2-1D Implementation of problem based learning in STEM undergraduate laboratory teaching

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Enhancing student engagement and promoting active learning not only helps students to gain deeper understanding of the material they study, but it also helps them to develop skills and graduate attributes so highly sought after by employers. Traditionally in STEM subjects, laboratory teaching is used to consolidate conceptual understanding, develop practical skills and inculcate an evidence based problem solving approach. At the same time, laboratory work promotes the active engagement of the students. However, it is easy for students to be distracted by technical details and simply follow a set instruction thereby missing out on the benefits of being actively engaged. Here we present an alternative to the traditional introductory level physics laboratory experiments which enhances students' learning by focusing on problem solving. Students are tasked with clearly stated challenges and are offered only limited instructions. The student focus is therefore on the planning, design and execution of the experiments as well as analysing and understanding results. Conceptual understanding is enhanced by connecting students' prior learning and experiences with the predominant use of everyday objects rather than traditional laboratory teaching equipment. Working in small groups, students achieved the aims of the experiments through self and peer-instruction. Discussions between learner and teacher moved into higher cognitive levels, became more focused on underlying concepts and interpretation of observations rather than technical issues with equipment. The entire laboratory component of a first year Physics course was successfully reorganised based on this approach. Students obtain better quality results, score more highly in tests and give highly positive feedback on their experience compared to when performing the same experiments with conventional educational equipment. Students perceive such an approach as particularly helpful in furthering their understanding. Laboratory teaching can truly fulfil the function for which it was originally conceived by following this approach.