physics understanding to students’ everyday lives or future careers.

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