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Integrating e-learning, physical models, 3-D printing and the pedagogy of flipped classroom for enhancing large-class teaching and learning effectiveness in mechanics

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Abstract:

Mechanics is a fundamental subject for many branches of science and engineering. It is difficult to learn, particularly for freshmen without a good background in physics and mathematics at high school level. For students in construction engineering-related disciplines, the subject is not just essential for them to proceed to advanced level courses, it also equips them with needed tools and knowledge for creating or discovering innovative solutions to many real-life problems. Furthermore, teaching mechanics to a large class with diversified student's background is equally difficult and challenging. Bearing in mind, all learners are different. However, in our traditional mode of teaching, most educational presentations and materials are the same for all. This creates a learning problem, by putting a burden on the learner to figure out how to engage with the content. It means that some learners will be bored, others will be lost, and very few are likely to discover paths through the content that result in optimal learning. Unless students are proactive in learning and/or relatively strong in physical science, otherwise they would find it very difficult to learn mechanics.

To enhance the learning of the subject and making more effective use of the class time, it is important and essential for students to take up a more proactive attitude to prepare for the class in advance, be more synchronous in learning during class, and be assessed after class, so as to ensure that the intended learning outcomes are achievable. To this end, this project aims to make use of the latest technology to develop a comprehensive platform which comprises an integration of four building blocks: 1) a self-directed, online learning and assessment module to motivate students to prepare for the class in advance; 2) application of student response system (clickers) that improve classroom dynamics and arousing students' interest in the subject; 3) a post-lecture, online assessment module for assessing and monitoring students' progress; and 4) a self-directed, online learning module that provides guidance for students to prepare physical models via 3-D printing technology to test their ability in creating innovative solutions for solving mechanics problems. The basic rationale behind the platform is partially based on the recent flipped classroom approach which is an instructional strategy and a type of blended learning that reverses the traditional learning environment by delivering instructional content, often online, outside of the classroom. This approach was tried out by the PI on a pilot basis last year for part of another construction course using self-developed, pre-lecture video (made online through Youtube) and in-class assessment works. Initial feedback from students reveal the learning effectiveness of the

course content and the better use of class time on engaging students to work rather than traditional mode of passive learning. The same idea is partially embedded in this proposed platform. It is anticipated that the proposed platform can be used by all freshmen taking a first course in mechanics.