
AC 2011-58: IT BASED INTERACTIVE TEACHING OF MATERIALS SCIENCE

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Information Technology Based Interactive Teaching of Materials Science

Introduction

The purpose of this paper is to describe an information technology-based interactive method of teaching a sophomore level Materials Science course for mechanical engineering students. Materials science is a unique course within the mechanical engineering curriculum in part because it is a concepts related science, and not a heavy calculation oriented, engineering course. Therefore, the sophomore level Materials Science class for mechanical engineering students requires a teaching method that is different from the usual problem solving based teaching methods.

Discussion

The developed interactive teaching method addresses several issues, including

- providing more time for lecturing and class discussions;
- retaining the interest of the students for the entire lecture period;
- making it possible for instructor and students to simultaneously share notes;
- monitoring the real time understanding of the covered subjects by students;
- providing opportunities for students to anonymously ask questions during lectures;
- creating virtual office hours;
- making instruction as paperless as possible.

Providing more time for lecturing and class discussions

Some traditional teaching techniques require students to copy instructor-presented materials from the board, transparency or slides. However, this action requires considerable lecture time and the majority of students merely copy the given information verbatim. To combat this problem, some instructors provide PowerPoint slides electronically or as an advanced handout. Instead, the interactive teaching methodology provides the course slides via software during lectures. This advantage allows the instructor and students to add notes to the slides in real time

Prior to class, students are required to connect their university-provided tablet PC to the class lecture computer using the DyKnow software (software). The instructor, incorporating the class lecture computer and the software, uploads the lecture slides and blocks out the students' access to outside applications. The instructor can see the name of the connected students and monitor their computer screens. The lecture slides, prepared in advance, simultaneously appear on the class room monitor and on the students' tablet PC.

Retaining the interest of the students for the entire lecture period

A key issue for all instructors is maintaining student attention for the entire class period. The discussed interactive teaching method accomplishes this with the incorporation of unannounced quizzes and requests for student feedback. Consequently, in order to respond, the students must continuously pay attention to the lectures. The software also makes it possible for the instructor to monitor and remotely control the students' computer screens.

Allowing for simultaneous sharing of notes between instructor and students

Using the software, the slides on the instructors' monitor, which are also shown on the main classroom screen, pop up instantaneously on the students' tablet PC monitor. The instructor is able to make comments and sketch on the classroom monitor. These notes are instantaneously shown on the students' tablet PC monitors. In addition, the students can take notes on the slides. All of the information created by the students and instructor on the slides can be saved.

Monitoring the real time understanding of the covered subjects

Such monitoring can be accomplished in two ways: (1) asking for instant feedback from, or (2) giving quizzes to the students.

The software includes a feature to ask the students about their level of understanding of a recently covered topic. The instructor's screen shows the summary of the responses, allowing the instructor to make a decision to review the covered topic or move on to a new topic. Another feature allows for multiple choice, short essay or calculation quizzes, which can be electronically graded. The results shown on the screen can be saved for grading purposes and the overall statistics can be shared with the students. Additionally, since the quizzes can be given at any time, the students are encouraged to continuously pay attention to the lectures.

Providing opportunities for the students to anonymously ask questions during lectures

The software makes it possible for the students to ask anonymous questions during the lectures via their computer. Based upon the nature of the questions, the instructor can choose to address them during the lecture with the entire class, or discuss it privately with applicable students at a later time.

Creating virtual office hours

An interactive feature of the software allows for the creation of virtual office hours. Students can contact the instructor with questions and demonstrate their work from any remote location during specific given timeframes. The instructor provides assistance and explanations on the shared screen in real time. Although an attempt was made to incorporate this feature of the software to offer such office hours the night before exams, quizzes and homework due dates, the trial run

was unsuccessful because the scheduled times of the virtual office hours could not match the late hour study schedule of the students.

Making instruction as paperless as possible

The use of this teaching methodology makes it possible to conduct completely paperless classes whereby the students prepare the multiple choice, short essay or calculation answers on the computer by typing or handwriting. Major multiple choice question exams can be conducted by the computer using additional software such as Blackboard/Vista. Longer essay and calculation exams can be also handled electronically using the tablet PC.

Limitations and key issues of using the teaching method

There are several limitations to implementing the discussed interactive teaching method, including:

- providing tablet PCs to each student, or a specially equipped computer laboratory;
- limiting the class size to below 25 students;
- generating student interest in, and willingness to use, the new software is difficult;
- spending more time on lecture preparation than using traditional teaching methods;
- requiring strong onsite IT support.

A pilot study to evaluate the effectiveness of the discussed interactive teaching method

It is difficult to determine the effectiveness of the IT based interactive teaching method due to such variables as the quality of the students, difficulty of exams, class sizes, and similarity of the presented materials during lectures. However, there was an attempt to create a pilot study minimizing some of the identified variables. A comparison of two Materials Science classes over two semesters with enrolments of 11 and 16 students, respectively, were selected. One class incorporated the interactive IT based teaching methodologies, while the other did not.

The quality level and the background of the students based upon their average freshman grade point average (GPA) were comparable. Identical textbooks were used in both classes. The homework assignments and exams were similar between classes. The final exams were identical large multiple choice exams (over 70 questions with 5 possible answers) and taken on computer utilizing Blackboard/Vista software which randomized both the questions and the answers. The performances of the students in the two classes were compared based on their final exam and final grades. The results are shown in Table 1.

Table 1. Comparison of the students' performance in non-interactive and interactive classes

	Non interactive class	Interactive class
Average Freshman GPA	2.96	2.83
Average Final Exam Grade (%)	72.6	72.8
Average Final Course Grade (%)	66.2	71.0

The scores of the identical final exams do not indicate statistical differences. The average final course grades demonstrate noticeable statistical differences. It is unclear whether this difference is due to teaching methodology or slight differences in exams and other assignments. Thus, the available limited data does not clearly indicate significant improvement in the students' performance by using the IT based interactive teaching method.

Conclusions

Based upon the limited available data, there is no evidence that the information technology based interactive teaching method improves the performance of the students. However, the technique still has several advantages, including:

- helping the students to concentrate on the lectures;
- giving instant feedback to the instructor;
- providing an opportunity for the students to add notes to the slides;
- allowing for instantaneous feed back to the students;
- improving the students' note taking skills on the tablet PC;
- saving significant lecture time previously spent on copying materials.

Consequently, implementation of the described information technology based interactive teaching method is advisable. To prove the effectiveness of the discussed interactive teaching methods requires a study with larger sample sizes and identical exams and assignments.