UC DAVIS EDUCATIONAL EFFECTIVENESS REVIEW

Team Report

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Preparatory Review Team Roster

Date of Visit: December 4-6, 2002

Type of Visit: Preparatory Review

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Educational Effectiveness Review Team Roster

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I. The UC Davis Institutional and Visit Context

Established as an experiment station site for the University of California in 1905, UC Davis became a general campus of the university in 1959 and has grown to a large public research institution that is an integral part of the ten-campus University of California system, California's land-grant institution. UC Davis serves over 29,000 students and reflects, more than most UC campuses, the land grant tradition.

UC Davis has a clearly stated commitment to undergraduate education and serving the community. Even in tight budgetary times, UC Davis enjoys the prestige advantage of the larger system of which it is a part and the generous support of the state of California. The landmass of the campus is the largest of any in the system and the town environment conducive to the mission.

The last on-site visit was conducted in October 1991. A subsequent fourth-year visit to focus on planning and general education in 1995 was later changed to a fourth year report. The recommendation for a fourth year visit was the result of the Commission's strong concerns about the university's requirements and practices with respect to general education and planning. The team also had concerns about the university's draft planning statement.

In 1997, the Commission completed its review of the fourth year report. It found that UC Davis had made considerable progress in the area of planning (although it found that planning remained reactive rather than proactive), and it concluded that a strong foundation for future planning had been laid. With respect to general education, the Commission found that

considerable effort had been expended, but that the results were not encouraging. A major concern was the absence of a General Education philosophy and the lack of coherence. While recognizing that a general education curriculum is a challenge for all large complex universities, the 1997 team believed that UC Davis could and should do better.

The Preparatory Review Team evaluated the review materials and visited the campus in December 2002. The Educational Effectiveness Review visit came in March 2003 just 3 months after the Preparatory Review visit. The compressed time frame left the institution less time to prepare for the second visit than would be typical under the new WASC process. Nevertheless, the UC Davis accreditation team responded to our needs during both site visits and with supplemental information in the three months between them. This report constitutes an amalgamation of the issues and concerns addressed in both the Preparatory and Effectiveness Reviews.

II. Alignment of the Educational Effectiveness Report with the Institutional Proposal

UC Davis chose to use the "special themes" model for the Educational Effectiveness Review. The two themes selected were student research and educational technology in undergraduate education. The Educational Effectiveness Report included narrative backed up by extensive links to other material on the UC Davis website. The basic approach of UC Davis is to provide tools that enable the faculty and students to fulfill the educational goals and to encourage the use of these tools. Although parts of the report are anecdotal, some discussions of key topics include data-driven analysis. There is growing development of educational objectives, metrics,

and analysis. There was considerable faculty input in developing the Educational Effectiveness Report and use of the Chancellor's Fall Conferences to engage faculty in educational issues. In addition, the Educational Effectiveness Essays and web links provided the additional information we requested about the planning process and General Education.

III. Evaluation of Educational Effectiveness at UC Davis

We conclude that the UC Davis campus culture supports a student-centered atmosphere of openness and teamwork that is rare in large public, or even private universities. In the self-study and our visit, we found a self-reflective university with high academic standards. There are many admirable strengths of the undergraduate educational experience at UC Davis. Perhaps the strongest feature of the campus landscape is the supportive and positive campus culture that generates a feeling of teamwork, and that makes more permeable the academic and administrative silos that are so common at large universities. This positive UC Davis hallmark is perhaps best illustrated by the remarkable and elaborate partnership between student affairs and academic affairs. This collaboration among those concerned with academic and student life even extends to offering undergraduates the opportunity to enroll in an academic minor in Leadership. The following sections summarize our review of Educational Effectiveness at UC Davis in its overall approach, in undergraduate research, in educational technology, and in general education.

A. Evaluation of UC Davis' Overall Approach to Educational Effectiveness

There are two general foundations for most academic initiatives and constructive educational change–the inspirational and the pragmatic–doing it because you want to versus doing it because you have to. Both are evident at UC Davis.

The inspirational foundation for innovation and change is doing it for self-improvement, especially for the enhancement of student learning and growth. We in higher education are at our best when we carry out educational change, assessment, and evaluation not to please outsiders, but to satisfy ourselves–to achieve an organizational climate of cooperative development and ongoing improvement, rather than authoritative finality.

The Pragmatic foundation for innovation and change recognizes the need to successfully compete for enrollments and resources and gain a strategic advantage over others. In an atmosphere of scarcity, those campuses that can measure their effectiveness and reshape themselves will do better in the competition for enrollments and resources and faculty than campuses that cannot. And on the campus, those academic departments and programs that are able to provide Presidents and Provosts with evidence about the impacts they are having on their students will be more successful in the competition for campus resources than academic units not able to provide such evidence.

In both the December Preparatory Review visit and the March Educational Effectiveness visit, we believe we have seen at UC Davis both the inspirational and the pragmatic in ample supply. Indeed, there is an array of initiatives and developments underway. On the inspirational side, doing it because you want to, we include the two themes (a) integrating research into the student learning experience, and (b) examining the impact of educational technology. On the more pragmatic side, doing it because you have to, are the revisions in General Education, the newly formalized seven educational objectives, and the enhancement of information built into the Academic Program Reviews. We see the draft "2020 Vision" Strategic Plan as a mix of the

inspirational and the pragmatic. In any case, what we have here is a rich array of constructive and important initiatives—each one having its own history, and impressive aspects.

Our team agrees on two recommendations that we believe embrace all the many activities that we have witnessed, heard about, and read about over the last few months. Each recommendation has several relevant subcomponents, especially in the case of the two themes: undergraduate research and educational technology. The first recommendation recognizes the need to better coordinate, synthesize, and integrate all the separate initiatives under the strategic plan – to connect the pieces. The second recommendation recognizes the need to continue building a culture of evidence.

The need to connect the pieces

One strong characteristic of the UC Davis culture is the decentralization and empowerment of the academic staff. What we think we have seen here is a great deal of autonomy and faculty initiated change bubbling-up. This culture has spawned a large number of disconnected projects and innovations. What we haven't seen (and this may be a function of the brevity of our visit) are the mechanisms for, and interest in, pulling the threads together, linking these efforts to larger institutional goals. For example, the seven educational objectives and the General Education Program appear to be independent, yet one could be a driver for the other, with a gain in educational clarity as a consequence. Historically, concern about the core experiences of the General Education program is one of the few pieces of glue holding universities together, yet there doesn't appear to be a strongly articulated role for general education in the undergraduate experience. The draft "2020 Vision" document could be a great

deal more explicit about the seven educational objectives, about the two research and technology themes, and about the General Education program. We see added value to UC Davis by pulling these threads together creating a more cohesive internal action agenda and external public image.

The need to strengthen the culture of evidence

WASC has increasingly emphasized institutional effectiveness, student learning outcomes, and more generally a "culture of evidence" in its accreditation standards. UC Davis has gradually built a culture of evidence in some areas (such as the personnel portfolios, program reviews, and student affairs operations), and it now needs to do the same in other less developed areas (such as the outcomes of undergraduate research, educational technology, and general education). In the materials on record and conversations alike, we found convincing evidence that UC Davis is a self-reflective institution that takes its educational responsibilities seriously. Indeed, the faculty culture seems unusually attentive to undergraduate students, compared to the majority of research universities with which we are acquainted. The administrative officers we met are well informed about faculty and student concerns, and are perceived by the general university community to be responsive.

Because of the effectiveness focus on undergraduate research and technology, our team generally did not review in depth the institutional mechanisms for maintaining academic and educational effectiveness at all levels of performance. However, there are four levels of university quality assurance reflected in the literature:

1) The classroom/course/student level–assessing the performance and learning outcomes of individual students.

2) The individual faculty member– review of faculty performance.
3) The department and program level–academic program reviews.
4) The University or institution level–strategic planning and evaluation research.

The UC Davis self-study documents, the website materials, and our interviews during the visit reflected on several of these effectiveness levels.

Educational Effectiveness at the Student Level

Three questions lie at the heart of student learning outcomes assessment:

1) What should our students learn and in what ways do we expect them to grow?
   Answering this question requires clear goals and objectives.
2) What do our students learn and in what ways do they actually grow?
   This is the measurement question.
3) What should we do to facilitate and enhance student learning and growth?
   This is the improvement question and requires effective use of assessment results.

Thus, academic assessment and program evaluation by its nature is goal driven, evidence based, and improvement oriented. UC Davis has momentum in each of these respects, and needs to continue down these paths. Having articulated its own particular goals for student learning and personal development, UC Davis now needs to develop suitable methods for measuring progress toward achieving those goals, and should establish the mechanisms for analyzing, reporting and using the results to improve outcomes in the future. There are three especially good readings for assisting institutions to move ahead with their outcomes assessment programs. Perhaps the best

20 pages ever written on outcomes assessment are contained in Terenzini's article on "Assessment with Open Eyes" (1989). Two books by Banta et al. (1996, 2002) constitute helpful resources for campus assessment efforts.

Faculty Effectiveness

There is at UC Davis an elaborate system of faculty assessment that documents faculty accomplishments in teaching, research and creative work, professional activity and recognition, and University or public service. This faculty assessment is linked to decisions about merit pay and steps within rank, and takes place every 2-3 years (depending on rank) for each ladder faculty member—including post-tenure faculty. Moreover, faculty teaching is evaluated by students at the end of each course each semester. Individual instructors and individual departments can vary the survey items and teaching dimensions that are assessed, but most assessments include the overall rating of the instructor and the overall rating of the course (on a 5-point response scale). These student evaluations are complemented by faculty peer evaluations of teaching that include classroom observations at the point of preparation for promotion and merit review. While research achievement is given priority over teaching, the great majority of the administrators, faculty committee chairs, and deans that we met emphasized the prominence of the teaching performance record in personnel decisions. Last, we should note the Teaching Resources Center and the numerous other instructional resources described in documents and websites.

Department and Program Effectiveness

Based upon the documents we reviewed and the discussions we held, the cumulative Program Reviews at UC Davis appear to create a culture of evidence, as articulated in the WASC materials. A number of well-known scholars in higher education (e.g., Barak and Mets, 1995; Banta, 1996) maintain that the most effective form of institutional assessment and improvement is program review. The Program Review Process at UC Davis appears to be integrated into the fabric of academic affairs and constitutes a constructive process of self-examination and continuous improvement. Separate graduate and undergraduate program reviews occur every six to eight years, except that disciplinary accreditations (e.g., ABET, AACSB, NLN, etc.) substitute for the UC Davis review. The self study and review process appears fairly traditional. The graduate review team usually includes three distinguished scholars (two from UC Davis and one from outside). Undergraduate program teams may include an off-campus member but are usually UC Davis faculty external to the department under review. At the heart of the process lies an assessment of program and faculty strengths, weaknesses, outcomes and actions from the previous review, and recommendations for future improvement. New guidelines are being developed that "will require units to go further than they have in the past to articulate program level educational objectives and develop measures of student learning."

The Program Review Process at UC Davis is time-consuming and expensive, but appears effective. One suggestion to improve this robust process is to make even better use of the extensive data collected. There is a general feeling that the rich array of information in these review documents can be better summarized and packaged for internal and external audiences. For example, the student survey data amounts to an assessment in the major and graduate field;

and as such could be aggregated and more fully analyzed showing trends and evidence of effectiveness to relevant internal and external audiences. Trends over time can be especially useful since most UC Davis departments have completed three or more review cycles. In addition, between reviews, departments could use key indicators to benchmark themselves against national indicators using data from IPEDS, CASPAR, and other sources. SARI regularly collects an array of information from students and alumni that should be systematically built into the program review documents.

Institutional Effectiveness

Like most of our own institutions, UC Davis may have collected more data than it has the time and resources to analyze and act upon. Above and beyond the regular university records maintained for all students, SARI lists 40 survey databases since 1998 alone containing potentially useful effectiveness information. This myriad of data collection activities includes surveys of students and recent alumni on matters ranging from admissions marketing to student lifestyle, and from freshman experiences to alumni outcomes. When one puts this activity along side the data generated by ORMP and the many performance requirements of the draft "2020 Vision" document, one sees the building of an enormous culture of evidence that will support decisions and policy development at all levels across the campus. In the past, UC Davis regarded the data warehouse project as a cornerstone in its efforts to build an accessible decision-support information system. The project requires cooperation and input from many campus offices. The current decentralization of analytical talent and information may lessen overall efficiency and effectiveness. We suspect that UC Davis could make it easier for faculty and administrators alike

to receive needed information by consolidating and integrating institutional research capacity under the Executive Vice Chancellor.

In summary, these UC Davis collective initiatives provide an atmosphere of innovation and energy. The reflective essays acknowledge the need to examine the impact and the outcomes of Undergraduate Research, Educational Technology, and General Education. Moreover, the draft "2020 Vision" document is very performance and metrics oriented. Many UC Davis committees and offices appear to be struggling with the challenges of measuring change, performance, and outcomes.

B. Evaluation of Undergraduate Research at UC Davis

According to faculty and administrators interviewed by the site team, the selection of undergraduate research as one of the two themes was based on its pervasiveness on campus and the presence of exemplary programs and courses that foster it. Faculty members were asked to participate in the selection of topics, with undergraduate research emerging as a valuable educational goal on which a majority of faculty could agree. The Educational Effectiveness Review on Student Research thus provides a description of the undergraduate research opportunities available to UC Davis students beginning in their Freshman year, along with limited statistical evidence about the scope of participation. The site visit included closer scrutiny of these offerings, with team members visiting classes, interviewing participating students and faculty as well as administrators responsible for research support.

There is a clear commitment to undergraduate research on the part of many faculty at UC Davis. Among administrators, Patricia Turner, Vice Provost-Undergraduate Studies, is most

responsible for advancing undergraduate research as a campus priority. However, both the scope of student participation in undergraduate research opportunities, and the integration of undergraduate research in the academic mission of the university were very difficult to ascertain. Therefore, the review team had some trouble wrestling with the general question posed in Section IIIB of the Educational Effectiveness Team Report Format, "How appropriate and effective is the model adopted by the institution? Does it enable the institution to explore topics and themes related to the institution's priorities and needs for the improvement of student learning?" Although laudable examples of undergraduate research opportunities were found throughout the institution, it was difficult to gauge their alignment with the core processes and educational objectives of the institution. Undergraduate research opportunities were neither clearly directed toward a sequence of learning experiences nor dedicated to the acquisition of a particular skill set. Despite the clear sense from administrators, students, and faculty of the importance of undergraduate research, no one appeared to believe the experience was either necessary or inherently desirable for all students at the institution. Thus, the theme seemed to bracket a segment of undergraduate education apart from general educational objectives, and assessment processes, such as academic program reviews.

Research opportunities at UC Davis are identified by the institution in six categories:

1) Coursework: including Freshman Seminars, the UC Davis Honors Challenge Program, Integrated Studies, and individual introductory courses regarded as exemplary such as Physics 7
2) Independent studies (194s;199s)

3) Sponsored research projects, including significant attention to underrepresented groups through programs such as BUSP and MURALS
4) Off-campus opportunities such as UCDC
5) Research conference
6) Undergraduate fellowships

The team was not certain that all these entities should count as research and, in fact, the Director of the UC Davis Honors Program specifically disavowed the association. Evidence provided in the written report and site visit include:

1) Two SARI surveys including data on undergraduate participation in research
2) Data from sponsored research projects and analysis of educational effectiveness through assessment activities (Ph.D. thesis; tracking of graduates of program)
3) Published research conference materials
4) Materials from Chancellor's Fall conference on undergraduate education
5) Interviews with administrators responsible for research on campus and faculty directors of related programs and courses
6) Site visits to "model" classes, e.g., Physics 7.

One of the most notable and distinctive aspects of UC Davis's sponsorship of undergraduate research opportunities is its genesis in vehicles for supporting women and underrepresented minority students in the late 1980's and 1990's. The Biology Undergraduate Scholars Program (BUSP) has enjoyed external funding that enabled underrepresented populations to be paired with a faculty mentor in a focused research project in the Life Sciences,

the most popular area of student majors. Tracking data are included in a 2002 report that shows the effectiveness of the BUSP program, including statistics from comparative studies of students who did and did not participate in the program (with statistical corrections to eliminate other factors). Research papers (Barlow and Villarejo) also included verifiable hypotheses about the effectiveness of the program.

Likewise, evidence is included about the effectiveness of the Mentorship in Undergraduate Research in Agriculture, Letters and Science (MURALS) program for juniors and seniors. Although studies of MURALS, like studies of BUSP acknowledge that it is difficult to conclude these programs directly caused the success of their student participants, both a Ph.D. dissertation assessing effectiveness, and other less data driven measures point to the effectiveness of the program. The potential exists to export "best practices" from these efforts, while recognizing that the expense of this model limits its widespread use throughout the undergraduate population.

Team members were positively impressed by the evident dedication of the individuals responsible for the various undergraduate research initiatives. Further, they are highly collegial, and we saw much evidence of a fine esprit de corps. The Dean of MPS shared with us an accounting of the number of faculty in his school who taught independent study courses/research during the past three years, and asserted his personal support for faculty devoting time to undergraduate research (in the form of workload credit).

However, data about the scope of undergraduates involved in research was spotty and contradictory. SARI statistics referenced in the Educational Effectiveness Report offered two different views of undergraduate participation in research. The disparate statistics point up an area for improvement in the quality of the evidence and methodologies used to measure effectiveness in this area. In responding to survey questions, both undergraduates and alumni appeared to be unsure what to include under the rubric of "research."

Defining Research Activities More Clearly: UC Davis needs to more carefully define what is included under the general rubric of research, with attention to varying disciplinary contexts (i.e., research in the science laboratory is different from archival research in humanities). In addition, we recommend that UC Davis specify the relationship between research opportunities and the other components of the student's academic career by proposing a model for developing student understanding of the research process. For example, faculty spoke of using the Freshman Seminar as a launching point for student understanding of what research means in different disciplinary contexts. Others spoke of the significance of Physics 7 as an opportunity for students to learn collaborative problem-solving. Still others mentioned the value of investigating an original topic with the assistance of a faculty mentor (independent studies).

Map the Sequence of Research Activities: Mapping the sequence of undergraduate research offerings will allow UC Davis to guide and track student pathways through the research landscape. In turn, these records of student experience with research will enable the kind of outcomes assessment and effectiveness on which the accreditation process is based. Specifically,

mapping the Sequence of Research Activities available for students, and the learning acquired in each activity will better enable the institution to:

1) Create a vision of research opportunities for students, thus creating a pathway for students who want to maximize their research opportunities.
2) Ensure accountability. With clearly defined sequences of research opportunities, the scope and learning of students can be more effectively measured.
3) Enable decisions about capacity. Is undergraduate research desirable for all students or should it be available to all who seek it?
4) Provide visibility to the value-added aspect of research institutions. Enable students and parents to understand how research faculty provide opportunities not just for graduate students and postdoctoral researchers, but for undergraduates attending the research university.
5) Help the institution decide on the strategic importance of undergraduate research. By charting all the undergraduate research opportunities, UC Davis can more directly confront how faculty involvement with undergraduate research is valued by the institution through academic personnel processes and in the context of faculty workload.

The team received, with considerable satisfaction, the news that UC Davis will likely make an undergraduate research center a key element in the emerging capital campaign. Such a center will help UC Davis move to the next level of institutionalization by providing leadership, coordination, and visibility for what are currently good but disparate educational programs. A successful capital campaign would also allow the selective expansion of existing programs to

provide greater access to those who seek an undergraduate research experience. The Undergraduate Research Center would allow the university to showcase the multiple ways a research institution provides extra value to its undergraduates. It appears that engagement with the WASC review has had the salutary effect of sharpening the institution's focus on undergraduate research at multiple administrative levels.

C. Evaluation of Educational Technology at UC Davis

In our review of the educational use of information technology at UC Davis, we focused primarily on the two areas emphasized in the educational technology essay: a) providing students with the skills and understanding to use technology effectively, and b) infusing technology into the teaching and learning process to improve faculty pedagogy and enhance student learning. In considering these issues, we also examined the institution's vision for the use of technology, planning and priority setting processes, infrastructure, and outcomes assessment methodologies. The online documentation and other materials provided to the visiting team variously referred to "information technology," "instructional technology," and "educational technology." Although in practice these are very different concepts, we shall assume the intended meaning in all cases is the educational use of information technology.

1) Providing Students with Technology Skills and Understanding

The technology essay correctly identifies the importance of understanding over technique. This issue is framed in the context of technology and, indeed, students do need at least a basic understanding of how to use technologies such as computers, electronic mail, and the Web. However, there is no mention of coordination or philosophical connection between these

resources, or how they relate to student learning or educational effectiveness. We recommend that *information literacy*, including the use of technology, be included in the strategic plan as one component of achieving educational effectiveness. Competency in the use of information is typically referred to as information literacy. As defined by the Association of College and Research Libraries' Information Literacy Competency Standards for Higher Education, (http://www.ala.org/acrl/ilintro.html), information literacy is the ability to:

1) Determine the extent of information needed
2) Access the needed information effectively and efficiently
3) Evaluate information and its sources critically
4) Incorporate selected information into one's knowledge base
5) Use information effectively to accomplish a specific purpose
6) Understand the economic, legal, and social issues surrounding the use of information, and access and use information ethically and legally

Literacy is the quality of being knowledgeable about a particular subject. It is of note that the ACRL definition of information literacy describes outcomes, or user capabilities. The National Research Council's 1999 report, *Being Fluent With Information Technology*, expands upon the preceding list of capabilities in the context of a research university (National Research Council, 1999). A summary of the NRC's definition of information literacy is included as Appendix A.

UC Davis provides its students with a broad array of technology resources, ranging from well-equipped PC labs to electronic mail to an institutional portal. All UC Davis students have

access to computers, high speed networks, online services, information resources, and communication tools. Use of these technologies is becoming woven into the fabric of daily student life at UC Davis, and it is apparent that students frequently use technology for both academic and social purposes. However, immersion in this technology-rich environment does not guarantee that students acquire any particular level of information literacy—or fluency—any more than throwing them into a swimming pool will teach them to swim. Some will swim, some will sink, and some will just get wet. It is the outcome, not the environment that is key to achieving the goals expressed by UC Davis in its technology essay. Student information literacy is a worthy objective in its own right. It also provides a sound foundation for increased use of technology in the curriculum by assuring that all students have access to the necessary technology tools, communication and information resources, and possess the knowledge of how to apply them in their academic work.

The Library and IET, provide programs and resources (e.g., the Library's information literacy and bibliographic instruction sessions, IET's Bovine Online CD-ROM and Student Computing Guide website) that aid students in discovering and using both the university's information resources as well as resources outside the institution. However, we were not able to find evidence that UC Davis has defined the specific competencies and understandings that it wishes its students to gain, nor that the institution has put in place processes to ensure that all students acquire at least a minimum level of these competencies and understandings. Students who spoke with the team indicated that the level of technology awareness and use varies greatly within the UC Davis student population.

Information literacy describes an individual's understanding of how to access and use information and the associated technology tools. In an academic setting, the application of information literacy requires shaping according to the student's chosen field of study. The use of information technology is now prevalent in most academic programs and, indeed, some are being reformed by it. It is therefore critical that the technology perspectives, skills, and information management requirements of each program be carefully considered and the requisite student preparation be integrated into the curriculum. We were informed during our visit that this is not a university requirement, and that only a few academic programs have explicitly addressed discipline-specific technology capabilities in their curricula.

Information Literacy: UC Davis needs to formalize its information literacy expectations for students and provide—through the Library, IET, and other appropriate sources—the necessary student training opportunities and assessment mechanisms to assure that each student acquires the desired level of information literacy. The National Research Council report and Association of College and Research Libraries resources can serve as guides.

Information literacy would be further strengthened if each academic major at UC Davis would review the relevant technology and information management requirements of students in—and graduates of—that major, and ensure that the curriculum includes the necessary experiences that will provide students with the identified skills and understandings. It is interesting to note that a similar call for student information literacy standards was made in 1998 by the Joint Campus Committee on Information Technology (http://it.ucdavis.edu/jccit/rec.html).

2) Improving Faculty Pedagogy and Student Learning With Enhanced Information Technology

Institutional Context: The information technology environment at UC Davis has expanded and improved greatly over the past five to seven years, commensurate with the university's growing stature as a major research university. The increasing impact of technology on both the content and delivery of the curriculum is evident at UC Davis, as it is at most U.S. higher education institutions. UC Davis has taken definitive steps to enable faculty to use technology in their courses. Examples include the course tools in MyUCDavis, Mediaworks, the Arbor, the Teaching Resources Center and its workshops, and the SITT summer program.

Evaluation of the Institutional Presentation: The Technology Essay poses probing questions regarding the educational efficacy of technology: "Does more effective electronic communication enhance real learning? Have advances in information technology really given us a tool to improve student learning?"

A call to apply information technology toward the improvement of teaching and learning has been sounded by many leading thinkers over the past decade, including *The Need for a National Learning Infrastructure* (Twigg, 1994), *Using Information Technology to Enhance Academic Productivity* (Massey & Zemsky, 1995), *Transforming Higher Education: A Vision for Learning in the 21st Century* (Dolence & Norris, 1995), *Revolutionary Strategy for the Knowledge Age* (Norris, 1997), and others. The authors of these reports noted that models of teaching and learning have changed little over the centuries, and there is much need for

improvement—improvement in quality, access, and cost—that can be achieved through the application of information technology (Daniel, 2000).

In charting a course for widespread use of technology in instruction, UC Davis will need to determine its goals for both the extent of adoption as well as the level of expected student learning outcomes. Until approximately 1990, most research comparing traditional face-to-face and technologically-enhanced instructional methods (including both classroom and virtual settings) found that the use of technology did not lead to either an increase or decrease in student learning compared to traditional instructional methods. Thomas L. Russell refers to the similarity of learning outcomes as the "no significant difference" phenomenon. Russell's recent book, *The No Significant Difference Phenomenon*, and associated website (http://teleeducation.nb.ca/nosignificantdifference/) summarize 355 research studies comparing traditional and technology-enhanced instructional settings, nearly all of which conclude that the differences in student learning outcomes were not statistically significant (Russell, 1999). The "no significant difference" effect has been cheered by educational technologists, who cite these results to support the claim that technology-enhanced instruction is "just as effective" as traditional classroom methods. Likewise, opponents of the use of technology take the same results to imply that if investments in instructional technology cannot yield improved learning outcomes such investments may be a waste of resources.

Richard Clark's 1983 attack on media comparison studies (Clark, 1983) heralded a significant shift in the direction of instructional technology research. Clark found that historically most comparative studies had used flawed methodologies and that it is the pedagogical approach

used, not the application of technology, that results in improved outcomes. Beginning in about 1990, studies began to be published that, indeed, found a statistically significant improvement in student learning when technology is used in appropriate ways, and when pedagogies are designed to take advantage of the new capabilities afforded by technology. Joy and Garcia (2000, p. 1) frame the issue well: "Learning effectiveness is a function of effective pedagogical practices. Accordingly, the question for ALN [Asynchronous Learning Networks] practitioners ought to be: what combination of instructional strategies and delivery media will best produce the desired learning outcome for the intended audience?" Sorg, et al. (1999) found that in well designed online courses where instructors had received extensive faculty development and instructional design assistance, students exhibited statistically significant increases in learning, improved critical thinking skills, and a feeling of self-empowerment. Similar positive learning outcome results are now being routinely reported by institutions that are implementing models of teaching and learning that have been transformed by new approaches, tools, and pedagogies. In summary, effective teaching with technology requires fundamentally different approaches and roles for both teachers and students.

The UC Davis technology and integrative essays indicate that the university's early efforts to infuse technology into teaching and learning have produced uneven results in terms of student learning outcomes, and express skepticism that such improvement is attainable on a large scale basis. The essay asks whether faculty are provided adequate support. Faculty who wish to use technology can receive training and some guidance on approaches; however, it appears that recommended instructional models, instructional design assistance, transformative faculty development, and assessment guidance are not systematically provided to faculty. We believe

faculty adoption rates and student learning outcomes would improve if faculty were provided systemic support in these areas.

Likewise, the essays express skepticism that instructional delivery costs can be reduced through the use of technology except in cases where brick and mortar construction can be avoided. Here again, a number of national models exist that demonstrate both instructional gains and reduced costs. Among the more prominent examples are the CUPLE Physics project at Rensselaer Polytechnic Institute, the Virginia Tech Math Emporium, and the 30 projects funded by the Pew Grant Program in Course Redesign (http://center.rpi.edu/PewGrant.html).

Finally, meaningful assessment of student learning outcomes in technology-enhanced learning environments requires moving beyond the customary (and typically flawed) "media comparison" studies that contrast grades awarded in traditional and technology-enhanced courses. As recommended by Joy & Garcia (2000), a more worthwhile approach would be to first establish intended learning outcomes, then test what combinations of pedagogical strategies and technologies will produce or exceed the desired outcomes. This will require both quantitative and qualitative approaches. Individual faculty or projects will require assistance with developing and implementing proper assessment strategies. In addition, the sophistication and effort required for institution-wide application of these methodologies will require centralized assessment support.

Focus on Core Educational Effectiveness: According to the technology and integrative essays, the educational effectiveness of early instructional technology efforts has been mixed. To ensure

that educational effectiveness results from future efforts, systemic instructional design, faculty development, and assessment are required and should be provided as soon as resources permit.

The team also observed that many courses, including high enrollment gateway courses, are taught by lecturers and teaching assistants. If the institution's goal is for technology to be widely infused in teaching and learning throughout the institution, it will be necessary to include these populations within the support environment. From instructional design to teaching evaluation, all instructors will need to be part of the community working to rethink teaching and learning. Models can be found for targeted programs such as the Technology Seminars in UCLA's Teaching Assistant Training Program (http://www.oid.ucla.edu/Tatp/index.html). A national overview, "Interesting Practices and Best Systems in Faculty Engagement and Support" by Paul Hagner appears on the EDUCAUSE NLII Key Documents page at www.educause.edu/nlii/keydocs/index.asp.

Provide Services to All Instructors: The important role that temporary instructors and teaching assistants play in undergraduate learning at UC Davis necessitates that they be included in the full range of instructional development services provided to faculty. Experiences with blended instruction will provide UC Davis with opportunities to review the responsibilities of a broad range of instructors, from upper division undergraduates to ladder faculty. Changes in the delivery of instruction to focus more on active learning could lead to opportunities to restructure the instructional workload. Several of the 30 redesigned courses cited above (http://center.rpi.edu/PewGrant.html) used shifts in teaching responsibility to improve learning outcomes while reducing costs.

Develop Institutional Strategy: Examples of instructional applications of technology provided to the visiting team fall into two categories: use by individual faculty in their courses, and college-level projects focused on one or more targets of opportunity, such as improving access. Faculty use of technology is supported through infrastructure such as the Smart Panels and video projectors found in most classrooms, and by workshops and mentoring programs such as SITT, the Arbor, and the Technology Partners Program. UC Davis has made significant investments in infrastructure and programs to support faculty adoption of technology. While these resources enable faculty to employ technology in their courses, they do not ensure that technology will be used in the most effective manner because most UC Davis faculty have not been introduced to transformative teaching models that foster active student learning, or provide instructional design support.

Initial efforts to engage individual faculty in the use of instructional technology and to implement larger-scale strategic projects with the colleges (e.g., Chem 2 and Psych 41) have been successful in increasing adoption and should be continued. However, these activities fall short of representing an institutional strategy for the use of instructional technology. The Strategic Planning process that is underway would be an excellent mechanism for articulating a vision and metrics for assessing its achievement.

Faculty and college-based instructional technology projects have to date been highly individualized. To achieve greater institutional momentum, successful instructional models should be identified and supported. In developing these models UC Davis should carefully examine both internal and external best practices.

Faculty adoption of instructional technology will be facilitated by identifying and providing appropriate faculty incentives, recognition, and rewards. In addition academic policy issues related to faculty use of instructional technology, such as intellectual property and workload, should be addressed in the very near future to reduce the possibility they become barriers to faculty adoption. Many institutions are observing significant growth in the rate of faculty adoption of technology in their courses. Rapid adoption can quickly lead to severe demands on infrastructure and support resources. The appropriate response may well be more resources; however support units must plan for growth by designing and implementing scalable support processes and procedures (Hagner, 2001). The advantages of shifting from "boutique" to "systemic" faculty support structures are discussed by Bates (2000).

As UC Davis builds the implementation plan for the "2020 Vision" strategic plan, a complementary focus on the educational technology core services will be critical to both influence the implementation and respond to new requirements that will become evident.

An overarching strategy is to establish processes that enable the campus to pay attention to the full set of core services and not just the parts. Rigidity or gaps anywhere in the administrative and academic environment can create far-reaching barriers to educational transformation. The balance among the components is a critical aspect of the prioritization process. Creating a cohesive educational technology environment will be vastly more important to faculty and students than pockets of excellence.

Thus, the issues that follow are interconnected and need to be addressed together. They have been selected to illustrate four "layers" of core services that fit together. There are others, of course, many of which are conventionally categorized as administrative services, such as classroom scheduling. While not expressly addressed in this analysis, these administrative policies and practices can become barriers to change if they are not adapted to the needs of a new learning and teaching environment. It will be important for the institution to establish a process to locate and address barriers to change in the existing policies and practices.

UC Davis has achieved significant progress in all four areas highlighted below. Not only does the campus have a breadth of experience and expertise on which to build, it has established both formal and informal processes to support an institutional approach to the next phase of creating a technology-enabled learning environment.

Develop a Cohesive Technology-Enabled Environment:

The physical plant: An increasing shift to active learning, which blended instruction enables, will have an impact on the physical plant. To understand how to repurpose existing classrooms and design flexible new teaching and learning spaces, it will be necessary to establish mechanisms to identify and track the changing requirements of blended instruction. Because UC Davis is entering a period of increased building construction, the university has a great opportunity to become a leader in rethinking the design of formal and informal spaces to support blended instruction. See Brown and Lippincott (2003). The provision of one or more experimental spaces could provide a mechanism to both encourage and study innovation in the use of space. Useful approaches and models could be co-developed as part of several national

initiatives (for example, with SCUP or EDUCAUSE) focused on new types of spaces for new types of learning work.

Core systems: The computer and network systems that support the use of technology in teaching and learning are no longer the underpinnings of just a few experiments: they are now mission critical. This part of the educational technology infrastructure is as essential to the educational mission as the purchasing or payroll systems are to the operations of the university. We recommend that UC Davis review the systems, services, funding, and policies associated with the educational technology infrastructure to ensure that they are cohesive and appropriate to institutional-wide requirements. In addition, this review needs to look to future scaling requirements to ensure there is the capacity to support a curriculum-wide integration of new pedagogical methodologies based on current and emerging technologies.

Instructional Materials: A library of instructional materials is a key component of the educational technology infrastructure because of the impact on cost, teaching strategies, and learning opportunities. Providing broad access to materials that are developed or adapted by UC Davis faculty will enable projects undertaken by a single faculty member or department to not only improve the return on investment, but also create permeable walls between courses and disciplines. An instructional materials library has the additional benefit of providing instructors with ideas and information from other disciplines while giving them access to materials they can directly use. The impact of a library of instructional materials on students can be just as far reaching as the impact on teaching. Instructional materials can function simultaneously as preparatory materials, refresher materials, course materials, reference materials and as general

interest materials. As the overall educational approach changes to one that is based on learning goals, the broad access to instructional materials across course and disciplinary boundaries will begin to shift student thinking away from a course-based focus to one based on learning.

The technical process for accomplishing this vision is to implement a repository architecture compatible with the MyUCDavis portal, the UC Davis online library catalog, and other libraries including the California Digital Library. Developers in the library and the course management system/learning management system communities are working on interoperability to make instructional repositories accessible from both types of systems. The adherence to national standards (see the Learning Objects Initiative at http://www.nmc.net/lo/index.shtml for information on standards and projects in this arena), as well as participation in Library-CMS bridging projects, will further enable UC Davis instructors to locate, use, and contribute to such repositories.

Policy Support: In addition to the technology implementation decisions of the repositories, there are policy issues associated with these and other materials used in the delivery of courses that need to be addressed in tandem with the development of systems such as MyUCDavis. Lynch (2002) lays out high level policy questions that address issues of access to and longevity of course websites. For example, he identifies the following types of access requiring policy decisions: for operational class purposes, for post-course faculty use, for post-course student use, for institutional record, and for course reuse. A useful starting point for UC Davis may be a discussion of the important first steps that Lynch lays out in his conclusion.

D. General Education at UC Davis

The WASC reviews of General Education in the 1990s cited the lack of educational philosophy and goals, the absence of coherence, and inadequate seat capacity in General Education courses collectively. On more than one occasion we were informed that the previous UC Davis General Education program requirements in the 1980s emphasized coherence, but due to a variety of problems that coherence was replaced by the practicality of the current requirements.

There are three components to the current General Education requirement at UC Davis:

1) Topical breadth (satisfied by taking 6 courses outside of the student's major)
2) Social-cultural diversity (1 course from approved list)
3) Writing experience (3 courses from approved list)

Since the 1997 WASC letter, UC Davis responded to the expressed concerns with respect to general education by taking several positive steps. After a series of campus conversations the University developed a General Education philosophy that appears in the Catalog, articulated educational objectives, implemented a modest restructuring of the Academic Senate governance structure, and acquired Hewlett Foundation grant support for enhancing the General Education Program. By creating an Undergraduate Council with a standing committee responsible for the General Education program and courses, and by using foundation support creatively, the campus has increased the number of General Education offerings, and strengthened the program by organizing attractive General Education course clusters in areas that seem to "fit" UC Davis well (e.g., Changing Agriculture, Global Population and Environmental Issues, Biodiversity and

Cultural Diversity, Food and Fiber). In addition, UC Davis is actively developing a General Education Scholars program where students complete courses in a General Education theme option and then choose a capstone experience, seminar, or curriculum-related internship to integrate key concepts. These positive actions mark significant progress since 1997, and they need to be continued in our view.

The meetings with faculty, students, chairs, and deans during our two visits and the additional information we received before the second visit left several clear impressions. First, the current program consists mainly of a menu of courses that students and faculty alike seem to prefer because it maximizes flexibility and choice, and it generates needed FTE enrollments for many departments. While this cafeteria approach has been strengthened by the organization of many General Education courses into theme clusters, it still falls short of the WASC-recommended minimum of 45 semester credit hours. In a recent cohort, approximately 25 percent of graduating seniors took 44 quarter units, or less, outside the college of their major. We assume that many of these students took additional courses outside the major, but not outside the college. On the other end of the continuum 25 percent of seniors took 87 units or more outside the college of their major. Apparently many students, including some that we met, undertake double majors and minors that add greatly to their "topical breadth." Thus, most but not all students experience academic breadth looking solely at courses taken.

Second, certain aspects of the General Education program have been strengthened, such as bringing greater clarity and organization to the diversity and writing requirements, and using the new data system and warehouse to identify students with common interests and clustering

them into General Education themes. The new course clusters and the General Education Scholars program add coherence to the topical breadth requirement that did not exist before. In addition, the writing requirement responds to faculty, employer, and alumni concerns. The number of General Education offerings and theme clusters has increased in recent years and taken the pressure off the supply versus demand problem that was evident in the 1990s.

Third, UC Davis has a cadre of faculty who enjoy teaching General Education courses and who are good at it, and who mostly are doing it for the right reasons (namely enhancing the intellectual depth and breadth of undergraduates). While faculty generally recognize the value of a General Education program that provides a coherent educational experience for students, they believe that UC Davis was forced to choose breadth over coherence during the 1990s, and that it will take many years to galvanize faculty agreement about a more coherent General Education structure. Indeed, some faculty that we met believe that students obtain satisfactory general education skills (such as writing and critical thinking) from courses in their major. Moreover, many faculty leaders and chairs fear that anticipated resources will not support a more elaborate General Education model.

The current permissive General Education requirements allow students to "double count" courses taken under the breadth, writing, and diversity requirements. Apparently, few students do so, but it is theoretically possible for a graduate to get by on six courses outside the GE topical breadth subject area that includes their major (or 24 quarter units) chosen carefully to double count requirements. Even recognizing that general education skills and knowledge are not acquired solely and exclusively in general education courses, no member of our team believes

that UC Davis graduates should enter their careers with as few as 24 General Education units. Moreover, we would be surprised if such students were as well prepared as their peers, or as prepared as they need to be. As it stands now, UC Davis lacks the evidence to support the sufficiency of the low level of general education requirements that currently exist, but such supporting evidence could be collected.

We recommend that UC Davis continue its deliberations about general education under the leadership of an appropriate campus spokesperson. It appears to us that campus actions surrounding General Education over the past decade have been episodic, and that no consistent advocate has emerged to lead an examination of General Education alternatives. As we see it, the campus faces a choice between two alternatives: (a) adopting a curricular structure that ensures student attainment of the stated educational objectives and general education breadth and skills; or (b) there needs to be outcomes assessment evidence that students are achieving these things upon graduation. In other words, UC Davis needs either to strengthen educational requirements on the front end or develop a system for accumulating and reflecting upon outcomes evidence on the back end of the student experience.

Just the simple step of eliminating the "double counting" of courses would guarantee a 40-unit General Education program for all UC Davis graduates. In addition, there are many Undergraduate experiences that can be legitimately incorporated into the General Education umbrella – study abroad, internships, and practica. The WASC Standards were written to avoid a "one size fits all" approach to General Education. However, the Commission's expectation is that institutions not reaching the 45 semester credit hours General Education guideline should

ensure that the expected outcomes for General Education and the baccalaureate are being met through other approaches (Criteria for Review 2.2). There needs to be assessment evidence that students are achieving the stated educational objectives, levels of attainment, breadth, and skills (C.F.R. 2.4 and 2.6). UC Davis needs to develop a system for accumulating and reflecting upon such evidence. For example, the university could undertake a special study of a group of seniors or alumni graduating with less than 45 GE units and see what is learned from it. A study could compare the educational outcomes of those who do and do not display obvious breadth on their transcripts. Measures of the seven new Educational Objectives need to be developed anyway, and student performance could be benchmarked against the course taking patterns on their transcripts.

IV. Preparatory Review Update

The Preparatory Review Report contained a review of University capacity under the framework of the four Commission Standards. With the exception of the one area highlighted in this report, that is, General Education, the team found no problematic areas when reviewing the University for educational effectiveness under the Standards, and found that the University is performing in an exemplary fashion. The issues and concerns raised in the Preparatory Review have been either resolved or incorporated into this report in the sections above, so they are only summarized here briefly:

1) The University appears to have made great progress toward addressing the planning challenges described in the 1997 Interim Report. The UC Davis reflective essays, administrative leadership, and faculty governance recognize the need to synthesize and draw connections among institutional mission, evidence of goal attainment, and

specific improvement strategies. The planning process is setting the direction for guiding the university's planning activities, the annual budget decisions, and performance outcomes. The draft "2020 Vision" document is an excellent start toward agreeing upon performance measures. UC Davis has created a viable and effective planning foundation to guide the University into the future.

2) UC Davis has made significant improvements in the organization and delivery of the general education program since 1997, but more work lies ahead, as discussed above. No member of our team believes that UC Davis graduates should enter their careers with as few as 24 General Education units. Whatever numbers of courses and units are required, UC Davis eventually needs evidence that students are achieving the stated educational objectives, levels of attainment, breadth, and skills. The University needs to develop a system for accumulating and reflecting upon such evidence, and strengthening the General Education requirements if the evidence warrants it.
3) Regarding the undergraduate research program, UC Davis needs to more carefully define what is included under the general rubric of research, and to map the sequence of undergraduate research offerings as preludes to the eventual measurement and evaluation of the program's impact on student outcomes.
4) Regarding educational technology, fiscal constraints emphasize the need to make information technology investments in a more strategic and cost-effective manner. As soon as resources permit, UC Davis needs to build systemic instructional design, faculty development, and assessment processes in order to ensure that educational effectiveness results from investments in technology. We recommend that UC Davis review the systems, services, funding, and policies associated with the educational

technology infrastructure to ensure that they are cohesive and appropriate to institutional-wide requirements.

V. Integrated Summary of Findings and Major Recommendations from the Preparatory Review and Educational Effectiveness Review

The UC Davis self-study and anecdotal evidence all point in the same direction. The faculty are of high quality, with strong commitments to both research and teaching. The students are bright and hard working. There is a positive belief in UC Davis on the part of all that we met. A large number of students are involved in research or research-like endeavors. There is a broad selection of courses that fulfill general education requirements. There are examples across the campus of the use of information/educational technology from Chemistry 2 and Physics 7 to the newly proposed major in Techno-culture. There is widespread optimism about the future of UC Davis.

Many UC Davis committees and offices appear to be struggling with the challenges of measuring change, performance, and outcomes. The Student Affairs Research and Information group (SARI) has for many years conducted institutional research at the university. This program of conceptually driven, periodic data collection and research has been widely shared and packaged for the diverse academic and administrative programs and offices across the campus, ranging from enrollment management and housing to academic program reviews and undergraduate educational outcomes. While much of General Education remains decentralized, faculty-initiated, and enrollment-driven, we were pleased to meet a number of faculty who

approach their General Education instruction with a spirit of service and citizenship, and who regularly assess student learning outcomes.

The culture of the campus is to let a thousand flowers bloom with little central direction. This decentralized approach has encouraged a rich array of constructive and important initiatives–each one having its own history, and impressive aspects. However, there has been little effort to coordinate or evaluate such efforts so that best practices can be communicated and spread to other disciplines. Outcomes assessment and building a culture of evidence has been largely a department/college activity centering on program reviews, personnel portfolios, and classroom level assessment. The wider use of SARI and ORMP research is beginning to enhance the outcomes evidence from students and alumni, and to build an administrative culture of evidence to support decisions and policies. The recently appointed Executive Vice Chancellor/Provost is strongly committed to a strategic plan more tightly coupled to metrics and outcomes; and it appears that there is broad acceptance of this direction.

The team received upon its arrival a new draft of a strategic plan, "2020 Vision," which included metrics and replaces the previously mentioned "Strategic Vision" document. This plan does tie goals to metrics and it appears to the team to be a very strong document. We suggest that the plan can be enhanced by including research and information technology as strategic elements. This plan does not yet directly address general education, or the research and technology themes of this review. Dialogue about this plan is now underway.

From the Preparatory and Educational Effectiveness Reviews, we arrived at two over-arching recommendations for encouraging the institution to continue down effectiveness paths that it is already traveling (see #1 and #2 below). We also formulated eight supporting recommendations (#3-10 below) that we hope will enrich the two themes and one recommendation where the institution is not yet in full accord with WASC Standards and Criteria for Review (#11 below).

Recommendations

1) **Connect the Pieces:** UC Davis needs to better coordinate, synthesize, and integrate all its separate educational initiatives under the strategic plan. We see added value to UC Davis by pulling these threads together creating a more cohesive internal action agenda and external public image.
2) **Strengthen the Culture of Evidence:** UC Davis has gradually built a culture of evidence in some areas (such as in student affairs, the personnel portfolios and program reviews), and it now needs to do the same in other less developed areas (such as the outcomes of undergraduate research, educational technology, and general education). Many UC Davis committees and offices appear to be struggling with the challenges of measuring change, performance, and outcomes. We believe that UC Davis could increase both efficiency and effectiveness by consolidating and integrating institutional research and decision support capacity under the Executive Vice Chancellor.
3) **Define Research Activities More Clearly**: UC Davis needs to more carefully define what is included under the general rubric of research, with attention to varying disciplinary contexts.

4) **Map the Sequence of Research Activities:** Mapping the sequence of undergraduate research offerings will allow UC Davis to guide and track student pathways through the research landscape. Such records of student experience with research will provide visibility to the value-added aspect of attending a research institution, help the institution decide on the strategic importance of undergraduate research, highlight the impact of undergraduate research on faculty workload, and enable the kind of outcomes assessment and effectiveness on which the accreditation process is based.
5) **Information Literacy:** We recommend that UC Davis formalize its technology use expectations for students and provide the necessary student training opportunities and assessment mechanisms to assure that each student acquires the desired level of information literacy.
6) **Technology in the Major:** We recommend that each academic major at UC Davis review the relevant technology and information management requirements of students in—and graduates of—that major, and ensure that the curriculum includes the necessary experiences that will provide students with the identified skills and understandings.
7) **Technology Effectiveness:** As soon as resources permit, UC Davis needs to build systemic instructional design, faculty development, and assessment processes in order to ensure that educational effectiveness results from investments in technology.
8) **Instructional Development:** In view of their substantial and important role, temporary instructors and teaching assistants need to be included in the full range of instructional development services provided to faculty.

9) **Technology strategy:** UC Davis should continue its efforts to engage individual faculty in the use of instructional technology and to implement larger-scale strategic projects with the colleges. Additionally, the institution needs a broad institutional strategy for the use of instructional technology. The "2020 Vision" planning process that is underway would be an excellent mechanism for articulating a technology vision and metrics for assessing its achievement. To achieve greater institutional momentum, successful instructional models should be identified and supported. In developing these models UC Davis should carefully examine both internal and external best practices. Faculty adoption of instructional technology will be facilitated by identifying and providing appropriate faculty incentives, recognition, and rewards. In addition academic policy issues related to faculty use of instructional technology, such as intellectual property and workload, should be addressed in the very near future to reduce barriers to faculty adoption.

10) **Technology facilities and infrastructure:** Because UC Davis is entering a period of increased building construction, the university has a great opportunity to become a leader in rethinking the design of formal and informal spaces to support blended instruction. The computer and network systems that support the use of technology in teaching and learning are no longer the underpinnings of just a few experiments: they are now mission critical. We recommend that UC Davis review the systems, services, funding, and policies associated with the educational technology infrastructure to ensure that they are cohesive and appropriate to institutional-wide requirements.

11) **General Education:** We recommend that UC Davis continue its deliberations about general education under the leadership of an appropriate campus spokesperson. As we

see it, the campus faces a choice between adopting a curricular structure that ensures student attainment of the stated general education objectives, breadth, and skills; or there needs to be outcomes assessment evidence that students are achieving these things upon graduation. UC Davis needs either to strengthen educational requirements on the front end of the student experience, or to develop a system for accumulating and reflecting upon outcomes evidence on the back end.

APPENDIX A
NATIONAL RESEARCH COUNCIL DEFINITION OF INFORMATION LITERACY

Intellectual Capabilities

1) Engage in sustained reasoning.
2) Manage complexity.
3) Test a solution.
4) Manage problems in faulty solutions.
5) Organize and navigate information structures and evaluate information.
6) Collaborate.
7) Communicate to other audiences.
8) Expect the unexpected.
9) Anticipate changing technologies.
10) Think about information technology abstractly.

Information Technology Concepts

1) Computers
2) Information systems
3) Networks
4) Digital representation of information
5) Information organization
6) Modeling and abstraction
7) Algorithmic thinking and programming
8) Universality
9) Limitations of information technology
10) Societal impact of information and information technology

Information Technology Skills

1) Setting up a personal computer
2) Using basic operating system features
3) Using a word processor to create a text document
4) Using a graphics or artwork package to create illustrations, slides, or other image-based expressions of ideas
5) Connecting a computer to a network
6) Using the Internet to find information and resources
7) Using a computer to communicate with others
8) Using a spreadsheet to model simple processes or financial tables
9) Using a database system to set up and access useful information
10) Using instructional materials to learn how to use new applications or features.

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