AN INTEGRATED APPROACH TO ACTIVE LEARNING

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ABSTRACT

We describe an integrated approach to active learning in a large first-year undergraduate physics class. A key feature of our approach is that we facilitate intensive in-class discussions by requiring students to engage in preparatory reading and answer short written quizzes before every class. We use software to rapidly analyse the student responses and identify the main issues faced by the students before the start of every class. This information is used to tune the topics discussed in class to focus on the major difficulties or misconceptions faced by the students. In our classes we present a minimum of content and focus on student discussion of the most challenging concepts. We mostly structure the discussions around multiple-choice conceptual questions that the students answer anonymously with an electronic response system, but we also use written exercises. We evaluated this approach using a mixed methods strategy including direct testing of student learning gains, observation of the in-class activities and student focus groups.

In common with other active learning approaches the student learning gains in our classes were very strong, over twice those reported in traditional classes. Observation of our classes revealed differences among the teaching staff in how much the interactive approach was adopted: the full benefit of the approach is not realised until the teaching is fully changed to the new mode. The student focus groups reported very high levels of engagement in the class sessions by both the students interviewed and their colleagues.

We also find that the data from our just-in-time analysis of the student responses significantly improves the preparation of the teaching staff as they start each class with rich information about exactly where the students find the material difficult. The student responses also provide excellent material for preparing new conceptual questions. It is otherwise very difficult for expert staff to write questions that directly target the misconceptions of their students.