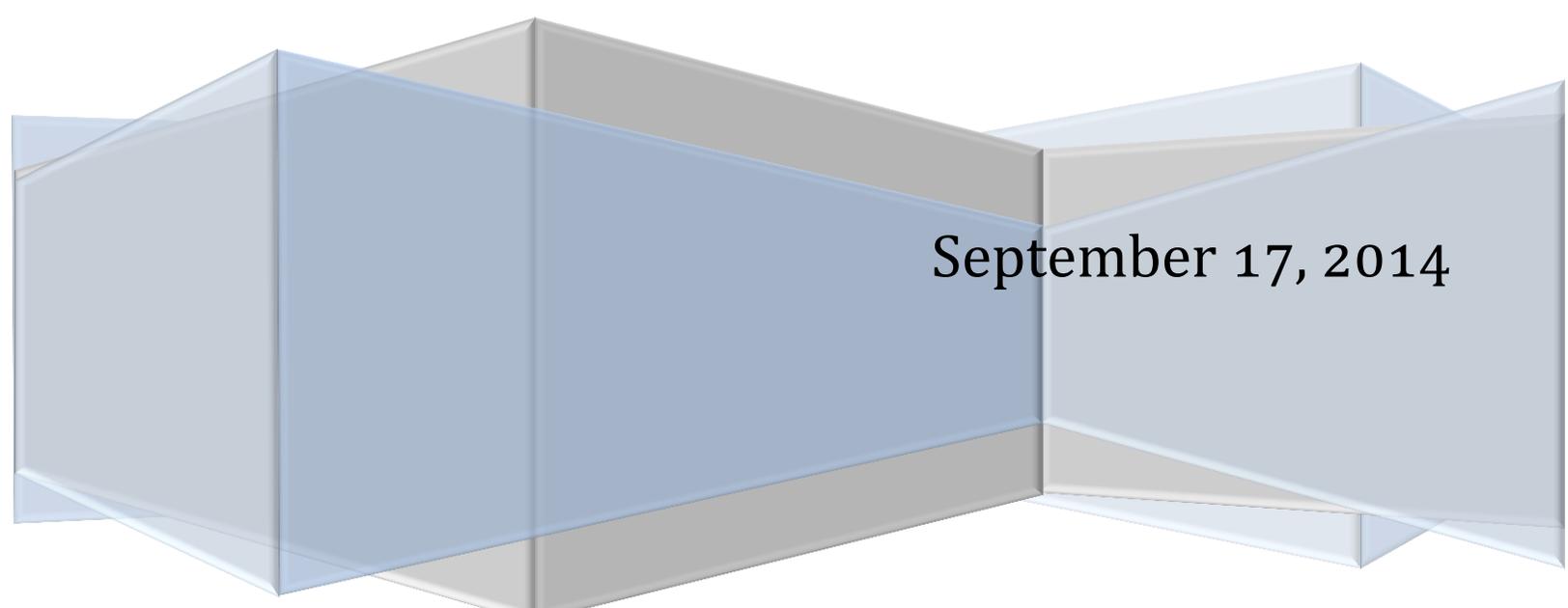


University of North Carolina at Chapel Hill

Report of the Task Force on Online Learning to Improve Access and Success

September 17, 2014



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Executive Summary

In the spring of 2014, UNC-Chapel Hill's Office of the Provost established the Task Force on Online Learning to Improve Access and Success (see Appendix 1 for the membership and charge). The Task Force (TF) worked over the spring and summer of 2014 to address sets of questions related to how technology can be leveraged to expand access to Carolina education, especially through online courses and programs; and how learning technology can improve residential educational programs. This report addresses those questions in the context of the University's current technical and economic climate and makes recommendations that are meant to advance our capabilities and effectiveness for the next three to five years. The TF views this document and associated recommendations as a basis for discussion about stimulating access and success as much as a roadmap for ongoing actions. The TF focused its work on four key areas: current strengths and weaknesses, needed resources, student access and success, and outcomes assessment.

Recommendations

The Task Force proposes a number of initiatives focused on increasing access to a Carolina education and maximizing student and faculty success by applying technologies and techniques that promote active learning. The recommendations of the Task Force are meant to reflect the campus mission to "serve as a center for research, scholarship and creativity and to teach a diverse community of undergraduate, graduate and professional students to become the next generation of leaders." They fall into four broad categories:

Provide campus-wide support for online learning

Recommendation 1. Establish a UNC-Chapel Hill online learning credit/reserve fund to incentivize and enable development of new online programs. The fund should be a capital campaign priority.

Recommendation 2. Establish a Resource Office for Online Learning (ROOL) within the Office of the Executive Vice Chancellor and Provost to support the development of online programs and coordinate online efforts across the University.

Recommendation 3. Appoint a standing faculty-administrative-student task force on educational technology trends and opportunities co-led by the Center for Faculty Excellence (CFE) and ITS-Teaching and Learning and including representatives from FITAC, the Libraries, and the student body. This task force would research, assess, pilot, and recommend teaching and learning technologies.

Use technology to improve residential education

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Recommendation 1. Build a recurring CFE competitive curriculum innovation fund to facilitate and encourage faculty use of technology. The fund will have the capacity to support multiple annual department and faculty-led initiatives—large (\$50,000) and small (\$10,000)—for residential, technology-assisted teaching. The fund will also support hiring additional faculty development staff in the CFE to support this effort.

Recommendation 2. Create a working committee to review academic policies, procedures, and calendars needed to support non-traditional blended or hybrid approaches to teaching and learning.

Recommendation 3. Allocate recurring annual funding of \$500,000 to redesign classrooms to facilitate interaction; instructor movement throughout the classroom; fluid use of multiple technologies; and easy transitions between lecture, discussion, small group, and independent work. This level of funding would support the renovation of one large lecture hall or multiple smaller classrooms each year.

Recommendation 4. Create an Active Learning Laboratory within the CFE to provide training and support in the use of key technology tools to instructors who are transitioning to blended learning models.

Expand access to a Carolina education

Recommendation 1. Offer a market-driven, online undergraduate degree-completion program for non-traditional students that serves the citizens of North Carolina, supports the UNC General Administration strategic plan, and demonstrates leadership in defining access and success for a public research university.

Recommendation 2. Expand market-driven, professional school certificate and degree programs for non-residential students.

Recommendation 3. Continue to research, develop, and assess online and hybrid degree credit outreach opportunities for students seeking college credit and pre-professional preparation.

Recommendation 4. Continue to research, develop, and assess online and hybrid non-credit enrichment opportunities for a worldwide audience, such as Massive Open Online Courses (MOOCs). These efforts should aim to promote UNC's global visibility and to leverage and evaluate new technologies that may migrate to credit-bearing courses.

Assess the outcomes of online teaching and learning

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Recommendation 1. Evaluate online programs through ongoing collaboration across the units and programs that are responsible for the design, development, and assessment of online and technology-assisted teaching.

Recommendation 2. Expand the assessment and evaluation capability of the CFE and the Office of Institutional Research and Assessment (OIRA) by hiring two additional program evaluation staff members to analyze online teaching and learning initiatives in order to assess their effectiveness and build a knowledge base for further innovation in teaching and learning.

Implementing these recommendations will require resources and a commitment to change. Many University systems and procedures will have to be revised to make administrative processes more adaptable, responsive, and efficient. Funding will have to be found. Incentives and evaluation procedures at individual, unit, and campus levels will have to be created. These initiatives will pose new challenges related to registration, tuition models, course scheduling, instructional design, and staffing patterns. No perfect solution is possible but models and practices will evolve over time. It is essential that we remain open to exploration of alternative models for organizing programs and to increased flexibility for students.

Introduction

In the past several years, online teaching and learning in higher education have expanded dramatically, sparking a great deal of discussion and debate. As the 2013 Babson Survey Research Group reports in *Grade Change: Tracking Online Education in the United States*, “online learning has become a fundamental component of today’s higher education environment.” National report findings include:

- More than 7.1 million students were taking at least one online course during the fall 2012 term, an increase of 411,000 students over the previous year.
- Thirty-three percent of higher education students now take at least one course online.
- The percentage of academic leaders rating the learning outcomes in online education as the same or superior to those in face-to-face grew from 57.2 percent in 2003 to 77.0 percent last year, but fell back to 74.1 percent this year. (1)

Technology has the potential to significantly expand access to higher education, especially for working adults who cannot participate in full-time residential programs. There is increasing evidence that learning outcomes in online learning equals and sometimes exceeds traditional face-to-face learning in both K-12 (2), and higher education (3). Additionally, restructuring courses to emphasize activity-based learning yields improved learning. For example, a recent study involving UNC students demonstrated that replacing lecture classes with activity-based experiences yielded significant gains in learning by minority and first-generation students (4). The potentials of leveraging technology to provide online courses and to ease transitions to active learning techniques are driving colleges and universities to establish online degree, certificate, and continuing education

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(for-credit and non-credit) programs, hybrid programs, and to rethink classroom infrastructure, course scheduling, and faculty support services.

To this end, some universities utilize existing campus units and resources, while others partner with companies such as 2U, Coursera, EdX, Udacity, Deltak, and others to assist them in providing online educational programs, technology, expertise, infrastructure, resources, and, perhaps most importantly, initial funding. MOOCs have allowed hundreds of thousands of students to learn from faculty at some of the world's best universities. In response to strategic and operational need, colleges and universities are researching and establishing new governance and organizational models to ensure campus-wide strategy, innovation, compliance, and efficiency. (5)

UNC-Chapel Hill, with its long history of involvement in distance and online education, has joined many other universities in exploring new modes of online teaching and learning, both off campus and on. To our existing array of eighteen online certificate and degree programs and two programs offering online, for-credit courses, we recently added two new online degree programs in partnership with 2U, and six MOOCs in partnership with Coursera. On campus, we initiated a robust effort to redesign large-enrollment courses by using technology to enhance large-lecture teaching practice and improve student learning outcomes. This report summarizes the work of a campus-wide task force charged with making recommendations for how the campus can leverage technology to improve access to a Carolina education and ensure that students are successful. The report is organized around the key questions stated in the charge to the Task Force (TF).

I. What are the strengths, weaknesses, and gaps in our use of online teaching and learning?

Online education and associated technologies at UNC-Chapel Hill fall into three primary categories, each described in turn below:

Credit-bearing certificate and degree-granting programs and courses. As noted in the 2007 Report of the Distance Education Task Force, chaired by Dean Barbara Rimer, UNC-Chapel Hill has been a leader in developing distance and online programs at the graduate and professional school level (see listing in Appendix 2). Currently, online degree and certificate programs are confined to the professional schools, and fully online, for-credit undergraduate courses are available primarily through the Friday Center for Continuing Education—with a dedicated marketing, course design, and student services staff—and Summer School. Those two entities provide a rich array of courses; in 2013–14, the Friday Center offered 264 online course offerings with 3,771 enrollments and the Summer School offered 22 online course offerings with 402 enrollments. At the undergraduate level, residential education remains the primary emphasis. The College of Arts and Sciences, which awards the majority of undergraduate degrees, limits undergraduate enrollments in online courses (see Appendix 3).

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In recent years, Kenan-Flagler Business School and the School of Government have partnered with a third-party vendor, 2U, to develop and market new online graduate programs. While these new programs are attracting students, some of the established in-house programs are seeing enrollment declines, which may be the result of increased competition, lack of in-house marketing resources, or not being able to keep up with technological advancements. As is typical with programs offered in partnership with third-party vendors, the 2U programs follow non-traditional academic calendars involving multiple admission cycles and shorter academic terms. These alternative schedules are preferable for non-traditional students but pose challenges for University systems such as PeopleSoft that are built on a semester-based calendar and require often time-consuming workarounds for the Registrar, Scholarships and Student Aid, and Student Accounts. As our inventory of online programs grows and the use of non-traditional calendars increases, University systems and procedures will have to be revised to make administrative processes more adaptable, responsive, and efficient.

Non-credit or Continuing Education Credit (CEU) opportunities. The University provides an array of non-credit (or CEU-credit) online programs for certification, professional development, and personal enrichment. Many professional schools and University centers and departments offer non-credit courses and other educational resources online, including the School of Public Health, the Friday Center, the School of Medicine, Frank Porter Graham Child Development Institute, Kenan-Flagler Business School, School of Nursing, School of Education/LEARN NC, UNC Libraries, The Writing Center, School of Government, and many others. For example, the School of Government provides extensive online programming in the form of synchronous and on-demand webinars, courses offering Continuing Legal Education credits, blogs, and various online tools. The NC Institute for Public Health in the Gillings School of Global Public Health offers webinars and free self-paced online training programs on a variety of topics. The NC Area Health Education Centers program in the School of Medicine provides online Continuing Medical Education opportunities for health care practitioners.

In addition, in early 2013, UNC-Chapel Hill entered into a partnership with Coursera to provide MOOCs, which represent an innovative approach to providing free, non-credit enrichment programs to the public on an enormous scale. Coursera provides a technology platform capable of handling huge numbers of simultaneous users, which would be beyond the capability of campus systems. The primary goals of the UNC-Chapel Hill MOOC initiative are to serve the public by extending learning opportunities to a global audience; develop digital assets that can be used in our residential courses; and to explore innovative, technology-enabled approaches to teaching and learning.

We have now created and offered six MOOCs and more are in development (see Appendix 4). As of September 2014, our MOOCs had enrolled a total of more than 208,000 individuals from 190 countries (approximately 30 percent of the enrollments are from developing economies). Initially, a task force and a working group whose members were drawn from across the university were formed to manage the MOOC initiative and create the MOOCs. That responsibility is now held by the Friday Center.

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Use of technology to strengthen student learning in on-campus, classroom-based courses.

Various online resources and techniques have been incorporated in classroom-based courses in recent years, involving both online learning activities and reconfigured classrooms. Course redesigns have taken a number of different forms in response to specific departmental and instructor needs. Introductory Spanish language classes were changed to a hybrid formula in 2007 for reasons of efficiency and consistency across sections, with online activities replacing some classroom meetings each week. Several large-enrollment courses, including Biology 101, Physics 116 and 117, Psychology 101 and 201, Economics 101, and Math 130, have been redesigned to incorporate online resources to promote greater levels of interaction and/or allow for active problem-solving. With guidance from the CFE and its 100+ initiative, faculty have used technology to integrate evidence-based teaching and learning methods, such as frequent low-stakes assessment. CFE's 100+ program has provided course redesign grants over the past three years to 37 individual faculty in 14 departments in the College of Arts and Sciences and in the Schools of Nursing, Law, and Public Health. In addition, the CFE is now working with the anthropology and history departments on comprehensive department-wide redesign projects. The CFE has also provided consultation on the design of a large introductory course in the School of Journalism, as well as the evaluation of the student learning outcomes. In entry-level science courses, redesigned courses have proven to be beneficial in improving student learning outcomes—particularly for student populations that previously have not performed well in these classes—and enhancing student engagement (4).

The College of Arts and Sciences received funding from the Association of American Universities to redesign introductory physics, biology, and chemistry courses. As part of this project, active research faculty in these disciplines are paired with those experienced in using instructional technologies to provide opportunities for active learning and increased student engagement. The College created a Task Force on Teaching Large Courses and appointed Kelly Hogan as Director of Instructional Innovation in the Office of Undergraduate Education.

The UNC Eshelman School of Pharmacy launched its Educational Renaissance initiative as an integral component of the school's strategic plan, and it speaks to the school's aspirations to transform education, enlighten students, and advance health care (6). As part of the strategic initiative, the school is transforming the curriculum of its professional doctor of pharmacy (PharmD) program, positioning its faculty members to be innovative and highly successful as educators and scholars, and creating an environment that fosters educational research and the scholarship of education. A defining component of this effort is leveraging technology to appropriately pair a cognitive development activity with the learning environment that best supports it. For example, technology can enable asynchronous self-paced activities for students to develop knowledge and comprehension of foundational content. In turn, learning foundational content before class allows students to apply, evaluate, and create in a communal setting during class where they can share ideas and challenge one another. In this classroom context, instructors can model critical thinking behaviors and nurture students through challenges and struggles. Thus, the appropriate application of technology facilitates the engagement of students and their

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interactions with faculty. In support of these efforts, the school has recruited key talent into a responsive-function Educational Technology R&D group that works with faculty to optimize what and how they teach and to advance the school as a model for educational innovation and excellence.

The UNC Eshelman School of Pharmacy has demonstrated early successes in using its approach for leveraging technology to enable higher-order cognitive activities in the classroom. For example, the teaching of pharmacokinetics serves as a model for educating students in large classrooms. Furthermore, the school's flipped classroom experience in pharmaceuticals has received widespread attention as a model for transforming student learning (7)(8)(5).

In the Gillings School of Global Public Health, during fall 2012, after a call for proposals to create new courses and/or redesign existing courses, six faculty grants were awarded to implement novel curricular changes. These ranged from revamping the core public health course in health behavior to a new course with a focus on diet, physical activity, smoking, and obesity to public health entrepreneurship. The Gillings School of Global Public Health also provided seed funding for an interdisciplinary health policy learning game called *FranklinStateSim* and the *Gillings Global Health Implementation Lab*. The latter is a graduate-level, interdisciplinary, field-based course in which teams of students apply their knowledge and experience to design and implement systematic solutions to complex public health problems in North Carolina and around the world, using online and in-person learning techniques, guided by mentors with strong practice experience.

The School of Medicine (SOM) has also recently redesigned its curriculum. A core principle in the development of the Translational Education at Carolina (TEC) curriculum is to provide for multiple modes for student learning. This demands that faculty attempt to provide video modules and online interactive tools in addition to traditional readings or lectures for content delivery, allowing student-centered choices for their most efficient learning. As in other health affairs schools, the new SOM curriculum incorporates simulations, artificial patients/robots, and other technology-based laboratories to deliver hands-on learning to students. For example, the School of Medicine operates a patient simulation lab (<http://www.med.unc.edu/csc/simulations/simulation/overview>) and also offers a multimedia development lab (www.med.unc.edu/ois/facilities/multimedialab) to help faculty produce multimedia materials. The School of Nursing operates a NOELLE Maternity Trainer robotic patient, and the School of Dentistry operates a 105-seat patient simulation laboratory.

The University's physical infrastructure strongly influences teaching and learning, and can either facilitate innovation or inhibit it. UNC-Chapel Hill's Information Technology Services (ITS) aims to provide a standard installation of technology in all general purpose classrooms on campus that are scheduled by the registrar (approximately 250 in all). Appendix 5 provides a description of the current configuration that aims to provide adequate audio-visual support for local and remote communication, media presentation, and computational support.

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The University's ability to redesign courses and leverage technology resources to initiate innovations in classroom-based teaching and learning is constrained by the configuration of our classrooms, which are designed for traditional lecture-style teaching; however, the campus has initiated some classroom changes to facilitate greater interaction and engagement. In 2010, the physics department created a studio classroom, based on the SCALE-UP (Student-Centered Active Learning Environment for Undergraduate Programs) model, following a design created by faculty at NC State University. This design includes technology-enabled desks in clusters to facilitate small group work by students as well as to enable faculty movement around the classroom. A second studio classroom currently is under construction. In other classrooms, we have replaced traditional tablet-arm seating with fixed swivel chairs and tablet-arm chairs on casters to facilitate interaction and a variety of teaching and learning methods. Plans are in place to renovate a large lecture hall, Greenlaw 101, which will involve removing fixed seating and installing moveable, clustered furniture and digital displays on all four walls. This will be our first interactive classroom of more than 100 seats. Evaluations to date indicate that redesigned classrooms enhance student engagement, develop a robust sense of community in the classroom, and allow for efficient team-based or collaborative learning. metrics that are indicators of improved student learning outcomes.

The School of Journalism and Mass Communication has redesigned several traditional classrooms into collaborative student workspaces. The School transformed a computer lab into the Advertising and Public Relations Innovation Lab, a collaborative teaching space offering conference tables and an adjustable flat-screen display, which can accommodate nearly any presentation format. The lab's corners hold circular project seating, and the walls are lined with transparent marker boards for brainstorming and collaboration. The renovated Reese News Lab, a former traditional lecture hall, now offers ten iMac workstations, three Macintosh Pro video editing stations, four Mac mini-presentation devices, a central meeting space, multiple large-screen displays, and seven Apple Thunderbolt displays that serve as docking stations for personal laptops. The Reese News Lab serves as both a classroom and a collaborative space for entrepreneurial student projects. The School created an incubator space that now houses HeelPrint Communications, a student-run creative agency.

Another example of classroom redesign is in the Gillings School of Global Public Health. Through a user-centered design process that included faculty, students, IT personnel, facility staff, and academic leaders, the School created a model twenty-first-century classroom, reimagining the selection, use, and placement of furniture, such as desks, light, technology (including AV technologies), white boards, electrical outlets, and other aspects of classrooms. The first project, a mid-sized (50-seat) multimedia classroom, opened fall 2013. It classroom features movable, powered tables, lecture capture technology, movable desks, multiple wall-mounted white boards and projection screens, and handheld white boards. A second, larger classroom went into operation in the fall of 2014. Faculty who taught in the new classroom reported that the design enhanced student discussions and learning, and students provided similar feedback. Perhaps the best marker of success is the fact that the new classroom is the most popular one in the School and is frequently requested as faculty members adopt more engaged learning techniques. The School also

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created three different collaboration spaces where students can meet informally in groups, work on their own, or use the space in other ways. Each has large LCD screen monitors, comfortable seating, work tables, and ample electrical outlets. Finally, the School has increased videoconference capability to six classrooms, ranging in capacity from 5 to 50, as a means to enhance global learning.

II. What support services and resources for online program development should be provided centrally and which should be distributed?

The University has not developed centralized resources sufficient to fully support online teaching and learning. While ITS supports our educational technology infrastructure, and the CFE supports the use of technology in campus-based programs, there is no comprehensive central support system for fully online programs. Schools that have online programs have built in-house capabilities to support program development and implementation or have contracted with third-party vendors. As noted earlier, newer online programs with non-traditional admission cycles and calendars pose challenges to central University administrative offices and systems. The growing scope and complexity of the online enterprise makes it imperative that we establish the necessary resources and funding to ensure that all academic units have the means to use technology to improve access and student success, that central administrative offices are appropriately supported, and that central systems are structured to accommodate all of the online program models that we choose to implement. These resources will provide all units with the opportunity to develop online programs that are consistent with their academic standards, goals, cultures, and practices. Centralization also will encourage collaboration and cooperation across academic units, including the development of shared resources, dissemination of best practices, and cost savings.

At present, UNC-Chapel Hill has used several different approaches to creating and implementing online programs, and as more units initiate online programs, the collective experience of these different models must be leveraged. It is useful to consider programs along two dimensions: operational and financial. The operational dimension refers to the amount of effort assumed by the local unit. A unit may offer a program that is entirely self-contained with all course development, marketing/recruitment, management, delivery, and administration done within that unit. Some of our earliest programs such as those in the Gillings School of Global Public Health took this approach. Other programs outsource one or more functions to other university partners (e.g., to the Friday Center) or to corporate partners (e.g., 2U partnerships with Kenan-Flagler School of Business and the School of Government). Partnerships may share risk and revenue or be fee-for-service agreements. The financial dimension refers to the tuition model used. Some programs use standard University tuition models with in-state and out-of-state differentials, and others use alternative models that depend on premium tuition that may or may not differentiate residency.

As UNC-Chapel Hill gains more experience in online programs, the Task Force recommends that we move toward maximizing operations that are controlled within the University and that maximize tuition that comes to the University. There certainly are functions that can

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and should be outsourced for the immediate years ahead (e.g., some marketing, specialized platforms that provide scalable and innovative capabilities), but ultimately UNC-Chapel Hill itself should be able to provide both incentives and support for most functions.

Our experiences to date have demonstrated that any program within a unit will affect people and services outside the unit, especially in administrative units. Already, a variety of University-wide administrative and support units are integral to the development and implementation of any degree program. These include Undergraduate and Graduate Admissions, Student Accounts, Registrar, Scholarships and Student Aid, University Counsel, the Graduate School, ITS, the Libraries, and Institutional Research. New online programs with alternative academic calendars pose additional challenges for these units. It is neither fair nor wise for academic programs to ask these administrative units to take on new or increased workloads without providing the necessary additional resources. A centralized resource office, an agreed-upon model for sharing tuition revenue, or both, would coordinate and integrate the required processes across these units.

UC-Berkeley's Resource Center for Online Education (BRCOE) provides a model worthy of emulation (online.berkeley.edu). BRCOE was founded on a set of core principles, including 1. a focus on the academic mission, 2. commitment to comprehensive excellence, 3. commitment to access, 4. innovation and research, 5. improving teaching and learning, and 6. revenue generation and contributions to the public good. BRCOE has several million dollars in credit/reserves (\$2,000,000 from UC-Berkeley's Chancellor's Office and \$2,000,000 from UC-Berkeley's Extension reserves) to provide start-up funding for new online programs in schools unable to provide it themselves. These amounts must be repaid from revenue with no interest, but they represent a financial model that retains revenue share within the university. Self-supporting programs pay a 15 percent university tax for central services provided by the university. Similar to the current Friday Center course design model, BRCOE provides assistance via a team of people including project managers, instructional designers, online pedagogy experts, multimedia specialists, and marketing specialists. Berkeley's Center for Teaching and Learning (CTL) provides assessment and evaluation resources. BRCOE was established fairly quickly in part because existing campus resources were brought together to form it. With the exception of new marketing and course development staff, all other staff resources were re-allocated from the CTL, ITS, the library, and the extension division (equivalent to our Friday Center). In addition, student affairs, the registrar, and university counsel are involved. Obviously, not all of these resources were transferred to BRCOE; BRCOE plays a coordinating role with other university units (e.g., student affairs, the registrar, and university counsel) to involve all necessary resources. The library plays a key role and has developed new resource guides. The respective responsibilities of the various units involved are carefully delineated.

Based on input from the BRCOE Director as well as input from campus leaders at other peer institutions (9), and a review of online program development opportunities and challenges identified at UNC-Chapel Hill, the Task Force makes the following recommendations:

Recommendation 1. Establish a UNC-Chapel Hill Online Learning credit/reserve fund

designed to incentivize and enable new online programs through loans with no interest and well-specified payback agreements (see UC-Berkeley BRCOE model). The fund should be a capital campaign priority.

Recommendation 2. Establish a Resource Office for Online Learning (ROOL) within the Office of the Executive Vice Chancellor and Provost to support the development of online programs across the University. The Resource Office for Online Learning—overseen by a director and a steering committee—would:

- manage the Online Learning credit/reserve fund (see Recommendation #1)
- conduct or contract for market research to determine program viability and marketing strategies
- provide guidance on compliance with University policies and procedures, UNC System policies, and federal and state laws and regulations
- coordinate with university administrative offices (Admissions, Registrar, Financial Aid, ITS, Legal Counsel, etc.) in the development of online programs and evaluation of administrative systems and resources needed to accommodate new online education models
- provide instructional design and course production facility and services
- create and maintain a “Carolina Online” site that will serve as a central University hub for promotion and demonstration of activity
- evaluate online program business and financial models and third-party partnerships
- collaborate with CFE to consult on pedagogy and online curriculum and instruction
- coordinate marketing of the University’s online degree programs and management of the University’s name, image, and brand in concert with the UNC-Chapel Hill Office of University Relations and UNC General Administration (UNC Online)
- collaborate with CFE and Institutional Research to ensure program outcomes assessment
- act as a repository of information on technologies, innovations, service-providers, and other resources for online teaching and learning.

Because the Office would take on some functions currently handled by existing units (e.g., the Friday Center, Center for Faculty Excellence, academic departments and schools, ITS) the campus will have to carefully consider how to coordinate or merge any currently distributed functions. The ROOL will collaborate closely with CFE as it supports and coordinates faculty use of technology in residential teaching and learning; the Friday Center as it supports part-time credit studies, non-degree courses, and the baccalaureate degree completion program (see Section IV, Recommendation 1); ITS Teaching and Learning as it develops and supports campus-wide technology innovations; the Office of Institutional Research and Assessment as it monitors and reports program and student data; the campus libraries to provide licensed materials and reference support; and with individual units as they develop and implement

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program delivery systems and staffing and support models. It is especially important that ROOL act as a stimulant to innovation across the campus rather than as a layer of impediment.

Recommendation 3. Appoint a standing faculty-administrator-student task force on educational technology trends and opportunities co-led by the Center for Faculty Excellence and ITS Teaching and Learning and including representatives from FITAC, the Libraries, and the student body. This task force would be charged with researching, assessing, piloting, and recommending teaching and learning technologies. A specific focus of the task force should be research on interactive social learning technologies and their impact on engagement and learning outcomes. Promising technologies might include simulation, gamification and game-informed learning, computerized grading, digital enhancement of textbooks, mobile learning, and learning management systems (see Appendix 6). Reports of the task force should be widely disseminated.

III. How can technology be used to improve residential education, i.e., to increase student access to and success in a full range of disciplines?

Building on our experience and successes, we are well positioned to work aggressively to use technology to transform residential education at all levels—undergraduate, graduate, and professional. As noted in Section I above, there are many initiatives in the College of Arts and Sciences and the professional schools to use technology-assisted teaching methods to improve learning outcomes and by the campus to transform the physical infrastructure of classrooms to support these outcomes. Initial assessments of course and classroom redesign initiatives have documented their positive impact, particularly for first-generation and underrepresented minority undergraduate students (4).

Just as online distance education programs improve access to higher education generally, redesigned courses improve student performance and allow them access to and success in career paths that previously, because of poor performance, would have been closed to them. Use of technology in classroom-based courses should focus on improving the effectiveness of the teaching-learning process through the use of evidence-based practices and approaches. Often online education is described as a method to “deliver content,” but we believe that technology use instead should focus on promoting active learning, authentic assessment, frequent and timely feedback, student-student and student-faculty interaction, and other research-based approaches. Students should learn through discussion, interaction, problem-solving, and other activities that go beyond reading, listening, and viewing. Technology use has the potential to increase academic flexibility by supporting hybrid approaches that could reduce the need for additional classroom space.

With the increased availability and use of technology comes the opportunity for online and residential programs to interface, dovetail, or overlap in many ways that could benefit both types of programs. All UNC-Chapel Hill programs, whether they are campus-based, online, or hybrid, aim to meet the mission of the university to “to serve as a center for research, scholarship and creativity and to teach a diverse community of undergraduate, graduate and professional students to become the next generation of leaders.” To this end, all

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programs—residential, hybrid, and online—must focus on delivering high-quality learning and human interactions. Many techniques and tools apply regardless of delivery modality. For example:

- systematic organization of concepts—both sequencing and chunking
- multi-channel examples to provide alternative learning opportunities to maximize individualization
- activity-based learning activities
- collaborative learning activities
- engaged discussion opportunities
- rapid and useful feedback on learning progress
- team-based learning
- situated learning through simulation, cases, or gaming
- student-led creation of content and course materials through the use of blogs, videos, or narrated online presentations
- problem-based, authentic, and constructivist learning approaches.

Although many elements of learning and teaching are shared across modalities, there are special tools and techniques that online learning demands. For example:

- responsive content management system(s) that support effective remote communication and collaboration
- instructional programs and activities that support asynchronous as well as synchronous learning that is under the learner's control
- Quality Matters framework (www.qualitymatters.org/rubric).

As our residential programs leverage more technology and online technologies continue to develop, it is certain that hybrid programs will emerge and that students (and faculty) will desire to move back and forth between online and residential programs. The Gillings School of Global Public Health has implemented accelerated models, and the growth of these models will allow students to graduate on an accelerated basis or accommodate special needs such as parenting or work responsibilities. These models also could help facilitate the creation of “three-plus-one” bachelor's/master's programs. These initiatives will pose new challenges related to registration, tuition models, course scheduling, content chunking, and staffing patterns. No perfect solution is possible but models and practices will evolve over time. It is essential that we remain open to exploration of alternative models for organizing programs and to increased flexibility for students. As new approaches emerge, it also will be necessary to share best practices across campus.

Recommendation 1. Facilitate and encourage faculty use of technology to promote active and interactive learning to improve students' learning outcomes.

- Build a recurring CFE competitive curriculum innovation fund that has the capacity to support multiple, annual large (\$50,000) and small (\$10,000) department and faculty-led initiatives for residential technology-assisted teaching. Incorporate the curriculum innovation fund into the University's capital campaign;

- Hire two additional faculty development staff in the CFE to help instructors transition to technology-assisted teaching and help departments develop a linked set of teaching approaches to ensure that students engage in active and interactive learning across departments and over the course of completing their majors or professional degrees.

Recommendation 2. Create a working committee to review academic policies, procedures, and calendars needed to support non-traditional blended or hybrid approaches to teaching and learning.

- Facilitate Registrar and academic units' efforts to develop a residential academic calendar built around learning-goal-defined chunks rather than unalterable, one-size-fits-all 15-week semesters.
- Provide funding to fast-track necessary IT changes that must be made in order to accommodate flexible calendars.
- Encourage deans and chairs to incentivize skills in non-traditional approaches to teaching as part of recruitment and promotion practices.
- Encourage the University and the College of Arts and Sciences to evaluate regularly its policies on online courses for undergraduate students.

Recommendation 3. Allocate recurring annual funding of \$500,000, administered by the Classroom Policy Steering Committee*, to redesign (renovate, reconfigure, and refurbish) classrooms to facilitate interaction among students and between faculty and students; instructor movement throughout the classroom; fluid use of multiple technologies; and easy transitions between lecture, discussion, small group, and independent work. This level of funding would support renovation of one large lecture hall or multiple smaller classrooms each year.

- Explore current prioritization of campus deferred maintenance to see if academic classroom upgrades might fall within the scope of pending improvements and therefore warrant higher prioritization.

Recommendation 4. Create an Active Learning Laboratory within the CFE to serve as the physical home for key technology tools to support instructors who are transitioning to blended learning models.

IV. How can technology be used to expand access to a Carolina education?

The Task Force envisions several distinct approaches to expanding access. The first—representing a major advance for public research institutions—is to create a baccalaureate degree-completion program. The second is to expand our already extensive efforts to reach students who desire professional and graduate degrees but who are unable to participate in residential programs. The third is to expand our efforts to support non-degree for-credit and non-credit courses and programs that enrich the lives of people in North Carolina and

* The CPSC includes representatives from all units involved in classroom scheduling, maintenance, construction, technology, and oversight.

the world. The first approach requires an entirely new set of resources while the second and third approaches secure economies of scale and collaboration by building upon the various programs underway in different schools and centers across the campus.

The 2012–2013 UNC-Chapel Hill Board of Trustees 21st Century Vision Committee on Access and Completion recommended “that UNC-Chapel Hill develop partnerships among its schools, departments, and programs, as well as partnerships with other public universities in North Carolina, that will allow the University to offer one or more flexible, high-quality degree-completion programs for adult learners with at least two years of previous college experience but no bachelor degree.” This follows the Board of Governors’ strategic initiative to increase the number of college graduates in North Carolina. Our recommendation was also informed by a custom research brief prepared by the Education Advisory Board (Career-focused Degree Completion Programs, 2012) that described programs across seven diverse university environments. It was also informed by examining the program at the University of Virginia.

Non-degree-credit continuing education opportunities also are important in fulfilling our obligation to serve the public of North Carolina and beyond. Such courses and programs help to extend Carolina’s global presence and educate and serve people who have no other means of interacting with UNC-Chapel Hill’s incredible faculty. Further, the digital assets created for online non-credit courses and programs help to enhance and enrich our for-credit programs, whether online or on-campus, and allow us the opportunity to develop and evaluate innovative approaches to teaching and learning.

Recommendation 1. UNC-Chapel Hill should offer a market-driven, online undergraduate degree-completion program for qualified non-traditional students[†] who either cannot participate in our residential programs or would be better served by the flexibility offered through online courses. Such a program would support the UNC General Administration strategic plan, and demonstrate leadership in defining access and success for a public research university by drawing from a number of professional schools and the College of Arts and Sciences in order to provide a professional career-focused curriculum. This program should

- provide access to non-traditional, diverse, adult learners
- welcome students who are capable of succeeding academically, enriching the experience of their classmates and faculty, and helping the University achieve its broad mission
- include special programs to reach and serve military veterans
- champion the research and teaching expertise of UNC-Chapel Hill tenured, clinical, and fixed-term faculty

[†] For the purposes of this report, a non-traditional student is one who has any one of the following characteristics: is age 25 or older; attends part time; works full time (35 hours or more per week); is considered financially independent (for purposes of determining eligibility for financial aid); has dependents other than a spouse; or is an active military or military veteran.

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- incorporate multimodal teaching environments with appropriate combinations of face-to-face, hybrid, and online formats
- integrate authentic, career-focused course activities and capstone projects
- demand high levels of faculty-student and student-student interactivity and engagement based on pedagogical best practices
- emphasize small-scale cohort programs that promote engagement and high-social presence
- help students achieve professional success through high-quality content, active learning techniques, and engaged instruction.

The William and Ida Friday Center for Continuing Education should serve as the administrative and coordinating unit for the undergraduate degree-completion program, with participating academic departments maintaining all academic control, regulations, and degree conferral. Policies for cost-sharing and cost-recovery must be clearly established as incentives for participation by academic and other administrative units. Assessment of outcomes must be conducted regularly and rigorously. The Friday Center will coordinate with appropriate campus offices to facilitate excellent student services (e.g., Undergraduate Admissions, professional school admissions, Financial Aid, Institutional Research)

Recommendation 2. UNC-Chapel Hill should expand professional school certificate and degree programs for non-residential students, relying on market analyses to guide the development of high-need programs. Support for marketing and instructional design through ROOL will be required to reach optimal enrollments.

Recommendation 3. UNC-Chapel Hill should further research, develop, and assess online and hybrid degree credit outreach opportunities for students seeking college credit and pre-professional preparation.

- Top priority should be given to developing post-baccalaureate pre-professional programs and revising Connect Carolina systems to accommodate enrollment of post-baccalaureate students. Further development and extension of Carolina Courses Online and Self-paced Courses is also a priority, with a special focus on reaching veterans and active military.
- Facilitate efforts to revise policies, procedures, and systems to allow the enrollment of non-traditional students and permit non-traditional calendars.

Recommendation 4. UNC-Chapel Hill should further research, develop, and assess online and hybrid non-credit enrichment opportunities for a worldwide audience, such as MOOCs. These efforts should aim to promote UNC's global visibility and to leverage and evaluate new technologies that may migrate to credit-bearing courses.

V. How should we assess outcomes of online teaching and learning?

The overarching framework for assessing the process and outcomes of online teaching and learning encompasses three levels of focus, as follows:

Focus Level	Process	Outcome
University (accountable to GA, BOG, State authorization, SACS)	Make programs more efficient and effective by providing centralized planning, infrastructure, and services.	Ensure online programs or technology-assisted teaching furthers the University mission, particularly to increase access and enhance quality.
Program (accountable to SACS, disciplinary accreditation, Provost, program improvement)	Make programs of online or technology-assisted teaching and learning better for schools/programs and faculty/staff.	Ensure online programs or technology-assisted teaching and learning meet the following expectations in terms of: reach, finance, and quality.
Students (accountable to their profession, NC, e.g., for licensure, national licensure reciprocity)	<p>Make the programs of online or technology-assisted teaching and learning better for students currently engaged in the programs by way of:</p> <ul style="list-style-type: none"> • resources contributing to student support • resources for programs/courses to provide support • incorporating student feedback. 	Ensure programs document student outcomes and students achieve intended outcomes as defined by the program expectations and goals.

University-level evaluation should be the responsibility of the CFE and ROOL.

At the program level, expectations for online programs and technology-assisted teaching are unclear and vary widely. Even with the help of centralized services, programs and units will need to clarify their goals and tailor their evaluation needs to meet accreditation requirements (e.g., for student-faculty ratio, learning outcomes, and quality control). Programs and units also must contend with unrealistic expectations of online or technology-assisted education (e.g., costs or changes in teaching or learning practices) on the parts of faculty, staff, administrators, and students. Furthermore, faculty may not value the growth of programs, as there are few incentives for tenured or tenure-track faculty to improve teaching or to teach more students. Thus, financing and cost may loom larger.

With regard to the student level, units have different resources (money, expertise) to commit to evaluation; some already have more capacity at learning assessment and

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documentation than others, but each program is highly dependent on analytic tools and personnel. Learning outcomes also vary across units and are measured differently. Although achievement of learning goals can be measured during a course, the learning outcomes—how students change as a result of the course—are much harder to measure. There are few incentives to measure learning outcomes and it is hard to do.

Recommendation 1. Those in units and programs that are responsible for the design, development, and assessment of online and technology-assisted teaching will:

- evaluate programs according to standards established by the Office of Institutional Research and Assessment (OIRA), CFE, and ROOL
- measure student outcomes after graduation, contributing to a common definition and consensus across the University about a minimum level of student support in a program or a course; and help faculty to understand and then use student feedback to improve courses.

Recommendation 2. Expand the assessment and evaluation capability of the CFE and the OIRA by hiring two additional program evaluation staff to analyze online teaching and learning initiatives in order to assess their effectiveness and build a knowledge base for further innovation in teaching and learning. The CFE and OIRA assessment teams will collaborate to assist faculty and departments in designing curriculum research projects and evaluating student outcomes as defined by the program expectations and goals. Expertise in the School of Education can also be an important resource.

VI. Summary and Conclusions

Higher education is in the midst of unprecedented public interest. Our costs and effectiveness are under challenge from many quarters. New technologies are emerging that promise to change the way students learn and the way universities develop and deliver education. Whether we are at the beginning of the end of higher education as we know it (major disruption) or the beginning of a renaissance in effectiveness and efficiency remains to be seen (10). UNC-Chapel Hill, as an educational leader, must grapple with these challenges by leveraging all the talent and resources our campus has to ensure that our mission continues to be achieved for the foreseeable future.

The recommendations of this Task Force aim to advance how we meet these challenges by coordinating efforts to maximize resources and proposing new initiatives and investments that will lead the campus forward. The TF views these recommendations and actions as the next steps on an ongoing journey toward improving access to a Carolina educational experience and toward maximizing success for all students, faculty, and staff associated with our educational enterprise.

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Appendix 1. Task Force Charge and Participants

Participants

Gary Marchionini—Chair, School of Information and Library Science
Stan Ahalt, Computer Science and RENCI
Mike Barker, Information Technology Services
Rob Bruce, Friday Center
Julie Byerley, School of Medicine
Susan Cates, Kenan-Flagler Business School
Deb Eaker-Rich, School of Education
Steve Farmer, University Admissions
Carol Hunter, University Libraries
Pam Joyner, School of Pharmacy
Susan King, School of Journalism and Mass Communication
Rachel Lillis, School of Journalism and Mass Communication
Eric Muller, School of Law and Center for Faculty Excellence
Todd Nicolet, School of Government
Abigail Panter, College of Arts and Sciences
Neel Patel, Student Member
Andrew Powell, Student Member
Tyler Ritter, Friday Center
Anna Maria Siega-Riz, Gillings School of Public Health
Molly Sutphen, Center for Faculty Excellence
Carol Tresolini, Provost's Office
Will Tricomi, Legal Counsel
Meredith Weiss, AVC for Administration
Lynn Williford, Institutional Research

Goal

Define a strategic direction for UNC-Chapel Hill in the use of technology-assisted teaching and learning to increase access and success. Recommend the administrative, governance, and funding structures needed to support this.

Tasks

- Consider our inventory of existing and planned UNC-CH programs and initiatives and their status (e.g., student populations served, whether static, growing, changing, etc.) and levels of success
 - Online degree and certificate programs
 - Online continuing education opportunities (credit and non-credit)
 - Course redesign initiatives
- Identify key questions about the use of online/distance/technology-assisted learning to improve access and success at UNC-CH
- Suggest answers to those questions
 - Examine programs and practices of peer universities

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Potential Key Questions

- What are the strengths, weaknesses, and gaps in our use of online teaching and learning?
- How can technology be used to improve residential education, i.e., to increase student access to and success in a full range of disciplines?
- How can technology be used to expand access to a Carolina education?
 - Should we offer an online or hybrid degree completion program for working adults?
 - What is the market for such a program?
 - How would we distinguish it from others?
 - How would it best be structured, organized, and run?
 - What should be our array or suite of online and hybrid outreach opportunities?
 - What is the future for UNC-Chapel Hill MOOCs?
 - How should we balance credit and non-credit offerings?
- How might online and residential programs interface, dovetail, or overlap?
 - What are the barriers to linking online and residential offerings?
 - How might they be overcome?
- What should be our stance with regard to partnerships with third-party providers (e.g., 2U, Academic Partnerships, Coursera)?
 - Should more services and resources be available in-house at the University to reduce the amount of revenue shared with third-party providers?
- How should we assess the process and outcomes of online teaching and learning?
- How can we best support the use of online teaching and learning?
 - What support services and resources should be provided centrally and which should be distributed?
 - How should classrooms be designed to accommodate technology-assisted teaching and learning?
 - How would administrative processes and structures need to change?

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Appendix 2. For-credit UNC Distance Education Programs, Spring 2014

School/Program
School of Journalism and Mass Communication
Master of Arts in Technology and Communication
Certificate in Technology and Communication
Department of Allied Health Sciences, School of Medicine
Master of Clinical Laboratory Science
Masters in Radiologic Science
Transitional Doctoral Program in Physical Therapy
Gillings School of Global Public Health
Certificate in Core Public Health Concepts
Certificate in Field Epidemiology
Certificate in Occupational Health Nursing
Certificate in Community Preparedness and Disaster Management
Certificate in Public Health Leadership
Certificate in Global Health
*Certificate in Maternal and Child Health Leadership
MPH in Public Health Leadership
*MPH in Maternal and Child Health
*MSPH in Maternal and Child Health
Executive DrPH in Health Leadership
MPH in Public Health Policy and Management
MHA in Public Health Policy and Management
School of Government
Master of Public Administration
Kenan-Flagler Business School
MBA@UNC
William and Ida Friday Center for Continuing Education
Carolina Courses Online
Self-Paced Courses Online

*Not currently accepting applicants.

Appendix 3. College of Arts and Sciences Policies on Distance-Learning Courses

The Undergraduate Bulletin lists the following policies that apply to distance-learning courses:

- (1) The maximum number of credit hours, all of which must be designated UNC–Chapel Hill or Semester Online, that can be counted toward an undergraduate degree in the College of Arts and Sciences is 24. There can be no exceptions to this upper limit.
- (2) First-semester, first-year students may not enroll in for-credit online courses unless unusual circumstances prevail, nor may first-year students take an online course in the summer prior to matriculation.
- (3) Full-time undergraduate students may enroll in a maximum of one for-credit online course (currently CCO or Semester Online) per regular semester (after the first semester, if they are a first-year student) and a maximum of two for-credit online courses per summer.
- (4) Degree-seeking students who are not enrolled may take a maximum of two for-credit online courses in a regular semester or summer.
- (5) No more than two for-credit online courses in any one department, curriculum, or professional school may count toward a major or minor in the College of Arts and Sciences.
- (6) Self-Paced courses cannot count toward a degree in the College of Arts and Sciences, other than in exceptional circumstances.
- (7) It is the responsibility of the Senior Associate Dean for Undergraduate Education, in consultation with the Associate Dean and Director of the Academic Advising Program, to determine whether students in unusual circumstances warrant an exception to these policies.

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Appendix 4. MOOCs

Carolina currently has five MOOCs in its Coursera Library. Most of these courses have completed their initial offerings, and will be available again periodically. Current courses include

1. “Fundamentals of Rehearsing Music Ensembles”
Evan Feldman, Department of Music, College of Arts and Sciences
1st offering completed with 16,248 total enrollments
2. “Metadata: Organizing and Discovering Information”
Jeff Pomerantz, School of Information and Library Science
2 offerings completed with 49,549 total enrollments
3. “What's Your Big Idea?”
Buck Goldstein, UNC-Chapel Hill and Holden Thorp, Washington University
1st offering completed with 38,760 total enrollments
2nd offering October 2014 with 12,621 enrollments to date
4. “Epidemiology: The Basic Science of Public Health”
Lorraine Alexander and Karin Yeatts, Gillings School of Global Public Health
1st offering completed with 33,783 total enrollments
5. “Introduction to Environmental Law and Policy”
Don Hornstein, School of Law
2 offerings completed with 35,596 total enrollments
3rd offering September 2014 with 8,786 enrollments to date

Courses in production include

6. “The American South”
William Ferris, Department of American Studies, College of Arts and Sciences
1st offering October 2014 with 3,170 enrollments to date
7. “Love 2.0 and Positive Psychology”
Barbara Fredrickson, Department of Psychology, College of Arts and Sciences
8. “Critical Thinking”
Ram Neta, Department of Philosophy, College of Arts and Sciences

Appendix 5. Classroom Hotline’s Classroom Technology Specifications

The Classroom Hotline subunit of ITS-Teaching and Learning provides information technology support for the General Purpose Classrooms (GPCs) at UNC-Chapel Hill. Via the support of the Office of the Chancellor and the Office of the Provost, the Classroom Hotline is installing technology into GPCs that have none and is undertaking comprehensive lifecycling in rooms that contain obsolete analog technologies.

The general types of equipment the Classroom Hotline implements are as follows:

Type	Description/Components
DIG-MC1	<ul style="list-style-type: none"> • digital video projector • document camera • Blu-Ray player • computer • touch panel • fixed or movable podium • laptop connection • ring-down phone
DIG-MC1-LV	LARGE-VENUE installation of DIG-MC1
DIG-MC1-WCC	DIG-MC1, plus: <ul style="list-style-type: none"> • web conference and capture capability built into computer
DIG-MC1-VTC	DIG-MC1, plus: <ul style="list-style-type: none"> • traditional H323 video conferencing and computer-based web conferencing and capture capability

Note:

1. The distinction between DIG-MC1 and DIG-MC1-LV is the size of the space; large venue cases require microphones and speech reinforcement.
2. Major renovations or substantial changes involved in converting rooms to “interactive classrooms” involve special planning, are custom-designed, and are handled as distinct, one-time projects.
3. Although synchronous video conference capability is limited to rooms of the DIG-MC1-WCC and DIG-MC1-VTC type, the Classroom Hotline does provide portable webcams that can be reserved and delivered by the Classroom Hotline.

Enhancement opportunities:

4. Add cameras and adequate audio technologies to GPCs in order to facilitate

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participation by remote participants. (This could risk reinforcing lecture-style instruction, but it could facilitate flipping classrooms and hybrid course offerings over time.)

5. In concert with (point 4), add lecture-capture technology as standard component to allow instructors to capture, archive, and easily present recorded lectures. (This could risk reinforcing lecture-style instruction, but it could facilitate flipping classrooms and hybrid course offerings over time.)
6. While not limited to serving (point 5), provide an enterprise media library solution that allows controlled and integrated presentation of recorded lectures, other media contents, and licensed contents (including instructor produced material, copyrighted material through University Libraries, and perhaps student-generated materials).

The cost of adding cameras and advanced audio capabilities will vary according to the physical space in the room; it thus is best approached in a systematic renovation program.

Appendix 6. Selected Technology Trends for Higher Education

Higher education has been adopting and adapting several kinds of technologies to promote learning and teaching practices. The following list is not meant to be exhaustive but rather to give some background on selected trends that UNC should monitor in the immediate years ahead.

1. Simulation Technology-based Learning

The use of simulation technology as a learning tool traces its roots to the urgent need to improve safety in the aviation industry. Simulation technologies such as sensors and virtual reality displays have since been adopted as established training tools in the military and certain high-risk industries such as nuclear energy. Simulation technology has been less widely adopted in higher education, with the exception of medical education. Medical simulations often involve a combination of traditional simulation techniques, such as team-based role-playing (e.g., an operating room team of anesthesiologists, surgeons, and nurses), and technology-based simulation techniques, such as software programs that mimic real-world medical emergencies (e.g., a mannequin “patient” hooked up to an anesthesia machine and various other hospital monitors that are programmed to signal cardiac arrest or another medical emergency). The major downside to the use of simulation technology in higher education is the high upfront development costs; however, the costs associated with commercial simulation technologies have been decreasing, thus encouraging their widespread adoption.

2. Gamification and Game-informed Learning

“Gamification” is a relatively new concept that was coined in 2002 by a British IT expert but only recently has become widely used. Gamification can be considered as a very specific type of simulation technology; it refers to the use of game theory and practices in the development of digital simulations for e-learning (i.e., *game-informed* learning). Gamification is based on the theory that students will be more engaged with the learning process and will ultimately achieve greater academic success if learning is based on gaming concepts such as competition, incentives, and goal attainment. Many e-learning games are available today; some of these are targeted for individual learners, but many are intended for teams, and some have options for either individuals or teams. Examples of popular e-learning games include Bridge Constructor (<https://itunes.apple.com/us/app/bridge-constructor-free/id507125352?mt=8>); Kerbal Space Program (<https://kerbalspaceprogram.com/>); and duolingo (<https://www.duolingo.com/>). While not strictly game-based, Codecademy (<http://www.codecademy.com>) and Youth Digital Studio (<http://www.youthdigitalstudio.com/>) incorporate gaming principles into their courses through the use of interactive feedback, badges for completion of exercises, and scorekeeping. While widely popular, the effectiveness of digital games in promoting student learning is unclear; indeed, the few studies that have been conducted have demonstrated mixed effects.

3. Collaborative Distance Learning Environments

Collaborative distance learning environments represent virtual active learning classrooms, but they aim to take the concepts of active learning one step further—through distant, distributed networks of students. Most courses that aim to achieve collaborative distance learning rely on a combination of technologies, such as e-mail, online forums, interactive whiteboards, user devices, cameras, sound amplification, multimedia (e.g., video, audio, Web), collaborative learning software (e.g., Google docs, Yammer, Red Pen, etc.), instructional games, and conferencing tools (Skype, Google+ Hangout, Blackboard Collaborate, WhatsApp, etc). Social media play a critical role in collaborative distance learning by promoting a seamless integration of technologies, humanizing virtual interactions, and enabling personalized learning. A novel example of collaborative distance learning is Maker Camp (<http://makercamp.com>), which is a free, “live”, interactive summer camp that was developed by Make in collaboration with Google and enables learners to go on virtual “field trips” to meet inspiring “makers” from around the world and embark on “maker” projects of their own. Major drawbacks to collaborative distance learning environments are their high upfront development costs and the lag-time between video and audio feeds, which can be disruptive to the learning experience and can also add time to any given lesson plan.

4. Computerized Grading

Computerized grading is not new; indeed, educators have relied on computerized grading for years, beginning with the Scantron “bubble sheet” solution for multiple choice questions. Computerized grading of written, free-form short answers or essays has not yet been fully realized but is rapidly gaining attention as a new technology for education (<http://research.microsoft.com/apps/pubs/default.aspx?id=220378>). Computerized grading applies the techniques of machine learning and artificial intelligence to determine, statistically, the probability that a human grader would give a particular grade to an essay. A software program does this by searching for aspects of writing such as the number of words, spelling, sentence structure, use of punctuation, average length of a word, average length of a sentence, accuracy of quotes against source material, etc. A number of companies are developing software for computer grading, and several have marketable products, such as the ETS eRater (<http://www.ets.org/erater/about>) and the Vantage Learning IntelliMetric system (<http://www.vantagelearning.com/products/intellimetric/>). An open source software product has also been released by edX (<http://code.edx.org/discern/>). Computerized grading has received mixed reviews among educators, with headlines claiming that “Computer grading will destroy our schools”. The National Council of Teachers of English has released a position statement in strong opposition to computerized grading. Proponents, however, argue that computerized grading will save costs, provide faster student feedback, and standardize the grading process.

5. Digital Enhancement of Textbooks and Mobile Learning

Electronic textbooks are becoming more and more popular in higher education. Part of the appeal is that they are more portable and less expensive than traditional hard cover

textbooks. E-textbooks also offer the opportunity to enhance the text with hyperlinks to additional resources, including other textbooks, videos, audio lectures, slide presentations, and (theoretically) real-world data sets or streaming sensor data. The goal of e-textbooks is to create a truly dynamic, interactive learning experience in which students and teachers can simultaneously immerse themselves in the learning experience. A variety of digital devices can be used to access e-textbooks, including laptops, e-readers, tablets, and other mobile devices. A number of companies specialize in the development and marketing of e-textbooks and other digital course materials, including Apple (<https://www.apple.com/education/ipad/ibooks-textbooks>), CourseSmart (<http://www.coursesmart.com>), and Google (https://play.google.com/store/books/category/coll_1673?hl=en). A significant drawback regarding e-textbooks is that publishers have not adopted a common platform with standardized approaches to the creation of digital textbook material, although IBM is working with a Polish company, Wydawnictwa Cyfrowe LLC, to create a cloud-based solution to this challenge. In addition, few studies have evaluated the effectiveness of e-textbooks in promoting student learning, and the results of those studies are conflicting.

6. Learning Management Systems (LMSs)

A variety of open source and commercial LMSs are available and designed to support all aspects of e-learning and the needs of all stakeholders, including learners, teachers/employers, administrators, and IT staff. A typical LMS provides automated administration (including integration with human resource systems), calendar support, courseware design and content, document and curriculum management, student registration support, tracking of organization and learner progress, basic assessment and testing tools, synchronous collaboration tools such as webcasts, and a variety of other features, including training in the software. Many LMSs are based on the cloud-based Software-as-a-Service (SaaS) model. According to a recent Capterra report (<http://www.capterra.com/learning-management-system-software/>), the 20 most popular LMS programs are: Moodle; Edmodo; ConnectEDU; Blackboard; SumTotal Systems; Schoology; Collaborize Classroom; Docebo; Desire2Learn; Interactyx; Litmos; DigitalChalk; Meridian Knowledge Solutions; Latitude Learning; Educadium; and Rcampus. A major drawback to LMSs is their high upfront costs. In addition, the LMS model tends to cater toward industry and continuing workplace education rather than traditional higher education.

7. Technical Infrastructure

To realize many of the potentials of technology that maximizes personalized and activity-based learning, several key technical developments bear monitoring.

- Immersive (virtual reality) or augmented (e.g., Google Glass) environments continue to evolve and will undoubtedly find more applications in education as prices fall and educators develop best practices for adapting instruction.
- Natural language processing (NLP) techniques continue to evolve and computational linguists will work with educators to apply these techniques to

language translation that supports global instruction, and to machine learning of evaluation rubrics that support automatic 'grading' of essays and interactive forum conversations.

- Data-intensive education continues to develop. Electronic Learning Records (or personal learning records) will evolve as more of human activities from birth are recorded or monitored by sensors and other devices. Just as electronic health records support better diagnosis and treatment (as well as research activities across populations), so records of reading, playing, interacting with media and other people will become more populated as children grow and educators will be able to leverage these records to personalize and optimize instruction. The use of 'badges' and other certifications of competency are also part of this evidence-based learning record trend.
- Alternative educational systems and workflows are often discussed and debated in the research and popular literature. Learning modules rather than courses, pay-for-skill rather than degree, customized instructional prescriptions, are among alternatives to university-based courses and degrees. New business models to support learning are emerging that may add new value (if only through spurring redoubled efforts to serve students better) to higher education.

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