Enhanced Transfer of Design Skills Using Professor In The Loop Structured Meetings

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Abstract
This paper presents an approach to teaching engineering design that is based on involving instructors with students during the design process using structured meetings called Professor In The Loop (PITL) meetings. The main idea is to enhance the transfer of design skills from instructors to students by providing instructors with a window for observing students working on their design. The instructors are able to provide the students with immediate feedback about their design approach and skills on an ongoing basis throughout the project.

PITL meetings have been tested in a third year engineering design course taken by all students enrolled in engineering programs at the University of Guelph. Information is given on how a meeting is conducted, how it is evaluated, and the types and nature of instructor feedback. The effectiveness of these meetings is validated using data from focussed end-of-term surveys.

1 Introduction
Engineering design is a skill that is difficult to teach effectively using the traditional teaching lecture-assignment-test format. Normally design courses include a design project where students work individually or collectively in a “learn by doing” approach. Students usually meet with the instructor(s) on a regular or as needed basis to ask questions or present a progress report. At the end of the term, students submit a design report which is marked.

In this standard approach the instructor often judges the final outcome of the design without knowledge of the students’ process. This has several drawbacks. Students may organize themselves so that some members of a group work on the technical aspects while other members work on writing aspects leading to a non-uniform design learning experience. A systematic approach for defining the problem, decomposing it, and evaluating different alternatives is often ignored or artificially followed. Finally, project management practices like scheduling and tracking with Gantt charts and conducting effective meetings are rarely practised.

On the other hand, more interaction and meetings with instructor can lead to students doing what the instructor wants them to do, effectively making the instructor the project leader. This paper presents a teaching technique for engineering design that is based on involving instructors with students during the design process using structured meetings called Professor In The Loop (PITL) meetings. The main idea is to enhance the transfer of design skills from instructors to students by providing instructors with a regular window for observing students while working on their design. The instructors are able to provide the students with immediate feedback about their design approach and skills on an ongoing basis throughout the project.

This paper is organized as follows. In section 2 the PITL format will be described including implementation details and scheduling. In section 3 student feedback about PITL from end-of-term surveys is presented. Finally, suggestions for implementing similar concepts in other courses in the future will be presented in section 4.

2 Description of the PITL

2.1 Format and procedure
The PITL technique has been tested while teaching a third year engineering design course taken by all students from all majors enrolled in engineering programs at the University of Guelph (four programs as of 2010). Typically PITL meetings are held weekly with each group except when other course activities such as design reviews take place. In this current academic year, six PITL meetings were held in the 12 week winter term. The meeting duration was 20 minutes per group and consisted of two parts. The first part was a 15 minute meeting among the students discussing their project,
during which the instructor(s) remained silent. Once this meeting was finished, the instructor provided oral feedback to the group during a 5 minutes period. In addition, a feedback form was filled out by the instructor(s) and uploaded to the website under the group’s own space. We were using Desire to Learn (D2L) which allows each group to have its own private space under the course website.

PITL meetings are scheduled during tutorial hours. Depending on the number of students, sufficient time is allocated to tutorial hours to allow a weekly meeting with each group for at least 20 minutes.

### 2.2 Instructor Feedback and evaluation

Figure 1 shows the feedback form filled by the instructor and submitted to students on the website. The form consists of three parts. The first part records group information like group ID, project name, time and date of PITL meeting, and attendance. Regarding attendance, students are told that PITL should be treated as a small quiz.

The second part provides specific performance feedback with regard to three areas. The first area relates to project progress in the previous week. The second area relates to the content of the meeting and the clarity of the discussion. The third area relates to the meeting format and previous preparation. There are four levels of performance: Exceeds expectation, Meets expectation, Below expectation, and unacceptable. These levels are equivalent to 10, 9, 7, and 4 respectively. The marking for the PITL is intentionally generous and meant to make the students take the PITL seriously but without adding too much pressure on them to the extent that they try to fake the meeting. The marks for all areas are added and averaged and one final mark is given to this PITL meeting. All PITL meetings were given a weight of 15%. That works out to 2.5-3% per meeting depending on how many PITL meetings were conducted.

The third part consists of written comments and specific action items that the group has decided to accomplish by the next meeting. The group progress can be tracked against these action items in the following PITL meeting.

### 3 Student feedback and Impact

Two surveys are administered to ENGG*3100 students at the end of the semester. The first is a generic university survey intended for evaluation of courses and instructors, and is of limited usefulness for evaluating specific initiatives within a course. Overall, student opinions of the overall quality of the course and the instructors have remained broadly similar over the last three years. The second survey is an anonymous three page survey of questions that seek feedback on specific aspects of the course. The survey is distributed to students during the final design reviews that are held during the last week of classes.

The survey has been administered in ENGG*3100 in 2008, 2009 and 2010. The majority of questions have remained the same, allowing comparison between years. Response rates of 95%, 93% and 81% of students in 2008, 2009 and 2010 respectively suggest the surveys represent true samples of student opinions. Of surveys returned, more than 90% included responses to all questions.

With respect to PITL meetings, two questions were asked as presented in Figure 2. A strong majority of students (81%, 76% and 82% in 2008, 2009 and 2010 respectively) agreed, or strongly agreed, with the statement that “feedback during professor in the loop (PITL) meetings was valuable and helped my group communicate and design more effectively than if we had not had PITL meetings”. Most students (70%, 73% and 80% in 2008, 2009 and 2010 respectively) agreed, or strongly agreed, with the second question (Q3 in Figure 2) which dealt with the PITL format. The apparent increase in agreement in this question over the last three years may
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Q2: The format of the PITL meetings (15 minutes group meeting, 5 minutes feedback) provided regular, structured meetings with instructors and TAs. Weekly PITL meetings improved our design process and resulting final design, relative to not having regular meetings with instructors and TAs.

a. Strongly agree  Comments: 
b. Agree  
c. No difference 
d. Disagree 
e. Strongly disagree

Figure 2: PITL feedback form

reflect the enhanced ability of the instructors in presenting the PITL format to the students.

Additional written comments were also provided by students regarding the PITL meetings. These comments varied from extremely positive to extremely negative. Most comments suggested that the primary value of the PITL meetings was the imposition of regular meetings with sufficient structure and marks attached so that groups were motivated to keep working throughout the semester. Many students commenting felt the observational part of the PITL format was not as valuable as discussion with the instructors.

In 2009 and 2010, students were asked if they were co-op or non-co-op students. (Roughly half of Guelph engineering students opt to participate in co-op programs.) The percentage of co-op students agreeing with the two PITL prompts was virtually identical to that of non-co-op students both years, suggesting co-op experience did not change the perceived value of the meeting format. Also, the PITL results for all students from the three years were very consistent, suggesting that the value of the meetings was not strongly correlated to specific projects or classes of students.

4 Discussion and conclusion

It is clear from the data presented that the students feel that it is important for them to have regular meetings with the instructors. We should also note that the authors felt that the PITL meetings were very important to have a good understanding of the design process that each group is following. PITL proved to be particularly valuable when several groups were working on the same design project. Contrast between how various groups explored the same problem were quite valuable and reflected different learning styles and experience. That allowed us to tailor our feedback to each group which reflected in the students support for the PITL meetings. We note that we took special care not to discourage students from exploring any direction of design to avoid having students reflecting our design preferences not theirs.

The PITL also allowed much better interaction with groups. The authors were able to know the students well and have a much better interaction with them than the standard lecture would allow.

In summary, PITL provides a valuable technique for enhancing the transfer of design skills from instructors to students. This is validated by three years of student feedback survey.