A TOOL TO STRATEGISE UNDERGRADUATE PHYSICS TEACHING

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Physics is the critical discipline that students must learn thoroughly before embarking on a journey of engineering studies or any career in STEM fields. Physics education research (PER) is the growing research field that identifies the need to understand Physics as well as the teaching-learning process of Physics. The findings of PER enriched the field of Physics by establishing how and what is learned, strengthening conceptual understanding, and producing quality research work. PER brings insights into strategies for teaching Physics while understanding the learner's cognitive and emotional advances during the learning process (Cummings, 2011).

This study we are presenting, explores the possibility of strategising the teaching techniques in large Under Graduate (UG) classrooms for engineering courses. The study employs a multiple-choice (MCQ) test from concept inventories and leads the teacher to implement higher-level Teaching-Learning Materials (TLMs). The study used a standard multiple-choice test on understanding vectors (TUV) (Barniol & Zavala, 2014) from Physport (https://www.physport.org/assessments). The test is implemented in two sections of UG engineering classrooms, consisting of 120 students. The students pursuing the course have joined the university after completing high school courses in mathematics, chemistry and physics. This study was conducted during the first week of their induction into the program, when the teachers and students lacked any rapport, and when the students' basic knowledge level was unknown to the teacher. Students' responses and scores are analysed using score-concentration analysis (Bao & Redish, 2001). It is not only the correct choice that matters, but also what wrong mental model makes the student select the wrong choice, and how the learning process should correct the model, that forms an essential aspect of our analysis.

We coupled an active learning strategy called peer learning (Zhang et al., 2017) to this study and studied the S-C variation of the group by conducting the TUV quiz before and after the students paired up and discussed their mental models with their peers. We calculated the normalised gain between pre- and post-scores. We thus established a process to conduct the test and do the analysis. After looking at the outcome of the C-S analysis, the teacher can strategise their choice of TLMs to help the students learn and appreciate concepts of Physics.

REFERENCES

Bao, L., & Redish, E. F. (2001). Concentration Analysis: A quantitative assessment of student states. *American Journal of Physics*, *69*(S1), S45–S53. https://doi.org/10.1119/1.1371253

Barniol, P., & Zavala, G. (2014). Test of understanding of vectors: A reliable multiple-choice vector concept test. *Physical Review Special Topics - Physics Education Research*, *10*(1). https://doi.org/10.1103/PhysRevSTPER.10.010121

Cummings, K. (2011). *A Developmental History of Physics Education Research*. The National Academies' Board on Science Education Commissioned Papers.

Zhang, P., Ding, L., & Mazur, E. (2017). Peer Instruction in introductory physics: A method to positively change students' attitudes and beliefs. *Physical Review Physics Education Research*, *13*(1). https://doi.org/10.1103/PhysRevPhysEducRes.13.010104

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