

A FRAMEWORK FOR EVALUATING CLASS SIZE IN ONLINE EDUCATION

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As universities across the nation turn to online delivery formats for many of their courses, the question of optimal class sizes has become increasingly controversial. This article reviews the current multidisciplinary research available to determine what, if any, guidance on online class size exists. The research to date offers no consensus regarding appropriate student-to-teacher ratios in online courses. The authors propose the use of 3 educational frameworks to guide class enrollment decisions that maintain educational quality: Bloom's taxonomy, objectivist-constructivist teaching strategies, and the community of inquiry model. Further research is recommended to assess student learning outcomes across courses of varying size.

Perhaps the biggest change in higher education in the past decade has been the explosion of courses and degree programs offered through online learning technologies. Colleges and universities around the world, involving programs across multiple disciplines, have moved selected educational offerings to web-based formats. Research findings on education strongly support the effectiveness of the online medium for cognitive learning. In comparison, studies on the learning of "soft skills" (e.g., developing skills in communication, leadership, empathy, interpersonal relationships, or socialization into a profession) are few and suggest mixed efficacy through online media (Benbunan-Fich, Hiltz, & Harasim, 2005; Hur-

ley, 2008; May & Short, 2003; Sitzmann, Wisher, Stewart, & Kraiger, 2004).

Institutions of higher education have scrambled to amass the resources and technical infrastructure required to mount online programming. The transition to online education has been rapid, driven largely by four factors: the information revolution, competitive forces in higher education, changes in student lifestyles and characteristics, and the rising imperative for expanded educational access for students of all nationalities, geographic locations, and personal circumstances.

The authors of this article have participated in the wave of online education. Like other faculty on most campuses, we attended work-

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shops at our university on using the new technology and setting up online courses. We struggled our first few semesters to make the courses work acceptably for our students and for us, and we incorporated new technical developments into our work on an ongoing basis. As online education has created a viable and effective niche in higher education at our university, across the United States, and internationally, new issues have emerged that demand informed responses (“Forum,” 2010; Moloney & Oakley, 2006). One of the more pressing current concerns of online faculty is, what are, or should be, the enrollment sizes for online courses? What impact do student-to-teacher ratios have on student learning and faculty workload? How can we objectively determine whether classes are too big or too small?

To answer these questions about class size, student learning, and our own effectiveness as online educators, the authors embarked on a review of the research literature. Most of the research we located is less than 12 years old. We compiled the results from studies completed by different disciplines on online higher education from many institutions around the world, and in this article we summarize our findings on class size. Our goal is to share with other faculty the current state of knowledge about class enrollments and educational effectiveness.

Although variations are present, we will use the terms online, web-based, and distance education synonymously, with all referring to computer-mediated higher education for students separated by place and time from faculty and other students. Because methods of online teaching do not vary significantly across educational levels, our review will be applicable to undergraduate, graduate, and doctoral studies.

UNIVERSITY PRESSURES TO INCREASE CLASS ENROLLMENTS IN ONLINE COURSES

Higher education institutions are facing revenue challenges resulting from domestic and global economic forces. Even before the onset of the widespread recession in the United

States, public universities saw cuts in state and county funding for education. Private colleges were not immune; many families with college-age children are adjusting to lower incomes. As a result, academic administrators in virtually all university settings are seeking new sources of revenue (Alexander, 2006; Drago & Peltier, 2004; Jaschik, 2010; Kelderman, 2011; Keller, 2009; Labi, 2009; Potter, 2003; Schrecker, 2010; Walters, 2006).

Given the absence of need for on-campus classrooms and facilities in online courses, many academic administrators have looked to increasing the enrollment size of distance programs as a means of generating additional revenue. Meanwhile, faculty have generally found that the workload associated with some online courses expands with numbers of students. When enrollment numbers swell in courses, students experience less direct individual contact with faculty, and many faculty perceive that the quality of education declines as they have less interaction with students and a limited ability to engage with individual learning needs. Many studies report on faculty concerns about the quality of education offered online, both within their own educational institutions and also, more broadly, in the national and international arenas (e.g., Dykman, & Davis, 2008; “Forum,” 2010; Keeton, 2004; Legg, Adelman, & Levitt, 2009; Little, 2009; Parry, 2009; Schifter, 2000; Shea, 2007; Wickersham & McElhany, 2010).

With rising pressures to increase university revenues and a concomitant growing alarm among faculty asked to enroll more students and teach larger sections, the authors sought research guidance on the evidence surrounding online class sizes and educational quality. We found that definitive answers do not exist, but that there are relevant variables to guide determinations of appropriate class sizes (e.g., Drago & Peltier, 2004).

THE RESEARCH ON CLASS SIZE

Research on online education is a multidisciplinary endeavor. Published studies of online research can be found in many journals, shown

in Table 1, as well as in books written by online experts (e.g. Armstrong & Fukami, 2009; Hiltz & Goldman, 2005). We drew on all of these resources in our literature search, reviewing articles written for many different disciplines.

We sought to identify, based on accumulated evidence, the impact of various enrollment numbers on student learning outcomes, faculty workload, student satisfaction, and other related issues of concern, and, to identify factors that may help determine enrollment numbers in course sections without compromising learning. As part of our extensive, albeit nonexhaustive, inquiry, we searched for measurement tools and/or evaluative criteria to assess student learning resulting from varying class sizes.

Research conclusions on appropriate class sizes—number of students per faculty member—are mixed and, in some cases, contradictory (see summary in Table 2). Additionally, there is scant distance education research on student learning outcomes associated with varying teaching approaches. The effects of course size studied by a range of disciplines have yielded the predominant finding that varying class sizes will create different group

dynamics and effects on faculty-student relationships (e.g., Arbaugh & Benbunan-Fich, 2005; Dykman, & Davis, 2008; Schellens & Valcke, 2006). Because of the immaturity of the research, the complexity of online education, and the number of relevant variables to consider (e.g., type of course, level of course, nature of learning expected in the course, setting, presence or absence of technology support and teaching assistants, faculty expertise in online education, evidence of student learning, etc.) (M. G. Moore, 2000), at this time the research findings on student:teacher ratios are inconclusive.

As shown in Table 2, we found studies that recommended anywhere from four to several hundred students in online courses. Larger classes are recognized as more impersonal and less individualized. Several studies have found that larger class section sizes were negatively associated with student learning, although “larger” was defined differently across studies (e.g., Arbaugh & Benbunan-Fich, 2005; Buckingham, 2003; Burruss et al., 2009; Schellens & Valcke, 2006). Research results indicate that classes larger than 30 students per faculty member can be delivered online, but such classes will inevitably take on the characteris-

TABLE 1
Selected Research Journals Containing Studies on Online Education

<i>Multidisciplinary Journals</i>
• <i>Academy of Management Learning and Education</i>
• <i>British Journal of Education Technology</i>
• <i>Computers & Education</i>
• <i>Distance Education</i>
• <i>International Journal of Nursing Education Scholarship</i>
• <i>International Review of Research in Open and Distance Learning</i>
• <i>Internet and Higher Education</i>
• <i>Journal of Asynchronous Learning Networks</i>
• <i>Journal of Information Systems Education</i>
• <i>Journal of Management Education</i>
• <i>Journal of Nursing Education</i>
• <i>Journal of Professional Nursing</i>
• <i>Journal of Technology in Human Services Learning Media and Technology</i>
• <i>Merlot Journal of Online Teaching and Learning</i>
• <i>Perspectives in Nursing Education</i>
• <i>Quarterly Review of Distance Education</i>
• <i>Review of Educational Research</i>

TABLE 2
Literature Review: Summary of Research Articles on Class Size in Online Courses

<i>Authors/Source</i>	<i>Class Size Recommendation</i>	<i>Notes</i>
Andersen and Avery (2008)	No size recommendation. Found that actual teaching time in hours per credit hour for web-based courses = 46.1 hours (<i>SD</i> 16.7); actual teaching time in hours per credit hour for face-to-face (F2F) courses = 39.4 hours (<i>SD</i> 13.2).	Descriptive study utilized time records from 11 web-based and five face-to-face graduate-level nursing courses in one large U.S. Midwestern university. Study focused on "direct teaching time" only; omitted inclusion of course development and preparation time during the semester.
Arbaugh and Benbunan-Fich (2005)	A study reported in this chapter was that class section sizes (of 30 or more students) were negatively associated with student learning.	Different class sizes create different group dynamics. Large classes are more impersonal and less individualized. Additional research needed to identify optimal student-instructor ratios.
Arbaugh (2005)	Study found no support for greater student satisfaction or self-perceived student learning with class sizes of 30 or less.	Characteristics of web-based instruction were predicted to impact two dependent variables: student satisfaction with the delivery medium, and self-perceived student learning. Sample: 40 web-based MBA classes over 11 semesters, taught by 16 different faculty, in a single Midwestern university, 1998-2001; enrollment range was 9-31 students/course.
Ascough (2002)	The author found that the workload for online course delivery is 50% to three times more work to design and run than teaching in the classroom.	This is an informational article on suggestions for designing and managing an online course, including considerations of faculty workload.
Berry (2008)	Asynchronous discussion group size should be limited to 4-9 students.	Conference presentation. Recommendations are based on author's literature review and experiences himself and with other faculty at the American Public University System.
Blood-Siegfried et al. (2008)	Indicated discussion groups should be limited to 10-12 students/group. Authors' university limits all online courses to a maximum of 25 students, perceived as necessary for effective student/faculty communication.	A group of six faculty members at a single university received funding to determine best practices in online courses. The group developed an evaluation rubric to measure quality in the graduate online curriculum, then applied the rubric to the core courses required of all graduate students. Concepts deemed of high importance to online education: <ul style="list-style-type: none"> • learner-centeredness • faculty-student interaction • student-student interaction
Brook and Oliver (2003)	Asynchronous environments: limit group size to 25. Synchronous environments: limit group size to 10.	The number of participants will influence class community development strategies in online courses.
Buckingham (2003)	For online discussions, recommends keeping the size of discussion groups to 6-10 students, with one faculty assigned to a group.	Article focused on key elements of quality online education: course design, research design, class size, levels of computer skills, technological support, and timeliness of feedback.

<p>Burruss, Billings, Brownrigg, Skiba, and Connors (2009)</p>	<p>Findings complex and mixed. For both graduate and undergraduate students:</p> <ul style="list-style-type: none"> • Student–faculty interaction—more exists in smaller classes; • Peer interaction—more exists in larger classes; better online than F2F; • Diverse learning—less opportunity in larger classes. <p>Graduate students:</p> <ul style="list-style-type: none"> • Professionalism [defined as the extent to which students “believe the content and concepts of the course prepare them for professional practice and for acquiring the values of the [nursing] profession” (p. 39)—better in smaller graduate classes (< 20 students). • Satisfaction: satisfaction decreased as class size grew; found the asynchronous conversations in larger classes unwieldy. • Connectedness: less in very large classes (> 40 students). • Social presence: higher in smaller graduate classes (< 20 students). <p>Undergraduate students:</p> <ul style="list-style-type: none"> • Satisfaction: size increase from small to medium produced higher satisfaction (> 20 students). • Social presence: class size increase from small to medium produced higher social presence (> 20 students). 	<p>This exploratory descriptive study examined class size in relation to the use of technology and to particular educational practices and outcomes. The sample consisted of undergraduate ($n = 265$) and graduate ($n = 863$) students enrolled in fully web-based courses.</p> <p>Class sizes were defined as very small (1 to 10 students), small (11 to 20 students), medium (21 to 30 students), large (31 to 40 students), and very large (41 students and above).</p> <p>Study reported more negative outcomes with very small or very large class sizes. Small, medium and large classes registered some differences in student satisfaction. Need fewer students enrolled in courses using active learning strategies. There were big differences between undergraduate and graduate course student outcomes (see middle column).</p>
<p>DiBiase and Rademacher (2005)</p>	<p>No specific class sizes recommended.</p> <p>Author asserts that economies of scale are possible (to some extent) with increasing enrollments in distance courses. This study reported a 12% gain in efficiency when moved from 18 to 49 students. Most time-consuming instructor activities:</p> <ol style="list-style-type: none"> 1. 40–55% of instructor effort: communications with students by threaded discussion and email, a consistently large share of effort, 2. 34–36% of instructor effort: Student assessment and feedback. 	<p>Research explores scalability in distance learning. The authors studied time spent teaching a course in geography eight times over a 3.5 year period. When faculty increased the average class size by a factor of 2.7 (from 18 to 49 students), their course-related workloads increased by a factor of about 2.5 (from 47.5 hours to 116.7 hours total), and average faculty time spent per student dropped from 3.2 to 2.4 hrs. Student satisfaction with the course was high overall and suffered no significant decline as a result of larger classes and increased instructional efficiency. Key variables exerting the most influence on teaching efficiency and student satisfaction: stability of the subject matter, instructor experience and knowledge, pedagogical approach, level of institutional support, and student maturity.</p> <p>Concludes that courses requiring the least instructor effort [objectivist teaching strategies] are the most scalable and efficient but may not be effective for satisfying students.</p>

(Table continues on next page)

TABLE 2
(Continued)

Authors/Source	Class Size Recommendation	Notes
Drago and Peltier (2004)	<p>Authors indicate that as the number of students increases in online classes, it becomes more time-consuming for the instructor to deal with issues as they come up. However, results from this study found that larger class sizes did not predict student-perceived course effectiveness, value of the course content, instructor support, better course structure or interactions; for two dependent variables, large class size predicted positive student perceptions. Authors conclude that online education quality factors important to students do not depend on class size.</p> <p>The quality fulcrum is around 20 students. For a new course or a new instructor, 15-20 students in an online class are ideal. For an established online class with an experienced online teacher, 25-30 students might be a workable number.</p> <p>Online classes may be too large (> 30) or too small (< 10-12). Large courses can be taught online, but they should call for less student contact with the instructor. Large classes demand that the fullness of the pedagogy be limited: fewer deliverables, much less feedback for students, much more of the "sink or swim" mentality for students.</p> <p>Optimal class size is 20 students.</p>	<p>Studied MBA courses, including 31 taught online, during an academic year at a large, regional university.</p> <p>Used class size (range of 22-83 students) as the independent variable; dependent variables representing elements of online effectiveness included: course content, instructor support, course structure, student-to-student interaction, instructor-to-student interaction, and global course effectiveness. Results indicated no significant relationship between class size and global course effectiveness. Class size showed some significance in predicting instructor support and course structure, but unexpectedly the direction of this association was positive.</p> <p>Author comments: "[T]he size of the class <i>determines</i> the learning objectives and course design. An online course designed for 15-20 students is necessarily a different kind of course from one designed for 35 or 50. It is unwise to take a class designed for 20 students and enroll 40-50 students in it. When it comes to online education, one size does not fit all!"</p> <p>"Nothing is more destructive to online student motivation than a faculty member who is not interacting with them."</p>
Keeton (2004)	<p>Optimal class size is 20 students.</p>	<p>Article reports on part of a larger study about best practices in online instruction; ultimate goal of research is to help faculty improve the quality of their teaching. Studied eight faculty who have each taught an average of 16 online courses. Measures of effective online teaching practice used in study were based on 20 years of best practices research in F2F instruction.</p>
Kenny (2002)	<p>Recommends small group sizes with similar skill level to enhance learning.</p>	<p>Author conducted a small qualitative study to explore the experiences of Australian students with online learning. Used individual interviews and focus group interviews of 21 students enrolled in a health informatics course.</p>
May and Short (2003)	<p>Reports on studies showing larger online classes (e.g., 50 students) are negatively associated with students' perceived learning and satisfaction (overcrowding).</p>	<p>Report on class sizes is from authors' own literature review.</p>

Orellana (2006)	Actual class size of the surveyed 131 faculty was 22.8; a class size of 18.9 was perceived as optimal to better achieve the course's intended level of interaction; and a class size of 15.9 was perceived as optimal to achieve the highest level of interaction.	Article presents findings of a study conducted to determine instructors' perceptions of optimal class sizes for online courses with different levels of interaction. A web-based survey method was employed. Online courses studied were those taught sometime in the last 5 years by a single instructor in undergraduate or graduate programs from U.S. colleges. Instructors described the level of interactive qualities in their most recently taught online course. Used a version of Roblyer and Wiencke's (2004) rubric for assessing interactive qualities in distance courses.
Rovai (2002)	Eight to 10 students are a reasonable estimate for the minimum critical mass needed to promote good interactions. At the opposite end of the continuum, 20-30 students are the most learners that a single online instructor can reasonably handle in a single class—if it contains active discussions.	Class size in online environments strongly influences learning activities. Too few members generate little interaction, and too many members generate a sense of being overwhelmed. Large classes (> 30 students) can be managed by team teaching or use of a teaching assistant.
Schellens and Valcke (2006)	Reviews literature, indicates that most researchers suggest a group size of 10-12 participants. Large group sizes (> 12) cause participants to deal with too high a number of messages and tend to invoke extraneous cognitive load. Larger groups require well-designed learning-oriented task structures. Study found large groups invoke more communication about nonsense topics and technical issues.	Study of 300 students working over 6 months in 38 electronic discussion groups. Purpose was to analyze knowledge construction and discourse in collaborative learning. The results clearly indicated that group size affects the types, structure and phase of knowledge construction in asynchronous discussion groups. Smaller- and average-sized groups performed at a quantitatively and qualitatively higher level.
Tomei (2006)	Online teaching demanded a minimum of 14% more time than traditional instruction. The calculation of ideal class size for the online format was 12 students.	This study examined the impact of substituting traditional F2F courses with distance-based education. Had a small sample of two classes, each 11 students: one taught online, the other F2F. Compared the time demands for each, analyzing the impact of distance learning demands on faculty teaching loads, and computed the ideal class size for an online course.
Visser (2000)	Found that the total work hours for developing and delivering a graduate-level course in public administration were twice as high for distance education as for traditional courses.	A case study of author's own work expenditure developing and delivering an online course. Conjectures that the accumulation of instructor experience in distance learning, the level of institutional support, and the support of a technically knowledgeable graduate assistant may help decrease the faculty's work expenditure.

tics of one-way faculty-to-student communication unless the group is broken into smaller discussion sections with a faculty member or teaching assistant assigned to each small group and thereby creating, in effect, smaller class sizes. For courses that have traditionally been designed for small enrollments, such as seminars, because learning depends on ongoing faculty-student interaction, 20-30 students or fewer per group is recommended by some researchers, while others recommend sections sizes in the range of 15-25 students. There is little support for extremely small class sizes, such as, 3-10 students (Dykman, & Davis, 2008), except in doctoral education.

The online literature consistently indicates that online education benefits student access but is not more efficient; that is, the workload and intensity of effort for faculty are in general heavier for online education than for classroom-based education (Ascough, 2002; Drago & Peltier, 2004; Fjermestad, Hiltz, & Zhang, 2005; Parry, 2009). There is consensus that the single greatest predictor of positive self-reported student learning is instructor-student interaction. Teacher immediacy (timely and personal responsiveness) is one of the key drivers of student satisfaction (Bonnell, Ludwig, & Smith, 2008; Keeton, 2004; Schutt, Allen, & Laumakis, 2009). Student-to-student interactions/activities are also predictive of reported learning, but at a level half that of instructor-student interaction (Bernar et al., 2004; Keeton, 2004; Marks, Sibley, & Arbaugh, 2005). A third driver of student learning and satisfaction is ease of use of technology.

Because study findings are limited and results are mixed (e.g., Drago & Peltier, 2004), specific research-based determinants of class size are not sufficient at this time to support a standardized enrollment recommendation for all online courses (Hewitt & Brett, 2007). However, studies to date are suggestive, and from these it is possible to develop guidelines on class size deriving from the existing research.

THE RESEARCH ON FACTORS RELEVANT TO DETERMINING OPTIMAL CLASS SIZE

A substantial body of distance learning research has developed in the past 10 years, informing online educators of effective teaching methods in web-based courses. Journals referenced earlier in Table 1 contain a plethora of studies identifying best practices. The goals and structure of quality online education are also well-researched and standardized through organizations such as Quality Matters (n.d.) and the Sloan Consortium (n.d.) (Little, 2009; Moore, 2008).

Determinations of pedagogically-sound student:teacher ratios relate directly to three dominant educational frameworks that appear repeatedly in the research literature: the objectivist-constructivist continuum, community of inquiry model, and Bloom's taxonomy. We discuss these below, followed by discussion of the implications of each for determinations of online class sizes.

The Objectivist-Constructivist Continuum

The objectivist-constructivist continuum is a well-established construct in education (Legg, Adelman, & Levitt, 2009), differentiating two approaches to education. In the objectivist model, students learn passively by receiving and assimilating knowledge communicated to them by the professor. It uses largely one-way communication, and students learn individually, independent from others. Courses of a factual or scientific nature are effectively delivered by the objectivist method. Constructivist approaches assume that learning of new content results from complex interactions among individual students, faculty, and student peers. As students experience new information, they "compare this to internalized knowledge constructs based on past experiences, and then modify their constructs accordingly ... knowledge has to be discovered, constructed, practiced, and validated by each learner"

(Benbunan-Fich et al., 2005, p. 21). Constructivist environments offer multiple representations of reality and encourage thoughtful reflection on students' own and others' experience (Arbaugh & Benbunan-Fich, 2006, p. 436). Constructivist learning often requires that students break down, restructure, and transform existing knowledge to mediate understanding (Legg et al., 2009). Constructivist educators approach teaching with the belief that knowledge must be actively created or constructed by students and integrated with preexisting knowledge (Bain, 2004; Benbunan-Fich et al., 2005; Schellens, & Valcke, 2006). All university faculty select teaching approaches that fall somewhere on the continuum between transmitting knowledge to students unidirectionally, and engaging with students to reconstruct knowledge and make new information individually meaningful.

In online education, the choice of teaching method along the objectivist-constructivist spectrum should have a direct relationship to the number of students enrolled in a course. Faculty using predominantly objectivist approaches, and objective test-based or quantifiable assessment methods, can effectively teach very large numbers online. This form of education is teacher-centered. Students will generally learn equally well if they are in a class of five or 500. While the workload for faculty will expand somewhat with rising numbers of students, it does not increase directly with class size. Conversely, constructivist teaching approaches require much smaller class sizes because they are learner-centered. The student work of learning—deconstructing old knowledge and integrating new and more complex information—typically depends on faculty interaction with individual students, and regular assessments and feedback; it is student-centered and teaching-intensive. Indeed, schools and universities exist because few people are capable of robust learning without focused facilitation from knowledgeable experts. Faculty workload using constructivist teaching methods expands

directly in relation to the number of enrolled students.

In objectivist learning, our literature review revealed that there is no recognized upper limit to the number of students per faculty member enrolled in online classes. Since learning occurs with the transmission of content from faculty to students in a teacher-centered process, and each student is expected to learn on his or her own, reflected in their performance on objective fact-based assessments, courses may enroll as many students as is logistically feasible. On the opposite end of the objectivist-constructivist continuum, smaller course sizes are necessary when there is a need for faculty interaction with students to assure learning. Faculty delivery of content, direct instruction, interaction with students, correction of misconceptions, and formative and summative evaluations of student learning constitute time-consuming pedagogy. As reflected in Table 2, a preponderance of the evidence suggests that no more than 20 students should be enrolled in such constructivist-designed courses, and some researchers argue for even smaller numbers.

In teaching-intensive constructivist learning classes, the research indicates that the numbers of students are a significant driver of faculty workload. In courses that use a combination of objectivist and constructivist approaches to teaching, considerations of student learning and faculty workload make it a judgment call for what the “right” number of student enrollments should be. Decisions on courses that fall in the middle of the objectivist-constructivist continuum need to take into account both learning effectiveness (largely a faculty determination), faculty workload, and university revenue needs (largely an administrative determination).

The Community of Inquiry Model

First developed in 2000 by Garrison, Anderson, and Archer, and later supported by the results of numerous studies (e.g., Anderson, Rourke, Garrison, & Archer, 2001;

Arbaugh, 2007; Arbaugh & Hwang, 2006; Garrison, 2007; Garrison, Anderson, & Archer, 2010; Garrison, Cleveland-Innes, & Fung, 2010; Meyer, 2006; Shea, 2006; Shea, Li, Swan, & Pickett, 2005), the community of inquiry (COI) model in online education assumes that the instructor's role is critical in potentiating student learning. The model proposes that teaching, cognitive, and social presence all contribute significantly to learning effectiveness within an online community.

Teaching/teacher presence in online education involves the design, facilitation, and direction of learning in service of students' construction of meaningful and educationally

worthwhile knowledge. Teaching presence is conceptualized as instructional design and organization, facilitating discourse and building understanding, and direct instruction (see Table 3). Activities associated with teaching presence are extensive, ranging from course design and syllabus construction, to course and learning strategy methods, to regular faculty interactions with individuals and groups of students, to formative and summative feedback. Cognitive presence marks the extent to which students demonstrate construction and integration of new meaning through sustained learning activities. Knowledge construction by individual students is often more visible in

TABLE 3
Summary of the Community of Inquiry Model

<i>Descriptions of Teaching, Cognitive and Social Presence</i>	
Teaching presence: A faculty activity	
1.	Course design and organization: <ul style="list-style-type: none"> • process, structure, evaluation, and interaction components of the course • setting classroom norms and netiquette, and curriculum expectations, so that students are aware of the implicit and explicit learning goals • designing methods, e.g. learner activities, mix of group and individual activities, and establishing time parameters • utilizing the medium effectively
2.	Facilitating discourse: <ul style="list-style-type: none"> • establishing teacher's social presence • creating a knowledge-building community; modeling appropriate behaviors, commenting upon/encouraging/reinforcing student responses • creating a positive learning environment, stimulating learning • identifying areas of consensus and shared understanding and disagreement • assessing efficacy • moving the discussion along, insuring effective and efficient use of time
3.	Direct instruction: <ul style="list-style-type: none"> • focusing discussion on specific issues, providing intellectual and scholarly leadership • sharing subject matter knowledge/expertise from diverse sources • directly assisting knowledge constructions, especially application and integration; summarizing knowledge frameworks • interjecting comments, referring students to information resources • diagnosing and correcting misconceptions, providing feedback • responding to technical concerns/issues
Cognitive presence: A student activity	
<ul style="list-style-type: none"> • Extent to which students are able to construct and integrate new meaning through sustained learning processes. Driven by faculty's teaching and social presence, and by other students' cognitive and social presence. 	
Social presence: A faculty and student activity	
<ul style="list-style-type: none"> • The ability of faculty and learners to project themselves socially and emotionally into a course, and create an identity as a 'real person' in the online environment. Driven by faculty's teaching and social presence, and by other students' cognitive and social presence. 	

Sources: From Anderson et al. (2001); Garrison et al. (2000); Brook and Oliver (2003); Fish and Wickersham (2009).

online courses than in classroom-based courses. Cognitive presence is influenced by the faculty's teaching and social presence, and by other students' cognitive and social presence. Social presence is reflected in the ability of faculty and learners to project themselves socially and emotionally into a course, and create an identity as a "real person" in the online environment. It too is affected by the faculty's teaching and social presence, and by other students' cognitive and social presence.

Beginning with the teacher's design and management of a course and his or her teaching presence, comprehensive use of the COI model has been shown to enhance student learning and satisfaction (Anderson et al., 2001; Arbaugh, 2007; Brook & Oliver, 2003; Garrison, 2007; Garrison et al., 2000; Meyer, 2006; Paulus et al., 2010; Richardson & Swan, 2003; Swan & Shea, 2005; Swan & Shih, 2005). Within the COI framework, teacher immediacy is a recognized driver of student learning and satisfaction. Immediacy "refers to behaviors that lessen the psychological distance between communicators" (Swan & Shea, 2005, p. 242), and can include a range of faculty actions, such as prompt and focused replies, warmth and friendliness, addressing students individually, use of humor or emotion, self-disclosure, greetings and closures, and use of connecting language (Lahaie, 2007).

Promotion of critical thinking is an additional element of the COI model especially relevant to higher education. Many educators find that active online learning strategies enhance faculty access to students' thinking capabilities (Leppa, 2004). Online teaching presence provides students with intellectual and scholarly direction by sharing faculties' subject matter expertise and assisting students with knowledge constructions, especially application and integration. By diagnosing and correcting misconceptions and providing students with feedback, faculty presence diminishes students' internalized barriers to learning new information.

Consistent with the COI model, when faculty prompt students to project social and cognitive identities into online education, learning assumes a more constructivist than objectivist profile. Objectivist teaching does draw on many elements of teaching presence, especially instructional design, organization, and direct instruction, but diminishes the relevance of social presence in one-way instruction. Cognitive knowledge is largely experienced autonomously by, rather than shared among, individual students.

Bloom's Taxonomy

Bloom's taxonomy is the third proposed educational framework related to determinations of appropriate class size (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956). The taxonomy is a classification of 6 levels of learning, moving from lower levels to higher-order thinking: knowledge, comprehension, application, analysis, synthesis, and evaluation. Faculty design instruction to draw on various levels of Bloom's taxonomy, and subsequently assess students' learning outcomes according to educational intent (Meyer, 2004). Although there is considerable variability in targeted taxonomic levels in higher education, typically more basic knowledge and comprehension levels are addressed in lower division courses in college, with more complex learning and critical thinking expected in upper division and graduate courses. Doctoral study disproportionately draws on learning at the analysis, synthesis, and evaluation levels. Arend (2007) also describes student learning associated with basic to complex cognition hierarchically, but uses different terminology: rehearsal (memorizing, reciting), elaboration (building internal connections), organizational (selecting appropriate information to connect to new information), critical thinking (developing new ways of thinking about content, applying prior knowledge to new situations, reaching decisions, and making evaluations), and metacognitive self-regulation (identifying

how to control and modify individual cognitive processes).

By historical practice, universities implicitly recognize that greater faculty-student interaction is necessary for effective education at the upper levels of Bloom's taxonomy: undergraduate courses tend to be large, sometimes with hundreds of students enrolled in introductory courses; upper division courses for students in their major move toward medium sizes of 20-50 students per faculty member, with some seminars of 20 or fewer students. In graduate education, the majority of classes are 25-30 students or fewer, often providing small seminars the final year; and doctoral level courses are almost always small seminars consisting of 12 or fewer students. These course sizes reflect common knowledge—that higher-order thinking and learning require more intensity of student-faculty interaction. In parallel form then, online education courses should reflect larger classes at lower levels and smaller classes at higher levels of Bloom's taxonomy.

Combinations of Factors Associated With the Three Frameworks

Were all college courses readily categorized as to their needs for objectivist or constructivist teaching strategies, targeted as to required levels of learning in Bloom's taxonomy, and consistently implemented using the COI model, it would be relatively simple to develop standardized enrollment sizes for online courses (see Table 4). But none of these constructs is consistently quantified and applied to college courses by discipline, level in the curriculum, type of student, or faculty preference. Courses with large amounts of factual information, such as introductory biology, may tend toward objectivist design, a need for teaching presence but little social presence, and student learning at the knowledge and comprehension levels. More advanced courses, in contrast, such as analysis of literary works by historical period, may require constructivist learning strategies, a high level of

teaching and cognitive presence, and learning at the application, analysis, and/or synthesis levels. Teaching intensity would be far greater for the latter course than the former, and thus smaller student section sizes would be appropriate to assure learning. Graduate courses in statistics or physiology may have a mix of teaching intensity factors and be appropriately sized at medium enrollments of 20-30 students, whereas a research methods and design course could demand greater faculty interaction with students and tend toward the more teaching-intensive elements of these frameworks. Doctoral-level courses and dissertation advisement are invariably high on constructivism; teaching, cognitive, and social presence; and at the upper levels of Bloom's taxonomy, thereby requiring very small numbers of students per faculty member (see Table 4).

The majority of college courses at the undergraduate level, and some courses at the graduate level, fall in the vast "in-between" gray areas of the three frameworks, making it impossible to standardize online course size. A political science curriculum may initially call for learning at the lower three levels of Bloom's taxonomy, but eventually demand constructivist teaching strategies to assure student assimilation of new ideas into preexisting knowledge constructs. A masters- or doctoral-level course on research methods may effectively use objectivist teaching strategies for basic concepts (e.g., research design and methods) but require interspersed constructivist COI modules to assure mastery. A doctoral-level course may be taught at higher levels of Bloom's taxonomy while using objectivist-delivered criteria for evaluating research articles. Thus, when the three frameworks are used with a mix of high and low teaching intensity factors, there is a need for a collaborative judgment call, with faculty serving as pedagogical experts and academic administrators weighing revenue pressures. For a mix of teaching-intensive and teaching-light elements in courses, it is useful for institutional parties to identify a priori the parameters of course enrollments sizes (e.g., 18-28 students). High-

TABLE 4
Teaching Intensity: Educational Design Frameworks Relevant to Determining Online Course Sizes

<i>Educational Framework</i>	<i>Dimensions</i>	<i>Recommended Course Sizes Associated With Framework Dimensions</i>
Constructivist-objectivist continuum	<ol style="list-style-type: none"> 1. Objectivist approach (all one-way) 2. Constructivist approach (all interactive) 	<ol style="list-style-type: none"> 1. Large: no known upper limits 2. Small-medium: ≤ 20-25 students
Community of inquiry model	<ol style="list-style-type: none"> 1. Teaching presence—faculty activity <ul style="list-style-type: none"> • Course design and organization • Facilitating discourse • Direct instruction 2. Cognitive presence: Student activity. Extent to which students are able to construct and integrate new meaning through sustained learning processes. Driven by faculty's teaching and social presence, and by other students' cognitive and social presence. 3. Social presence: Faculty and student activity. The ability of faculty and learners to project themselves socially and emotionally into a course, and create an identity as a "real person" in the online environment. Driven by faculty's teaching and social presence, and by other students' cognitive and social presence. 	<ol style="list-style-type: none"> 1. Use of COI principles of course design and organization only: recommended enrollment of > 25 students (medium-large) 2. Full use of COI principles of teaching, cognitive, and social presence, including: frequent, substantive faculty-student interaction; promotion of critical thinking; teacher immediacy; direct instruction; regular formative and summative feedback; correction of students' misconceptions; in-depth assessments and evaluation: recommended enrollment of ≤ 20 students (small-medium)
Bloom's Taxonomy	<ol style="list-style-type: none"> 1. Lower levels: knowledge, comprehension 2. Middle level: application 3. Upper levels: analysis, synthesis, and evaluation 	<ol style="list-style-type: none"> 1. Medium-large: ≥ 30 students 2. Medium: 16-40 students 3. Small: ≤ 15 students
Total: Conclusions on varying combinations of all three frameworks	<ol style="list-style-type: none"> 1. In combination, use of objectivist teaching strategies, limited implementation of the COI model, and lower levels of learning in Bloom's taxonomy 2. Varying combinations of middle levels of all three frameworks 3. In combination, use of constructivist teaching strategies, full implementation of the COI model, and higher levels of learning in Bloom's taxonomy 	<ol style="list-style-type: none"> 1. Large: ≥ 30 students 2. Medium: 16-30 students 3. Small: ≤ 15 students

Note: The recommended course sizes are based on a synthesis of research findings from the literature review, and implications for teaching strategies from the three educational frameworks.

quality pedagogy and financial stability are each central aspects of healthy universities and both must be addressed in decisions about course enrollment.

CONCLUSION

Online education has come of age and its future is bright. Distance learning is well established in higher education domestically and internationally, and it has enabled univer-

sities to educate more diverse and dispersed populations of students than was possible in location-specific institutions. With maturation, online education faces a rising call to examine and improve the quality of teaching and learning from a distance.

We have presented here the state of the evidence surrounding one factor related to quality of education: enrollment sizes in online courses. The current research findings on the "right" size of online courses is instructive but not conclusive. Three dominant educational

frameworks—the objectivist-constructivist continuum, COI model, and Bloom’s taxonomy—were presented to provide guidance in determining pedagogically effective and revenue-sensitive online course sizes. The frameworks provide insight about teaching-intensive or teaching-light online courses, and serve as key factors for understanding the educational and workload dynamics of online teaching. Based on the existing research, we have suggested ranges of course sizes associated with higher or lower levels of teaching intensity (see Table 4).

There are a number of pedagogical and technological paths forward that will advance our understanding and improve the quality of online education. For those aspects of teaching and learning associated with the faculty role, one path points toward the development of research-based measures and evaluative criteria to assess student learning outcomes within courses of varying class sizes. The three educational frameworks presented above are likely to play prominent roles in these developments.

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