Tutoring Fundamental of Mechanics

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Abstract

This paper reflects on the first hand experience by one of the authors (RA) on tutoring a large cohort of students in the School of Engineering at the University of Western Sydney. In particular, tutoring "Fundamental of Mechanics" is addressed in this paper with a focus on the following aspects:

1. being a first year subject its cohort is facing university teaching and learning for the first time and therefore in a special need of guidance and mentoring
2. students come from diverse socio-economic and ethnic background and have not yet formed comforting friendships they took years to develop during High School .years
3. there is a high degree of motivation and enthusiasm amongst the students that needs to be nurtured and reinforced to avoid high attrition rates.
4. being a large class, there is no opportunity , or very little at best, for one-to-one interaction with the lecturer

The subject matter provides one of the first opportunities to students for developing a professional approach to solving problems that were part of a high school Physics Curriculum. Students needed guidance to disciplined and methodical approach to solving set problems. In particular, students encountered difficulties in recognizing the generic technique to problem solving. Preference for inductive reasoning based on a given set of problems and solutions was preferred as an aid to similar problem solving, rather than developing a deductive approach based on the theory given during lectures.

Tutoring role was found to be essential for developing a rapport with students as tutoring classes were comparatively small – some 20 students on average. It provided the needed feedback to the lecturer during weekly meetings as to the students' comprehension and the subject matter needing further formal elaboration

Index Terms æ mechanics, tutoring, first year, large classes

INTRODUCTION

Teaching a large cohort is a common aspect in Universities. Consequently, first year students who are coming from High Schools are not familiar with this environment of study. They are more relaxed in face-to-face (FTF) approach that brings them back to the small classes, especially that students have the motivation to avoid high attrition rates as indicated in [1]. However, it is discouraging for them when they attend large lecture halls that hold hundreds of students. Many students may avoid asking questions that help them understanding their subjects. It is well recognized that tutorial was found to be essential for developing a rapport with students as tutoring classes were comparatively small – some 20 students on average. Dividing this huge number of students into groups may give them the motivation to express their ideas and ask questions in more flexible situation. However, this feeling is not enough to proceed in their subjects. Based on the author experience with first year students in Fundamental of Mechanics subject, students encountered difficulties in recognizing the generic technique to problem solving. Mainly, this is attributed to diversity in their socio-economic and educational background. Some students hate to study mathematics and physics. Small number of students does not have mathematics and physics background. In order to handle these obstacles in one hour tutoring session, the mission is getting harder. This paper addresses this issue in its negative and positive sides. It is organized as followed. Section I gives students' background. In Section II, it is proposed a tutoring strategy. Measuring the success of this strategy is addressed in section III. The authors' recommendation is given in section IV. Finally, Section V is to conclude.

STUDENTS' BACKGROUND

The importance of tutoring is emphasized because it translated into FTF interaction to students in small classes such that all who need help get it. As resultant, the author is able to separate them into three groups:

- Group of students who have a sufficient background in scientific subjects is very dynamic in term of thinking and solving problems. They may still need some guidance whereas within an adequate portion of explanation. This figure is captured from the results obtained in their quizzes. It is observed that from 80 to 90% of them have succeeded with range of grades varied from credit to high distinction .

- Students with poor scientific background are suffering from difficulties in understanding theories and to apply them in appropriate way.

- Finally, students who came from High Schools with no scientific background are the most targeted during tutoring sessions. Failure in the subject was expected. This expectation has been approved among their results. It is obtained that there was 100% fail.

TUTORING STRATEGY

As introduced above, teaching large cohorts requires special conditions to be effective. As complementary, FTF interaction with students has been applied to minimize failing percentage in Fundamental of Mechanics. In order to obtain the intended outcome a tutoring strategy has been developed. This strategy aims at enhancing and examining students' progress throughout the semester. Considering students' background, knowledge, and solving problems skills, the proposed strategy consists of the following:

1- Dividing the class into groups. Each group contains 3-4 students from different background

2- Distribute a set of exercises on the students

3- Make a margin on the whiteboard of certain width. This is to write related theories and formulas to be used in solving problems

4- While doing step 3, ask students to read the set and then write notes concerning each exercise

5- Exercises must be ranged from lowest to highest level in term of difficulty. This way allows students to build solutions in progressive scenario

6- Students start solving problems

7- Academic in charge hovers amongst groups providing help and checking the written notes

8- Common notes and questions are explained on the whiteboard for all students to gain time

9- Using electronic media through e-learning platform is yet another way of contact with students rather than FTF in outside class time. This may be used for further understanding of the materials

MEASURING SUCCESS

The success of the proposed strategy is deduced from significant changes in the behavior of the students during tutorial sessions, especially in recognizing the generic technique to problem solving. Some indications of these changes are given below:

- Quality of the questions in class has been improved. This is attributed to the way of explaining. During tutorial sessions, students are now able to record notes and formulas used in solving problems within more comprehen-

sive environment.

- The time factor is an integral attribute of tutorial session. Academic in charge put boundless efforts to achieve the entire set during 1-2 hours. Based on the principal author's experience, this was impossible. By applying the proposed strategy, the time is well optimized and more questions can be addressed.

- Thinking ability and problems solving skills for the students have recorded a significant progress

- The effectiveness of this strategy can be also assessed through the results of four quizzes which are part of the assessment for Fundamental of Mechanics subject

RECOMMENDATIONS

From authors' experience, it is recommended to enhance materials delivery using a technology-supported instructional method that is intended to allow learner interactivity in a large lecture class, thus advance deeper learning. In particular, it is proposed using a "personal response system" (e.g. clickers) which allows students holding remote control device to press the button corresponding to their answer to a multiple choice question projected on a screen, then obtain the class distribution of answers, and discuss the thinking leading to the correct answer [2]. In order to benefit from this technology, it is suggested to examine a knowledge discovery scenario. This is organized as followed:

- Apply the technology proposed above

- In the first lecture for Fundamental of Mechanics, the lecturer should indicate critical points in the materials related to the first year students' background, knowledge and skills in both physics and mathematics. By applying multiple choice questions approach, instructors can capture the needed information

- Divide students into categories based on their answers

This scenario may assist instructors in developing their unit outlines and learning guide in more effective approach in order to deliver interactive Fundamental of Mechanics sessions. Expected outcome is ranged as followed:

- Enhance lectures performance in term of contents

- Assign students to relevant tutorial sessions according to their levels

- Optimize time for discovering knowledge and grouping students during tutorial sessions

This form of instructional technology has been suggested as effective tool that can be used to support instructional methods that enhance cognitive activity during learning which in turn leads to better test performance [3]. Major advantage of this method is that immediate feedback should allow students to develop their thinking skills for estimating how well they understood the lecture materials and for how to answer tutorial questions.

CONCLUSION

Concerning first year teaching of large cohorts in Fundamental of Mechanics subject, this paper addresses the rationale of examining the problems that may confront either the instructors or the students. The latter may come from various background and different level of thinking in term of solving problems. This paper proposes a strategy that can be applied by academic in charge during tutorial sessions. This strategy consists on face-to-face interaction with students. Based on authors' experience this approach has a significant impact on the students' performance. The authors have also recommended the use of instructional technology in order to classify students and enhance their

cognitive activity.

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