

followed by completion of an initial prototype and authorship of a written design brief. Opportunities for peer review of this document during class meetings throughout the fall semester prioritize interdisciplinary engagement and build professional communication skills. During the spring semester, the focus shifts to product development, as the teams collaborate to develop a form model and iterative functional prototypes as well as marketing and manufacturing plans for their products. The course experience culminates in team presentations during the university-wide undergraduate research symposium.

CATME peer-evaluation survey results indicate that interdisciplinary teams generally have higher satisfaction than teams composed solely of engineers. The CATME peer-evaluation survey was administered three times over the course of the academic year. In each iteration, students provide self-evaluation scores as well as a score for each of their teammates on the following characteristics:

- Having relevant knowledge and skills (H)
- Interacting with teammates (I)
- Contributing to the team's work (C)
- Keeping the team on track (K)
- Expecting quality (E)

Teams with students from four or five different majors demonstrated higher average scores across each of these categories than teams with representatives from one or two majors.

Direct and indirect assessment measures offer evidence of student learning gains related to written and oral communication competencies with evidence of greater gains since the inception of the formal partnership with the URO. An independent panel of university faculty and staff reviews and scores project funding requests submitted to the URO. All of the proposals were funded for the 2015–2016 course sequence, with five funded in full, in contrast to 33.3 percent that were funded in the previous year. On a scale of 1–5 with 5 as the highest possible score, the average rating for proposals from students in the BME Design course sequence increased from 3.22 for the spring 2015 funding cycle to 3.50 for the spring 2016 funding cycle. Results from the post course iteration of the Classroom Undergraduate Research Experience (CURE) Survey provide student self-assessments of learning in this domain. Respondents ($n=17$) reported above average gains in their abilities to write a research proposal, present results orally, present results in written papers or reports, present posters, and critique the work of other students. Administered by David Lopatto, professor

of psychology at Grinnell College, the CURE survey report includes course-specific results as well as nationally normed data drawn from all participating courses.

In addition, several interdisciplinary teams have won design awards in external competitions such as the BME Start competition sponsored by VentureWell, the MIT Enterprise Forum, and the Social Finance Global Innovation competition sponsored by BNY Mellon. Many teams have also continued commercial development of their design projects after the completion of the course. One such example is the Calibrace+, a flexible brace that alleviates posture issues in patients with Parkinson's disease. Initially developed as the People Prop by a BME design team, it is being marketed commercially by Abilife. 

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Research-Intensive Course Designation

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Integrating undergraduate research into the curriculum is growing in popularity within academic institutions. This practice provides an opportunity for faculty to expose and engage more students to authentic research practices within their courses and scaffold the development of research skills toward a capstone research experience. The process of recognizing research-intensive activities on student transcripts remains limited at many institutions to honors students and through formal theses. A need exists to provide evidence of additional curricular research-intensive activities that do not appear on student transcripts. Such activities could include individual or group classroom projects whereby students are actively engaged in the research process. For students, transcript designation is an opportunity to showcase their research accomplishments. For faculty, this practice can provide credit for intensive undergraduate research mentorship and be applied to annual reports and other promotion portfolios. A few institutions nationwide have begun the process of establishing institutional mechanisms for certifying and designating research-intensive courses. As part of institutional reaccreditation through the Commission on Colleges of the Southern Association of Colleges and Schools (SACSCOC), Florida Atlantic University (FAU) and George Mason University (Mason) implemented quality enhancement plans (QEPs), which included developing university-wide mecha-

nisms for certifying research-intensive courses. These models follow below.

Florida Atlantic University Research-Intensive (RI) Course Designation. Florida Atlantic University is a public university with high research activity, enrolling approximately 30,000 students (including 25,471 undergraduates) and ranking as the most diverse in Florida's 12-institution state university system. FAU encompasses six campuses across a six-county service region in South Florida, with more than 180 degree programs. FAU implemented a QEP, *Distinction through Discovery* (2013), to expand a culture of undergraduate research and inquiry across all campuses and programs.

Within this plan, FAU established a mechanism to recognize research-intensive, curricular activities through the research-intensive (RI) course designation. RI courses actively engage students in the process of original and/or applied research. Students address a research question and generate tangible research outcomes such as communicating results. Courses are taken for a letter grade of which a significant portion must be tied to the RI assignment. RI projects may be individual or group projects; however, each student receives an individual assessment. FAU has a separate course designation, directed independent research (DIR), for individualized, independent research activities.

FAU established a committee of faculty from all colleges, the Undergraduate Research Curriculum Committee (URCC), to launch the RI designation. The URCC serves as a subcommittee of the University's Undergraduate Programs Committee. The URCC crafted an RI Designation Manual that includes RI definitions, application guidelines, and course submission procedures. Faculty submit a course syllabus and cover letter that demonstrate how the course meets the student learning outcome and RI requirements. After department and college approvals, the URCC reviews portfolios and provides recommendations or revisions. Final approval occurs through the faculty senate. The RI designation may be applied to individual sections of courses and/or the entire course. RI courses include the prefix "RI" in the course title; the designation appears on student transcripts. Course approvals began in spring 2016. To date, 27 RI courses and 76 DIR courses from four colleges have been approved. A three-year syllabi review process for certified courses ensures sustainability of RI activities in the curriculum.

George Mason University Research and Scholarship (RS)-Intensive Course Designation. George Mason University is a public university with high research activity located near Washington, DC, in Fairfax, Virginia. More than 198 degree programs serve a diverse population of almost 34,000 students (includ-

ing 21,990 undergraduates). Mason adopted the *Students as Scholars* QEP (2011), a university-wide initiative to improve student success through increased participation in, and celebration of, undergraduate research and creative activities.

A central element of this QEP was establishing scaffolded learning experiences, culminating with research and scholarship (RS)-intensive courses. In RS courses, students conduct authentic scholarly work that composes a significant portion of the class, and students have the opportunity to disseminate their results beyond the classroom. RS courses are generally upper division, and departments are encouraged to designate both "classroom"-type and individualized scholarly activity ("independent research") courses. The registrar identifies RS courses with an RS attribute that appears on student transcripts. This designation is applied to entire courses, not just individual sections.

A faculty planning committee first proposed the RS designation and worked with the provost and registrar to approve and implement the designation. The plan was presented to the faculty senate and the Board of Visitors. Because the RS designation is not required for graduation, neither group needed to approve it.

Mason established a Faculty and Curricular Activities Committee (FCA) to review and approve courses. Faculty submit a portfolio that includes the syllabus, a narrative statement describing the course and a plan for sustainability, a curriculum map demonstrating course activities that meet student learning outcomes, and a statement of support from the chair. The FCA reviews the proposed courses. Outcomes can include approval as submitted, approval with minor revisions, return for revision, and denial. Since 2012, 80 RS courses have been approved in all undergraduate schools and colleges. The assessment and FCA committees review course portfolios (including revised syllabi, a faculty reflective statement, and student work samples) after the first incarnation of the course and after any significant changes to the course.

Conclusion. The experience with research-intensive courses shows that several elements of the process are vital to institutional success:

- *Broad faculty participation* to define the course criteria (percentage of the course grade associated with the research requirement, student learning outcomes, instructor requirements, and research outcomes)
- *Establishment of a review mechanism* within the institution

- *Interaction with the registrar's office* to ensure feasible processes for transcript designation
- *Assessment* of the courses to ensure sustainability
- *Support of faculty* as they develop, submit, and teach the courses
- *Direct communication with students* to let them know the benefits of the courses and encourage registration

Other higher education institutions should consider designating research-intensive courses in student transcripts, as such a practice helps to develop a shared understanding of student research across disciplines as well as demonstrate student involvement in the diverse conduct of research across institutions. 

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