CALIFORNIA INSTITUTE OF TECHNOLOGY

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To: Jean-Lou Chameau, President
cc: Ed Stolper, Provost

From: **committee on online educa**tion: Mike Brown, Mani Chandy (Chair), Cassandra Horii, Melany Hunt, John Johnson, Beverley McKeon, Rob Phillips, Antonio Rangel, Sarah Reisman

You formed the committee on online education in October of this year with the following charge: *Report to the Caltech administration about strategies for online education that enriches our undergraduate and graduate programs and recognizes the changing landscape of educational resources and opportunities.* This memorandum contains the committee's report.

Online courses and educational technologies are making significant changes in education around the world. The changes are so profound that they merit the engagement of the entire Caltech community in an ongoing conversation. The committee submits this report as a part of this conversation.

The focus of the report

This report contains the committee's recommendations on (1) online courses offered by Caltech personnel that may be taken by non-Caltech students to acquire "certificates" or "statements of completion" from Caltech, and (2) online courses offered by non-Caltech institutions for which Caltech students may seek academic credit.

Many members of the Caltech faculty already put course and other material online. In some cases, the material requires Caltech registration and passwords, and in other cases the material is open to everybody. This committee did not consider policies regarding material that faculty may put online. (We note, however, that solutions to problem sets and exams that are posted online may be accessible for years; this may result in misuse of the material and possible Honor Code violations at Caltech and other institutions.)

The environment for learning at Caltech

A faculty member is the appropriate person to determine the optimum learning environment for his or her courses. Some courses may be best taught using chalk and blackboards while others may benefit from the latest online technologies. Some instructors use online technology to improve residential education at Caltech; for

example they "flip the classroom" so that classes are used for discussion and interactive problem solving, and students are expected to interact with material or watch videos outside of class. Other instructors use computer tablets for animation, annotation, and running simulations in the class. The Caltech administration should continue to foster the use of technology to facilitate learning.

The committee finds that new online material and platforms offer a significant opportunity for improving learning at Caltech. Flipping the classroom allows students to spend more time on solving problems, projects and experimentation. Faculty members may use online material to teach courses that would not be offered otherwise; this alternative is especially relevant to options with small numbers of faculty members compared to Caltech's peer institutions. Graduate students can benefit from specialty courses that are not offered frequently. Some options are unable to staff key undergraduate courses every year; students may be able to plan more flexible course schedules by taking a few online courses with help from instructors and TAs. Professors may recommend that students take online courses before starting on SURF projects. Online courses and related technologies can improve the environment for learning at Caltech in many ways.

Extending Caltech's educational impact

Caltech education, defined broadly, already has a significant impact outside Caltech. Caltech achieves its biggest impact through its graduates and research. Other examples of significant impact include textbooks, monographs, Caltech TEDx events and "*The Mechanical Universe*"—a series of 52 30-minute educational videos developed by David Goodstein, Jim Blinn and Richard Olenick.

Professor Yaser Abu-Mostafa offered an online course "*Learning from Data*" completed by thousands of students, many of whom have commented on the excellent quality of the course. Henry Lester, George Djorgovski, and Antonio Rangel are offering online instructional material through *Coursera* this academic year in biology, astronomy, and economics; these courses will also be taken by many thousands of non-Caltech students.

Different forms of computer-based education have been available for decades; what is new is the potential to reach hundreds of thousands of students, the availability of high quality material from peer institutions, and the development of sophisticated interactive online educational platforms. MOOC (Massive Open Online Course) platforms such as *EdX*, *Udacity* and *Coursera* are improving and reducing the effort required to produce online educational offerings.

MOOCs help extend an institution's educational impact, encourage the best students to apply to the institution, help in identifying excellent students, and may—at some point—add revenue to the institution. Prospective students around the world will learn about the breadth and depth of Caltech's work, especially in newer areas. Online offerings may help satisfy some government agencies' requirements for

"broader impact" in grant applications and come with built-in learning analytics, thereby simplifying required evaluation of impact.

Online educational offerings also carry potential risks. Some students who would have otherwise come to Caltech as fulltime resident students may choose to get degrees from other institutions and obtain statements of completion for Caltech's online offerings. Job seekers and applicants to graduate programs may include statements of completion of online offerings from Caltech in their resumes. The difference between such statements and credit for regular Caltech courses should be made clear to employers, educational institutions and the public at large. Our peer institutions face the same problems and a multi-institutional approach is likely to emerge in the next few years.

RECOMMENDATIONS

The committee recommends that Caltech carry out a pilot project over the next two years to determine a uniquely Caltech strategy for offering educational material online to non-Caltech students. The strategy should be tailored to Caltech's characteristics—our emphasis on excellence, our small size, and our wide variation in faculty-student ratios across different options.

The pilot project

Offering the very best massive open online courses in key areas will extend Caltech's impact. The committee recommends that Caltech experiment with the development of a small number of superb MOOCs; identify best practices from the experiment; and then develop an ongoing strategy. This recommendation follows Caltech's approach to everything: few and excellent is preferable to many and less-than-excellent; and careful experimentation, pilot projects, and unbiased data help in making decisions.

A significant amount of an instructor's time is required to develop a Caltech-quality, online course. Instructors of online courses will need student and staff support for using online technologies effectively—for example to make interactive teaching modules with homework sets suitable for online grading, simulations/animations of scientific processes, and handle the logistics of massive online courses.

The administration should ask Caltech faculty members to submit proposals for offering online educational material and select a *small number* for investment. The proposal could be short, but should include a description of the benefits of the course, to external and/or Caltech students, estimates of faculty time, staff time, and other resources required. These courses should be developed in 6 – 12 months and offered the following year. Instructors of existing online offerings may also submit proposals for time and resources.

The Institute should monitor the project and identify strengths, weaknesses and best practices. In addition, the Institute should keep abreast of innovations at other

universities. Different options may choose to develop or use online material in different ways, and the evaluation of the experiment should be sensitive to the heterogeneity across options. Ideally, the experiment should include at least one course from each division.

A possible timeframe is as follows: Issue the call for proposals in the first quarter of 2013; select courses for investment by the end of the first quarter; offer 5 to 10 MOOCs in the 2013-14 academic year; conclude the experiment and report to the institute by the end of that academic year.

Statements of Completion of Online Offerings

The committee expects that the institute will have a mechanism for offering statements of completion for its offerings of online courses after the experiment is completed; however, the institute has to determine *immediately* whether Caltech faculty can give statements of completion for MOOCs that they are offering currently.

The committee recommends that any statement of completion emphasize that the statement is for an online "offering," and not a Caltech course. The statement of completion should also indicate that it does not imply Caltech credit. The committee recommends that the institute approve an interim format for completion of online educational offerings until the proposed pilot project is complete. One possibility is something along the following lines: "John Doe has successfully completed an online non-credit offering on Quantum Computing given by Prof. Jane Smith of the California Institute of Technology"

Example statements of completion from Coursera contain additional language clarifying the limits and scope of the statements. We recommend using the language employed by Stanford and other universities, such as:

Please note: some online offerings may draw on material from courses taught on campus but they are not equivalent to on-campus courses. This statement does not affirm that this student was enrolled at the California Institute of Technology in any way, nor does it confer a university grade, course credit or degree, and it does not verify the identity of the student.

An instructor proposing to implement an online educational offering in which students can get a statement of completion that includes Caltech's name should get permission from a Caltech organization such as the Provost's office. The committee believes that Caltech faculty and administration will ensure that only the best educational offerings will be made public.

Should Caltech's name appear on the statement of completion? Caltech will benefit from being associated with the superb online offerings that we expect Caltech faculty to develop. We recommend that a statement that includes a phrase such as " … offering by Prof. Jane Smith of the *California Institute of Technology*" is

appropriate. Caltech's name on the statement affirms that Prof. Jane Smith is indeed a professor at Caltech. This use of Caltech's name is consistent with its use in identifying authors of papers and books, and in identifying speakers at events.

Online courses do not change the manner in which students get credit for a Caltech course: they must be admitted to Caltech, pay tuition, enroll in courses, and get a grade from a Caltech instructor for a course in the catalog.

Benefits to Caltech students for online courses offered elsewhere

Caltech students may benefit from online courses offered by other institutions just as they benefit from any other material. The committee recommends that the institute continue its current policy for offering credit: *Only Caltech faculty can give Caltech credit*.

The institute has a policy for allowing students to transfer credit for courses taken from some institutions. Students must petition for transfer of credit and get approval from a faculty member before they take the course. A faculty member approving transfer of credit may ask to see the student's assignments after the student takes the course and may require the student to take tests before giving final approval. The committee recommends that the same policies continue. The two key requirements for obtaining Caltech credit for a non-Caltech course are that the student must get credit for an approved course at an approved institution (and not merely a certificate from an organization) and a Caltech faculty member must approve transfer of credit.

Summary

The committee believes that online educational technology offers a huge opportunity for Caltech. The institute should determine a strategy to exploit this technology that fits Caltech's uniqueness. The committee recommends a controlled experiment with a few courses offered in the next year so that the institute moves quickly and carefully.

ADDENDUM

The addendum discusses some of the reasons for the committee's recommendation that Caltech pay attention to changes in online educational technology and start developing a strategy to capitalize on these changes.

Caltech's excellence and size

Caltech's excellent, small, cooperative student body and faculty allow small groups at the institute to learn by doing: solving problems, conducting experiments, analyzing data, and discussing issues. Online material can help students and faculty spend more time working together on doing things and less time, if appropriate, listening to lectures.

Motivated students

Caltech's students are motivated. Their motivation makes them likely to learn material in which they are interested from papers, books, as well as online material. The quality of Caltech's students makes online, and other, material even more useful than it would be in a community with less motivated students. The institute should continue to study ways in which online material can help members of the Caltech community to learn.

Options with small numbers of faculty

Some options at Caltech are much smaller than their competition in peer institutions. The small number of faculty in these options result in some key courses being offered only every alternate year or even less frequently. Even relatively popular undergraduate courses cannot be offered every year, and as a consequence undergraduates have limited flexibility in planning their schedules. Likewise, graduate students have to wait to take courses that are helpful in their research. Online material can help these options offer better educational programs for both undergraduates and graduates.

SURF programs

The SURF program is an important part of a student's academic experience. Some students want to do SURF projects but don't have some classes or skillsets that will get them the most benefit from the projects. SURF mentors could ask students to take online courses before they start their projects.

Our competition if moving

The committee believes that MOOCs will play an important role in education in the U.S. and elsewhere. Our peer institutions are offering educational opportunities to the world through MOOCs. Our competitors will use MOOCs to attract and evaluate students worldwide, and recruit the very best ones. Caltech may choose to use MOOCs in ways that are different from those of other institutions; however, the committee believes that Caltech must explore the use of these platforms for offering learning opportunities to people outside Caltech. The institute's challenge is to find a strategy that fits Caltech's unique role.

Caltech's niche areas

Caltech can offer online learning opportunities in niche interdisciplinary area in which Caltech excels. These learning opportunities do not have to correspond to courses; however, new online platforms may offer ways for large numbers of people to learn about areas in which Caltech is blazing a trail. A person learning from this online material may be a scientist at a national lab or an executive in a company as well as a student at a university. Caltech instructors can also offer learning opportunities that mirror Caltech courses. Online platforms are valuable ways of teaching large numbers of people about areas in which Caltech excels.

Reaching professionals and other communities

Several working professionals are taking Henry Lester's online course, "Drugs and the Brain." These professionals include over a hundred MDs and a hundred therapists. Online educational offerings help Caltech reach communities that are not reached by more traditional educational methods.