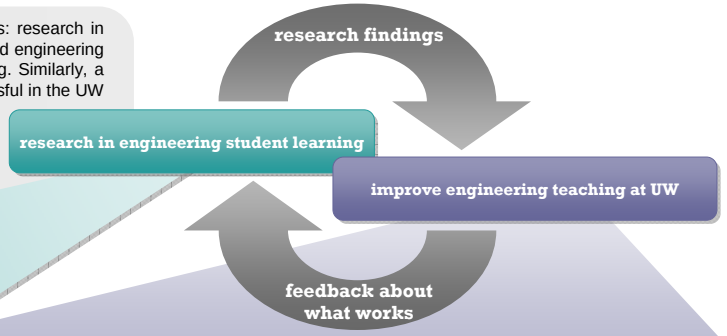
CELT

center for engineering learning and teaching

university of washington

The Center for Engineering Learning and Teaching (CELT) – founded in 1998 at the University of Washington – is focused on two synergistic activities: research in engineering education and improving engineering teaching through instructional development. This dual-role structure is based on an awareness that a solid engineering education research base is needed to inform educators about how their students learn and that this research should drive and support effective teaching. Similarly, a broad understanding of what takes place in engineering classrooms is important for pinpointing important areas for research. This model has proven successful in the UW College of Engineering and has had an impact on engineering education at national and global levels.

Our mission: To conduct internationally recognized research engineering learning, to promote teaching effectiveness in engineering classrooms at the UW, and to be a model for effecting change in colleges of engineering.



research in engineering student learning

CELT educational researchers work on funded research projects with colleagues from the University of Washington and across the nation to conduct research that advances engineering education. CELT's research agenda includes many aspects of scholarship in engineering education. Research is ongoing in the areas of design learning, knowledge integration of learners, understanding the student learning experience, and the significant challenge of integrating research findings with teaching innovations.

Example:

Research questions

How do years of experience shape how expert engineers solve design problems? What have they learned to do that sets them apart from engineering students?

Method

Participants: 19 engineers with an average of 19 years of experience, 26 first-year, and 24 senior engineering students.

Experiment: Given 3 hours to design a community playground (working individually in a lab setting) and asked to think aloud.

Analyses

Line-by-line coding of participants' think-aloud commentary by mode of design activity and type of information considered.

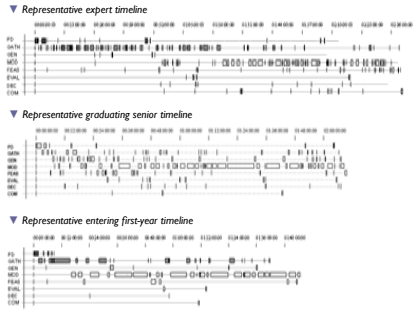
Selected findings

Compared to freshmen, ***seniors…***

…have higher quality designs
…scope the problem more effectively
by considering more categories of information
…make more transitions among design steps
…spend more time iterating
…progress farther in the design process.

Compared to students, ***experts…***

…spend more time solving the problems in all design stages
…exhibit a 'cascade' pattern of transitions
…scope the problem more effectively
by gathering more information (explicitly)
by covering more categories of information.



Implications for engineering education

This research provides empirical insights and rich representations that can illustrate important aspects of the design process that may be inadequately stressed in design texts. For example, the importance of spending adequate time at the beginning of a design process scoping the problem, and similarly, attending to each of the elements of project realization at the end of the process.

improve engineering teaching at UW

CELT instructional consultants build on current research to offer a diverse set of program elements with a goal to improve engineering learning and teaching in the College of Engineering at the University of Washington. This includes working with individual instructors, conducting workshops and seminars, and active participation in strategic-level initiatives.

Example:

Current project

The CELT team is collaborating with engineering instructors in project-based courses to improve their students' awareness of the components, complexities, and benefits of well-planned and executed engineering design processes. Drawing from our design research findings, we developed interactive seminars, in which students analyzed design process timelines and formed insights for discussion. In these seminars, students compared their own analyses with those of their peers and to findings from our design research.

In winter 2008, the CELT team facilitated a 90-minute seminar for 38 seniors in a capstone design course. The seminar was entitled "*How Prepared Are You? Compare Your Engineering Skills With Other Graduating Seniors.*" The seminar was seen as helpful by both the students and the instructor. Students were particularly interested in our findings that showed how much more complete a representative senior design process is than that of a representative freshmen and that senior design processes are beginning to look more like the experts.

In spring 2008, the CELT team facilitated a 50-minute interactive seminar entitled *Engineering Design Processes*, with 35 students in a junior level structures course. The course was centered on a team-based design/build project. In addition to the seminar, CELT developed several instruments for use by student teams to help them record, monitor, and plan their project design processes.

These examples illustrate how educational research that is current and discipline-focused can readily compliment an instructional development process. These interactive seminars, not only benefit students, but by working collaboratively with engineering faculty in the planning and implementation of the seminars CELT can concretely demonstrate important learning theories and pedagogical principles, which also benefit students in future courses. Additionally, by asking students and instructors to bench-test our findings we get a better idea of their usefulness and clarity, and we also learn what students view as important that we might study further.

CELT as a Resource for Educational Research in Engineering

An important aspect of our mission is to provide assistance to faculty and graduate students in the development of engineering education research or research with an educational component. CELT provides a broad range of assistance to CoE researchers, from consulting on research proposal development, assisting in the gathering and analysis of data, to more substantial research collaborations.

CELT as a Resource for Teaching Improvement in Engineering

Our approach to faculty development begins with meeting and resolving the immediate concerns of faculty members. Through one-to-one consultations as well as needs-specific workshops and seminars, CELT helps engineering faculty base their teaching practices on well-grounded understandings of learning, course design, and student development, rather than reproducing traditional educational models.

CELT as a Resource for Systems-level Improvement in Engineering

As a direct result of our local and national recognition in engineering education, and the rapport we've developed amongst engineering faculty, CELT is often invited to join in college and department level curriculum and policy improvement initiatives.

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