

AC 2007-2391: A CASE STUDY ON THE USE OF SEMINARS IN ENGINEERING COURSES - A COMPARISON BETWEEN A GRADUATE AND AN UNDERGRADUATE COURSE

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A Case Study on the Use of Seminars in Engineering Courses A Comparison Between a Graduate and an Undergraduate Course

Abstract

This paper presents comparison of results obtained in two distinct courses, one graduate and one undergraduate, where engineering economy was one of the main components of the course.

The graduate course is the advanced version of the undergraduate course. In both it was used the same methodology of assigning projects that involved the preparation of a report and a subsequent presentation of the results in an internal seminar.

For the undergraduate course two seminars were presented by each group, one involving engineering economy and other involving managerial aspects of the industry. For the graduate course only one project was proposed since the project involved a more in depth analysis of the topic developed.

Both courses were taught two years in a row and the paper presents comments and observations regarding the different results obtained in graduate and undergraduate levels.

Introduction

Undergraduate engineering courses with a seminar component appear to be very common in engineering programs across North American universities. Even though we could not find an academic work reporting how extensively this resource is utilized in engineering courses, an expedited research through 10 largely recognized engineering programs in United States and Canada indicated that all engineering curricula had some courses with a seminar component (see institutions listed in Table I.)

One of the main reasons for the presence of seminars in those programs is probably the recognition that engineers should have the ability to work in groups and communicate effectively¹.

Seminars at the University of Alberta are part of various courses in all four engineering departments and ten different engineering programs. The most common format for the courses with seminars is to have a weekly work load of three hours of classes and one hour for seminars.

It must be noticed that, even though most programs have some courses with seminars, those courses do not constitute the majority in the program. Actually, most courses follow the traditional format of lectures, assignments, lab classes and exams. Courses with seminars may have all the previously mentioned tools. The seminars are an additional learning and/or evaluation tool.

In addition it is important to notice that use of the weekly seminar hour varies a lot from course to course. Each instructor may use that time in a different fashion. Some prefer to use it as an extra class where certain particular topics of the course are reviewed. Others may use it as a class for exercises while in other cases the instructor may reserve the seminar time for guest lecturers.

Of course the format in which the seminar time is used to actually give the students the opportunity to actively discuss and/or present a specific topic is also present in many courses. Additionally, there are courses where a combination of two or more of the abovementioned formats is used.

Methodology Discussion

In the particular case of the two courses discussed in this paper, one undergraduate and another graduate, the option was to use the seminar time for discussion of specific topics. The main objective was to give the participants an enhanced opportunity for cooperative learning and team working.

Undergraduate Course

The undergraduate fourth year course, present in most petroleum engineering programs in North America², is a course on “Oil and Gas Property Evaluation”. This course, which presents topics related to economic and property evaluation in petroleum engineering, as described in the university’s calendar, carries important aspects on economic analysis, project evaluation, economic decision tools and industry regulations.

The course was originally designed with a weekly workload of two hours of lectures and 3 hours of lab work (basically use of computational tools). In order to increase the time available for presentation of the theoretical topics, time was reallocated so the course ended up with an average of three hours of lectures and two hours for seminars. Computational tools still remained an important part of the course and were used in assignments as well as in the preparation of the topics presented at the seminars.

At the beginning of the term the students were divided in groups of two or three participants. Each group received the assignment of preparing two distinct reports. Besides the report the groups also had to prepare associated presentations that later would be featured in the seminars.

The reports should be based in published work previously chosen by the instructor. Each group received a technical article where applied engineering economy was the main topic discussed. The second article, even being interconnected with various engineering economy aspects, was basically related to managerial and political problems associated to the energy industry.

To better illustrate the distinction between the two articles let us take as an example the papers given to Group 1 (Fall 2005). This group received an engineering economy paper

which title was “Production Based Probabilistic Economics for Unconventional Gas³.” The paper basically analyzed the economics of a producing gas field utilizing probabilistic distributions for gas production and prices. The second article, “The Middle East and North Africa in a Changing Oil Market⁴,” analyzed the tremendous changes undergone in the worldwide oil market in the past three decades and its political consequences in those two regions.

Another example of a pair of articles given to a group is listed in References 5 and 6.

On the day of the presentation, the group presenting had the task of creating the proper environment for questions, discussions and comments from the audience.

The number of seminar sessions varied from one year to another according to the number of students enrolled in the course, but basically each group had about 20 minutes for presentation plus another 15-20 minutes for discussions. Presence in the seminars was mandatory and all participants should attend all presentations from all groups. The instructor, as well as the TA for the course, acting as moderators/facilitators, interceded to clarify certain topics and to encourage discussion on controversial points.

Graduate Course

The graduate course, focused on advanced petroleum economics and risk analysis, is part of a graduate program in petroleum engineering and is normally attended by MSc. and PhD. students in petroleum engineering as well as some graduate students from other programs such as mining, chemical and mechanical engineering.

Since the course is directed to graduate students, the focus of the seminar is different. In an attempt to incorporate a research component to the course, the students were asked to develop a project in which they would apply engineering economy and risk analysis to a subject of their interest. This focus was different from the one in the undergraduate course where the students simply analyze, in a critical way, a published work.

Students doing graduate work in petroleum engineering deal with a number of diverse subjects which creates opportunity for development of countless different projects. This explanation is necessary to point out that the possibility of two different students to develop a similar work is practically nonexistent. Students from other programs were encouraged to develop projects in their area of interest which further increased the diversity of projects presented. Still, in order to keep the projects’ topics as diverse as possible, the students were asked to think about a topic during the first four weeks of the course and to have an appointment with the instructor during the fifth week in order to discuss and define their project’s theme.

Contrary to the methodology adopted in the undergraduate course, for the graduate students the projects were individual assignments, which was possible due to the small number of students attending the course, 12 to 15 participants, compared with the relatively large number, 30 to 35 participants, attending the undergraduate course.

All projects had an engineering economy component and most of the projects also used some of the decision analysis tools explored during the course. The creativity and novelty of the projects varied widely, with some being later proposed and accepted in refereed international conferences and others presenting conventional treatment of a certain industry problem. Nevertheless, all projects served well the original purpose of having seminar presentations where opportunities were created for discussion and knowledge sharing.

Comparison of Results and Feedback

The results analyzed in this paper refer to courses offered during Fall 2004 and 2005 (undergraduate) and Winter 2005 and 2006 (graduate course).

The attempt of trying to increase awareness of the students for the importance of economic issues in various engineering fields was based on the observation that, while the majority of students are technically well prepared, they lack business related skills and knowledge of current major financial challenges faced by the industry^{2,7}. Nevertheless, it must be emphasized that the courses were not being developed as part of a research project on education methodology. Also, when the courses were being taught, there was not a directed effort to collect results in a systematic way so it could be later published in a paper. The idea and opportunity of reporting the experience in this article came afterwards, which will make it much more of a case study than a research report.

Even though the undergraduate course was a fourth year course with the majority of participants preparing for graduation, it was noticed that initially students demonstrated some reservation towards the seminar proposal. Clearly, a more traditional approach, with regular home assignments and exams was preferred by them.

During the development of the projects there were some students that enthusiastically prepared themselves for the seminars and made extra effort to write an interesting report that would go beyond the conclusions contained in the assigned papers. However, it appears that the format itself did not contribute to increase general interest in the course or in the subjects being developed.

It is obvious that in a seminar the point is not only to have a good and interesting presentation but also to engage the audience in a vivid discussion that potentially increases awareness of the topic being discussed and create opportunity for learning and knowledge sharing. The attempts made to encourage discussion and generate such environment were just partially achieved. Although this could be related to the interest raised by the topic being discussed, class observation showed that groups better prepared for their presentation managed to get the most involvement from the audience.

Based on the grades obtained by the groups on the seminars, which were pretty much related to the quality of the presentations and the level of discussion generated, we can say that 20% of the groups managed to attend or exceed the expectations of such a learning tool while 30%

could be considered within the average expectancy. Somewhat surprisingly 50% presented work classified below the expectations and were graded accordingly.

On the graduate level, as explained before, the students were not allowed to form groups. Each participant could freely choose a certain process or project from the energy industry or a theoretical topic in petroleum engineering (or other area for non petroleum students). The main task would be to study the chosen topic using economic and risk analysis.

To better illustrate the type of work developed, here we present some of the titles of projects chosen by the students.

- Production Forecasting and Decision Analysis for an Oil Field;
- Uncertainty Assessment by Using Experimental Design and Risk Analysis Techniques, Applied to Offshore Heavy Oil Recovery;
- A Probabilistic Approach in Reserves Estimation;
- Economic Analysis of Athabasca Steam Assisted Gravity Drainage Project;
- Economic Feasibility of the CO₂ Miscible Flooding Process;
- Use of Probabilistic Methods and Risk Analysis to Reduce Oil Well Control Problems.

After developing the project during the course, each student presented in the last week of the term his/her project in an internal seminar where all participants were present. Again, the main point of the seminar, besides presenting the results of each project, was to propitiate an environment where fruitful discussion could take place. Even though the quality of projects presented varied widely, the participation of the group in the discussions following the seminar presentation was really impressive.

The participants actively discussed the projects' results questioning weak points, suggesting improvements and challenging controversial conclusions. More important, since all themes presented were current issues of the industry, they certainly ended up with a better understanding of the main economic issues and challenges being presently faced by the energy industry.

Comments on Course Evaluation

As it is mandatory for all courses, a multiple choice questionnaire for course evaluation was distributed to all students at the end of the course. One of the problems with this type of evaluation is that, while most of participants will readily answer the multiple choice questions, not many will take the time to write about the highlights and weak points of the course as well as general comments on the overall course quality.

The evaluation, made anonymously and without the presence of the instructor, comprised of 15 statements and the students used a scale from 1 to 5 to demonstrate agreement or disagreement with each statement. In the way the statements were presented, statements receiving high marks indicated appreciation for the course and/or instructor, while low marks indicated problems with the course. Examples of statements in the questionnaire are as follows:

- I am motivated to learn more about these subject areas.
- I increased my knowledge of the subject areas in this course.
- The instructor provided constructive feedback throughout the course.
- The course was well organized.

For the graduate course the average for 2005 and 2006, with a total of 25 students responding the questionnaire, was as follows:

- Two statements had the maximum possible average mark, 5;
- Five statements averaged 4.9;
- Seven statements averaged 4.8;
- One statement averaged 4.7.

There were not enough general comments about the seminar that could allow a more definitive conclusion about the students' opinion. However, a strong supportive point was that all observations related to the seminar, eight in twenty five responses, were very positive with most of them emphasizing the importance of the opportunity to discuss current actual industry economic and managerial issues.

For the undergraduate course, taught in 2004 and 2005, a total of 45 students responded the questionnaire. The results were as follows:

- Two statements averaged 4.8;
- One statement averaged 4.7;
- Three statements averaged 4.6;
- Five statements averaged 4.5;
- Four statements averaged 4.4.

The lack of comments on the seminar was even more frustrating than in the graduate course. There were just six comments, all positives, over a total of forty five responses.

It should be mentioned that the comments reported here are exclusively related to the seminar. Of course there were other comments, positive and negative ones, related to other aspects of the course. Those are not mentioned here since they are not the focus of this work.

A table with the complete questionnaire and all evaluation results for both courses is presented in Appendix 1.

Conclusions and Final Remarks

As mentioned before, this is a case study and not a pre-designed educational experiment. For that matter, most of the possible conclusions are not obtained from pre-designed surveys.

It was noticed, probably due to maturity and better understanding of the importance of economic issues in their future career, that graduate students valued the seminars and put more effort on its preparation than most of the undergraduate students.

Even though the use of seminar was not a complete failure in the undergraduate level, it is clear that improvements must be made in order to get more involvement from the participants. Possible alternatives could include the elimination of one of the seminars and individual assignments instead of group assignments.

Apparently, from what was observed in these two courses, students at graduate level are more open to the seminar format and easily get involved in the development of the associated project. Undergraduate students, at least based in this particular experience, feel more comfortable with regular assignments and prefer not to expose their ideas in front of an audience.

All remarks and conclusions are limited to the observation over a period of two years. More decisive remarks will possibly be available a few years from now.

TABLE I

Sample of North American Universities Having Engineering Courses With Seminar Component

Institution	Country
Stanford University	USA
University of Alberta	Canada
University of Calgary	Canada
University of Tulsa	USA
University of Texas	Austin – USA
Colorado School of Mines	USA
University of Calgary	Canada
University of Saskatchewan	Canada
Louisiana State University	USA
Texas A&M	College Station – USA

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Acknowledgement:

The Natural Sciences and Engineering Research Council of Canada (NSERC) has been for more than 25 years a major sponsor of research and education in engineering. Particularly at the School of Mining and Petroleum Engineering at the University of Alberta, NSERC has contributed to a number of research projects and education of numerous students. NSERC continuous support is acknowledge by the author.

Appendix 1 – Questionnaire and Evaluation Results

<u>Questions</u> Marks can vary from 1 (strongly disagree) to 5 (strongly agree)	<u>Evaluation</u> Undergraduate Course	<u>Evaluation</u> Graduate Course
The goals and objectives of the course were clear.	4.5	4.7
In-class time was used effectively.	4.4	4.8
I am motivated to learn more about these subject areas.	4.4	4.9
I increased my knowledge of the subject areas in this course.	4.5	4.9
Overall, the quality of the course was excellent.	4.5	4.8
The instructor spoke clearly.	4.4	4.8
The instructor was well prepared.	4.6	4.8
The instructor treated the students with respect.	4.8	5.0
The instructor provided constructive feedback throughout this course.	4.6	4.8
Overall, this instructor was excellent.	4.7	5.0
The course was well organized.	4.4	4.8
The instructor seems to enjoy teaching.	4.8	4.9
The instructor was accessible outside of class.	4.5	4.9
The instructor explained concepts clearly.	4.5	4.8
The instructor was helpful.	4.6	4.9