

AN APPRAISAL OF AN ONLINE TUTORIAL SYSTEM FOR THE TEACHING AND LEARNING OF ENGINEERING PHYSICS IN CONJUNCTION WITH CONTEXTUAL PHYSICS AND MATHEMATICS

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ABSTRACT

Due to the Australian Federal Government's policy of increasing the participation rate of students in the tertiary sector, the number of students has increased tremendously in engineering schools in Australia over the last few years. While from a social equity point of view this is a welcome initiative, it has, however, raised a number of issues and problems in the teaching and learning of engineering physics in large first year classes. Students now come with a diverse background of skills, motivations and prior knowledge in the subject. It was imperative that a new system of teaching and learning of the subject be investigated and developed.

One way of engaging students from diverse backgrounds is to offer a range of learning environments, particularly those that engage deep learning and reasoning processes. Consequently, a Socratic online learning and assessment tool called MasteringPhysics (MP) was utilised. The tool provides self-paced tutorials in an individualised coaching mode. It provides students with hints and instant feedback, specially designed conceptual questions, builds confidence by providing simpler sub-problems, assessment of student learning, simulations and a grade book which provides the lecturer with timely information on how well the class or an individual student is performing. This allows for timely intervention to answer the learning issues faced by the student or students. The tool began to be used in 2007 with 350 students and continued to be used in Semester 1 in 2014 in a first year undergraduate class in an engineering degree course. Students did their weekly online tutorial assignments which normally consisted of ten questions which they were expected to take between 1.5 and 2 hours.

The response to the use of the online tutorial system (MP) has been positive. Slightly over 70% of the students found completing the MP assignments increased their understanding of engineering physics. 69% found that MP assisted them in developing analytical problem solving skills. These are essential skills for would be engineers. Slightly over 70% noted that the feedback they received from MP assisted them in their learning of engineering physics. A high number (86%) of the students were able to see the relevance of the problems in MP to their course work. This attests to the fact that using a contextual method (see below) of teaching engineering physics, along with the associated mathematics, to solve engineering problems has been an effective method of teaching first year engineering physics.

In tandem with the use of the online tutorial system, the author used a contextual method of teaching engineering physics which also relied on using the *Just In Time* mathematics technique in the contextual physics mode. What this does is to show the students how the concepts and principals of physics are applied in real life and authentic problems in the engineering industry. For example, rather than just teaching the concept of force in a theoretical setting and showing the students the derivation of the components of the forces acting on an object as is usually done in pure physics classes, we show them how the forces act on a bridge or a structure. This has proved to be a useful way to enhance students learning of the concepts of physics.

To overcome the problem of a poor background in mathematics the author has used the *Just in Time Mathematics* approach. What this entails is to introduce the students to the mathematics that is required for the particular engineering topic that is to be taught in the lectures for the day. This also provides a revision of the mathematics that they may or may not have been taught in their mathematics classes. For example, before the topic on standing waves and the electromagnetic wave equation are taught the mathematics (trigonometric identities and partial derivatives) that is to be used in deriving these equations is revised in the first 15 to 20 minutes of the 3 hours engineering physics lectures. This approach of contextualising the mathematics allows students to see immediately the usefulness of the mathematics that is relevant to solving the engineering problems at hand.

The combination of the online tutorial system with the use of the contextual mathematics and physics approach in the solving of engineering problems, and the revision of the mathematics before a new topic in engineering physics is introduced has been responsible in the decrease in the failure rate over the last ten years. The percentage of the failure rate in engineering physics from 2002 to the mid-semester examination in 2014 showed a decrease from 32% to 11%. The increase in the retention rate of engineering students is in keeping with the University's retention policy.

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