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An assessment of students' understanding of Newtonian Mechanics

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The Force Concept Inventory (FCI) pretest [1] comprising of 30 multiple choice questions was administered at the commencement of the academic year to ~950 First-Year Engineering students registered for a full-year Mechanics course. The purpose of the diagnostic assessment was to acquire information on students' prior knowledge of their understanding of basics concepts of Newtonian Mechanics. In addition, this instrument has been utilized to ascertain areas of weakness in students' understanding which could be targeted during the academic year and to evaluate the possibility of applying the test to assess the effectiveness of instruction. The class attained a weak average mark of 33% which is similar to results reported in [2]. The collective responses for individual questions have been evaluated and will be discussed in terms of students' misconceptions.

In order to ascertain whether the FCI data gives evidence of any correlation to interactive classroom activities, the results of the first class test based on dimensional analysis, force vectors and vector operations in vector geometry and vector algebra formulation were compared with the FCI responses. We found a roughly linear correspondence with $R^2 0.16$. The classroom activities included the use of "clickers" in the majority of lectures coupled with more focused co-operative group work in tutorial sessions. The class average was for the test was ~53% and the pass rate in the region of 56%. Although the test coverage was limited to a very small basic component of Mechanics, a refined analysis shows that students who performed well in the FCI test also produced good class test results – amongst students who got 60% or more for the FCI, the pass rate for the class test was ~88% and of the students who failed the class test, only ~3% attained 60% or more for the FCI. Conversely, competence in the class test was not strongly correlated with the FCI test – of the students who passed the class test, only ~16% achieved 60% or more for the FCI while the class test pass rate amongst students who obtained less than 60% for the FCI was 52%. It should be noted that students in general performed much better in the class test. In order to validate these preliminary findings, upcoming class tests and examinations scores will be compared with the FCI test results. The impact of teaching and learning will be re-evaluated by conducting a FCI post-test after the completion of the syllabus on statics and dynamics.

References

- [1] D. Hestenes and M. Wells (1992). Mechanics Baseline Test. The Physics Teacher 30, 159-166.
- [2] D. Hestenes, M. Wells, and G. Swackhamer (1992). Force Concept Inventory. The Physics Teacher 30, March 1992, 141-158.

Apply to be considered for a student award (Yes / No)?

No

Level for award (Hons, MSc, PhD, N/A)?

N/A

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