

Encouraging Peer-to-Peer Learning in Technical Graphics: A Strategy for Consideration

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Abstract

This digest provides a snapshot of the way Technical Graphics is taught at one university in Ireland. It describes challenges encountered in teaching the module, discusses an innovative approach developed to help address highly differential student skill and experience, and reports initial how future qualitative analysis will assess efficacy of the intervention. The intervention was a peer-debrief strategy for pairing entering freshmen, to encourage knowledge-sharing and peer-to-peer mentoring. The institution has always taken a practical hands-on approach to learning and teaching. Socratic method and self-directed learning are poignant underpinnings of the education.

Introduction

This digest provides a snapshot of the way Technical Graphics is taught at one university in Ireland. It describes challenges encountered in teaching the module, discusses an innovative approach developed to help address highly differential student skill and experience, and reports initial how future qualitative analysis will assess efficacy of the intervention. Data collected include course evaluations, reflective student essays, and final grades.

The educational intervention involved implementing a peer-debrief strategy in a Technical Graphics module conducted for a group of 28 highly diverse students. The module was conducted in the autumn semester of 2017 and an innovative, impromptu method was used for pairing entering freshmen, to encourage knowledge-sharing and peer-to-peer mentoring. Forthcoming analysis of data will aid this Action Research project, and findings will be implemented into practice the next time the author is assigned to teach the module (spring 2020).

Course Context and Design

Technological University Dublin (TU Dublin) offers a four-year Bachelor of Engineering (BEng) degree. Coursework in Technical Graphics spans two semesters, with two hours per week spent learning basic drafting skills in one semester and CAD in the other semester. Although students are randomly assigned to groups, the challenges of teaching the class in the fall semester still differ from teaching in the spring semester, largely because the students are brand new to university and have yet to form social networks. The course is practice-based and all BEng students must complete it, regardless of their level of preparation.

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The syllabus (or “module descriptor”) and learning activities for both Tech Graphic and CAD are provided to the instructors of individual sections. Sections are taught in rooms with tilting drawing surfaces designed to accommodate 32 students simultaneously. Students use set squares and other very basic equipment for drawing and can use lockers in the building to store their equipment between classes if needed.

Teachers provide a short demonstration or explanation at the outset of each class, providing each student with a handout explaining the drawing activity for the day. Each week the students produce a different kind of engineering drawing, in order to learn the way engineers communicate technical information and to read, interpret, and create such content themselves.

Educational Challenges

In the fall of 2017, a section of students 28 completed drafting on Mondays in the 4-6 PM timeslot. Two instructors led the class using the syllabus, assignment handouts, and teaching methods prescribed by the module designer.

A primary challenge was to bring 28 students with widely different level of experience and skill in reading drawings and drafting up to the minimum standard within 12 weeks’ time. Other challenges were to provide timely feedback and fair and transparent marking (grading/assessment) within a system where 40% is the minimum pass mark. A challenge more prominent in the first semester is introducing students to collaborative, peer learning methods including problem- and project-based learning and self-directed learning. Most have never encountered these active learning methods, as Irish schools rely heavily upon rote learning with high-stakes exit exams rather than continuous assessment.

By the end of the first day of class, it was apparent vast discrepancies existed separating experienced drawers from those who had never seen or used the tools, and could not decode a technical drawing with top, front and side views of a simple metal hinge. Although the handout was meant to serve as the guide under this course design, with teacher providing basic tutoring, some students were much more able to interpret the language and graphic content of the handout than others.

Educational Intervention

To help break the ice (in that the students were brand new to university, this was their first day of classes, although it followed a week of freshman orientation) and to address the discrepancy in past exposure to the methods, techniques, and conventions, the lead instructor proposed a novel solution. At the end of the first class meeting, she asked students to identify their level of comfort

and confidence with the day's assignment (using the T-square and set squares to draw a page border, title block, and sets of lines at 15, 30, 45, 60, 75 and 90 degrees). Roughly one third of the students indicated that they had prior experience and a high level of comfort; she asked them to stand in the front of the room.

Then she asked those who were new to the subject or who felt overwhelmed or very uneasy about the day's assignment to identify themselves. About one third of the students identify themselves this way, and she asked them to stand in another part of the room. This left one third of the student sitting at their desks, representing the middle tier of experience and comfort.

At this point, she invited each student in the novice group to select one from the experienced group and to ask that person to serve as his or her mentor for the course. She asked the each of the individuals in the middle group to pair up with one other, effectively creating a buddy system.

Starting with the second class meeting, students were directed to consult their buddy when any questions or confusion emerged and to try to resolve the issue by working together. Initially, there was quite a bit of resistance, particularly on the part of some international students, who wanted immediate attention from the lead teacher whenever they encountered confusion. Other students more readily accepted the format and began asking questions of each other—a type of peer-to-peer learning they had not encountered before in school.

In particular, some of the most novice students and those with the most need for help were the least willing to ask other students for advice. Some resisted the system, waving to the teachers rather than asking a friend at the slightest un-surety. The teachers remained steadfast and encouraged pairing; they helped coach the most reluctant through the process of working together to resolve problems. By mid-semester, students were accustomed to the process and adopted it freely, although the original selections of mentor and buddy did not always stick, all students eventually found peers they were comfortable conferring with in times of trouble.

Data Collection

As noted above, data include course evaluations, reflective student essays, and final grades. All of these were submitted in handwritten form. Data were translated manually into digital format by the lead author two years after the course finished, and verified for accuracy.

The university's standard course evaluation form was used. One copy was provided to the Assistant Head of School and the original set was retained by the instructors for use in improving their delivery. Prompts for reflection included:

- Was the subject new to you, or had you studied this before?
- Was the way it's taught different than your used to? If so, how?
- Did it change the way you think about classes, the role of your teacher, or the role of your classmates?
- Has it changed anything else?

- Did you find it interesting and a good level of challenge?

In all, 28 students submitted essays (which could be written in class or before class) and 24 students submitted surveys. Raw data are provided as collected via the reflective essays (Appendix A) and qualitative portions of the course evaluation survey (Appendix B). Quantitative data have been stored in a spreadsheet and are not provided here.

Study Design

To culminate this Action Research project, the author will use grounded theory (Charmez, 2104) interpret student experience and identify learning outcomes. Qualitative data will be imported into NVivo 12 for analysis and identification of themes. Quantitative data will be entered into SPSS and analyzed for statistical relationships. The data sets will be triangulated to identify correlations. Findings will be used to enhance delivery of this module, shared with instructors running other sections, and potentially used to re-design or restructure the module in the future.

Conclusions

Overall, student response was positive to the course and the buddy system used. Observations made during data entry were that some experienced students needed more challenge but that helping teach others and being allowed to leave once the drawing was finished took off the edge. Response from novice students was highly positive regarding the pairing system; a number of these students would still like more direction from the teacher, however. Grading was the most problematic of the areas, based on the ratings students assigned in the course survey. Library and digital teaching resources are not utilized, as reflected in the high frequency that “non-applicable” was assigned to question in this category. It appears that students answered the survey candidly (despite the fact that the university does not collate evaluations nor use them to determine promotions). They also gave good attention to the reflective essay, collected one week prior to the course evaluation while the lead teacher was away.