SUPPLEMENTARY VIDEO TUTORIALS FOR INTRODUCTORY PHYSICS COURSES

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The Project Motivation

- Problem solving is a major stumbling block in physics courses for first year students in STEM and life sciences programs.
- Between 35% and 40% of students in our Science programs did not take grade 12 physics.
- Novice students often indicate that they do not know how to approach problem-solving.
- The issues of problem-solving are difficult to address in large-enrollment classes which are typical in today's science, engineering and pre-medical programs.

The Project Motivation

- A research project on the effectiveness of the active learning strategies in large-enrollment courses commissioned by Higher Education Quality Council of Ontario (HEQCO) was conducted by Ryerson faculty members in 2012-2013.
- The project involved the students in a large-enrollment (400+) first year introductory physics class for science programs.
- The study examined how the active engagement strategies such as Peer Instructions, online self-tutoring/homework and laboratory component of the course influenced students learning.

*HEQCO is an agency of the Government of Ontario that was cr
bring evidence-based research to the service of continued improv
education system in Ontario. As stated on its website, "As part of its mandate, HEQCO evaluates the

Findings from the research project

- The students' perceptions of the pedagogic strategies used in the courses were probed in in-depth interviews with the student volunteers.
- The interviews with students revealed a strong interest in additional web-based materials specific to the topics covered in a course syllabus.
- Students expressed particular interest in materials aimed at the development of problem-solving skills.
- Students particularly value the materials accessible on demand.

- The project consisted on creating several “tutorials” for the introductory physics using screen capture.
- The tutorials addressed the issue that are considered to be difficult for the students
- The project was funded by Learning and Teaching Enchainment Fund (LEFT)

The funds were used:

- to hire a Ryerson student to create the power point slides and corresponding scripts for the videos

- to hire a Ryerson student to record the voice and screen capture and produce the videos

-too pay for captioning the videos for hearing impaired viewers.

The Project Team

- Two faculty members (grant holders)
- Two upper level undergraduate students who took our introductory physics courses during their first year and also worked as learning study group facilitators.
- The scripts and power points were created by one of the students with the input and guidance of the faculty members (grant holders).

The Process

- Subtopics selection
- Choosing meaningful examples
- Script writing and editing
- Preparing dynamic Power Point presentations
- Recording (via screen capture with Camtasia)
- Video captioning for individuals with impaired hearing
- Compliance with the ideas and best practices behind the universal design.

The Supplementary Tutorials

- The video tutorials consist of a theoretical introduction - review of the main concepts in the topic the video addresses followed by problem solving tips and examples of application.
- The power point dynamic slides were screen-captured and voice track added using Camtasia
- Ryerson University students were able to access the videos through D2L Brightspace (former “Desire to Learn” course management platform) and/or Google Drive.

Choice of Topics

For the first set on the tutorials we focused our attention on typical topics of 1st year physics curriculum which are found to be particular challenging for the students (as found by Physics Education research (PER):

- Math essentials (Review of Math Tools)
- Kinematics
- Simple Harmonic Motion
- Waves
- Magnetism

Kinematics

- It is known that the novice students have difficulty differentiating between velocity and acceleration.
- It is common for the novice students to assume that in any motion the acceleration is constant.
- Students struggle with the visualization of motion which manifests itself in the inability to construct the graphs of motion.

Simple Harmonic Motion (Oscillations)

- Oscillatory motion is another topic the students have difficulty grasping
- The most difficult aspect being the concept of phase in oscillations.

One-Dimensional Waves

- The spatial/temporal nature of waves makes this topic even more challenging than oscillations.
- In addition to dealing with phase, the students need to distinguish between different representations of wave motion.
- Many students have difficulty distinguishing between the oscillation of a particle at a certain location and the progression of the wave as it moves in space.

Magnetism

- Well-documented difficulties with magnetism tend to persist well beyond the courses at the introductory level.
- The three-dimensional nature of the magnetic force makes visualization more difficult
- The students struggle with proper use of vector analysis, in particular the cross product.

Math Review

- In addition to physics content, a tutorial with a review of the mathematics concepts needed for the introductory physics courses was also created.
- The students enter university with math skills that vary dramatically
- vectors and trigonometry which are particularly important for kinematics and magnetism. Students are encouraged to study this video tutorial prior to all the others.

Video Recording and Dissemination

- The screen capture and voice recording was done using CAMTASIA.

- These videos, have been made available during the Winter 2017 term via D2L course management system to students in introductory physics course for Science programs and through Google Drive for students in introductory physics course for Engineering programs .

Stundents' Feedback

"The tutorial video idea is a brilliant one. I really appreciate the effort the professors and the faculty puts in to ensure we get the best of our resources, as do other students as well I'm sure. Thank you for making this option as I have been wanting something like this." (First year engineering student).

Note that the grant recipients were not teaching either one of the courses to which the videos were made available.

SURVEY

A survey to gather the students' opinions about the videos was prepared and made available to science programs students in D2L and to engineering programs students as a digital document.

So far a total of twelve students have responded and completed the survey.

Though the number of replies is not large, it is clear from the answers that the impact of the videos was very positive, with students saying that they helped better understand the material and wanting to have videos for more topics.

Student Feedback

The students appreciate:

- The opportunity to access the tutorials at their convenience
- The opportunity to progress through the tutorials with their own pace, pause, re-watch

The students find that

- The online tutorials reinforced what students learned in the lectures and in-class tutorials
- The online tutorials provided more confidence in problem-solving
- It was easier to learn form the tutorial than from the textbook
- The tutorials were easy to follow.

Future Development

- We plan to create more tutorials

- We would like to incorporate a self-assessment part (built-in quizzes) in the new tutorials.

Conclusion

These supplemental online materials, which reinforces lecture and tutorial learning, give students the opportunity to better understand the fundamental concepts as well as acquire and practice problem solving techniques.

Since Physics is a fundamental course for both Science and Engineering students, we can extrapolate that a better preparation in first year Physics courses will have a positive repercussion in the courses that follow.