The aim of the Journal of Asynchronous Learning Networks is to describe original work in asynchronous learning networks (ALN), including experimental results. Our mission is to provide practitioners in online education with knowledge about the very best research in online learning. Papers emphasizing results, backed by data are the norm. Occasionally, papers reviewing broad areas are published, including critical reviews of thematic areas. Entire issues are published from time-to-time around single topic or disciplinary areas. The Journal adheres to traditional standards of review and authors are encouraged to provide quantitative data. The original objective of the Journal was to establish ALN as a field by publishing articles from authoritative and reliable sources. The Journal is now a major resource for knowledge about online learning.

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WHY ONLINE EDUCATION WILL ATTAIN FULL SCALE

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ABSTRACT

Online higher education has attained scale and is poised to take the next step in its growth. Although significant obstacles to a full scale adoption of online education remain, we will see full scale adoption of online higher education within the next five to ten years. Practically all higher education students will experience online education in some form during their collegiate career, and college students will be able to take online or blended degree programs and certificates in almost any subject. Full scale online education will occur as the result of compounded growth, increased familiarity and acceptance, various models of scalability, and possible wildcards which may accelerate growth. Online education will also attain full scale by becoming fully integrated into mainstream education. This transformation is necessary for online learning to reach its potential to improve the quality of education.

KEYWORDS

Online education, blended learning, scale

I. INTRODUCTION

At the 15th annual Sloan-C international conference in October 2009, the featured speaker Dr. A. Frank Mayadas called for his audience of online educators to embrace the opportunity and challenge of "moving online education to a truly large scale" [1]. His remarks reflected online education's transformation in recent years from a relative novelty to a significant force in higher education. From fall 2002 to fall 2009, online higher education enrollments in the United States rose from fewer than 10 percent of total enrollments (around 1.6 million learners) to almost 30 percent of total enrollments (around 5.6 million learners) [2]. Online higher education has attained scale and is poised to take the next step in its growth; indeed, Dr. Mayadas views the "scale-up" of online higher education as "the final frontier" in the process of attaining full "mainstream" status [3].

At the same time, a rising concern with online higher education's ability to scale has accompanied this rapid enrollment increase. Significant obstacles to a full scale adoption of online education remain, most notably level of faculty acceptance, financial issues, and various structural issues such as organizational structures or tenure and promotion policies. Online education is still not widely accepted at certain types of institutions, for instance at many of those where research and publication are higher priorities [2, 4, 5].

Will these obstacles retard the growth of online higher education before it can attain full scale adoption? Or will online higher education attain full scale despite these obstacles? This paper argues that the answer to the latter question is a resounding *yes*. Not only will we will see full scale adoption of online higher education, but it will happen within the next five to ten years.

II. WHAT IS "FULL SCALE" ONLINE EDUCATION?

The definition of online education used here is simply ***the use of online technologies in formal higher education for teaching and learning***. This definition includes not only courses, programs, and other learning experiences which are delivered exclusively via online means, but also the use of online technologies for teaching and learning in the entire spectrum of educational delivery, including blended and classroom courses. Thus, full scale online education will have the following characteristics:

1. The use of online technologies for teaching and learning will soon become a routine, commonplace, and integral part of the educational experience.
2. Practically all higher education students will experience online education in some form during their collegiate career. The experience will become as commonplace for them as owning a telephone in the U.S. (95 percent availability in 1990; around 98 percent from 2003-2008) [6, 7].
3. A majority of higher education students will take at least one online course during a given academic year.
4. A large majority of higher education students (70-80 percent) will take at least one online course during their collegiate careers.
5. Online courses will comprise a sizable proportion (20 percent or more) of the total credit hours in higher education.

Blended courses will comprise much of the remainder of the total credit hours in higher education.

College students will be able to take online or online/blended degree programs and certificates in almost any subject of their choosing at the associate, bachelor's, master's, and postgraduate certificate levels; that is, a full complement of online or online/blended degree programs will be available.

The realization of full scale online education has been informed by several different dimensions. The formulation closest to the Sloan Consortium, of course, is the one to which it owes its existence: the concept of Asynchronous Learning Networks (ALN) formulated by Dr. Mayadas at the Alfred P. Sloan Foundation. The ALN concept was based on "asynchronous interactivity" as distinct from previous distance education approaches such as self-study or interactive television, which offered limited possibilities for interaction. Instead, ALNs utilized the power of networks—not just electronic computer networks, but networks of people involved in the learning process—to create interactive communities which "provide learning to anyone who wishes to learn, at a time and place of the learner's choice" and not confined by the constraints of a classroom [8].

The metrics used to measure progress in adoption of ALN are reflected in the annual Sloan Survey of Online Learning, which measures the growth of online education in terms of the number and percentage of higher education students who have taken at least one online course during an academic year. The survey defines online courses as those in which 80 percent of instruction is delivered online [2, 9]. (The annual survey data also provides an estimate of the number of institutions which offer online courses or programs, but these figures are typically not emphasized or cited.)

Online education will achieve full scale not just in terms of realizing the "ALN" vision of anywhere, anytime learning in online higher education, but also across the entire spectrum of education delivery:

Blended learning in higher education typically refers to courses and programs which combine online and classroom delivery modes. In practice, the distinction between online and blended is somewhat arbitrary, and different definitions are used. For example, the annual Sloan Survey of Online Learning defines a blended course as one in which 20-79 percent of the instruction is delivered online [2], while the Southern Association of Colleges and Universities sets the threshold for online and distance education courses at 50 percent [10], and the Commission for Higher Education uses the same 50 percent threshold for online education programs [11]. These contrasting definitions highlight the more important point: online

education delivery happens on a continuum which includes entirely online courses at one end, entirely 'face-to-face' courses at the other end, and a huge range of blended options in between.

Although Sloan-C issued a report on blended learning in 2007 [12], obtaining reasonably good estimates of blended learning adoption is extremely difficult. Much of the adoption of blended learning happens outside the purview of centralized administrative units or is otherwise not tracked for credit courses. For instance, it is quite easy for faculty to add discussions or other online assignments to classroom courses without detection [13, 14]. Nonetheless, the available information indicates that blended learning continues to grow. A few institutions which track both online and blended learning enrollments have found that blended learning has grown at their institutions over the past five years. At the University of Central Florida, blended learning registrations increased over 40 percent from 16,781 to 23,397 between the 2005-2006 and 2009-2010 academic years and have increased five-fold over the past nine years; UCF's blended courses have generated a 30 percent increase in student credit hours between fall 2009 and fall 2010 [15]. At the University of Illinois at Springfield, blended learning has steadily risen from 29 percent to 34 percent of all enrollments between the 2005-2006 and 2009-2010 academic years [16]; this represents an even larger overall growth since UIS's total enrollments have grown by about 15 percent during that period [17, 18].

The apparent growth in blended learning strongly suggests that the collegiate careers of practically all higher education students will soon be a blended learning experience. In some cases, the online portion of that learning experience will be in complete courses and even degree programs; in others, it will be in blended courses. Even students who do not take online or blended courses will still experience online education embedded into their classroom courses as a supplement to classroom learning—lessons, assignments, group projects, research projects, and other learning experiences for which online delivery will be used for the teaching and learning process. Within the broad higher education landscape, there will still be holdouts and pockets where purely online degree and certificate programs do not become widespread or ubiquitous—doctoral degree programs, elite liberal arts institutions, and many departments. Even in these locations, however, the use of online technologies will still have a presence—independent study and other specialty courses, research projects, other lessons and assignments. Essentially all higher education students will experience online education in some form during their collegiate career, thus making the use of online technologies for teaching and learning a routine, commonplace, and integral part of the educational experience—in other words, online education will attain full scale.

III. HOW AND WHY FULL SCALE ONLINE EDUCATION WILL HAPPEN

Online education will achieve full scale within the next five to ten years for several compelling reasons:

A. The compounding effect: growth breeds growth

U.S. online higher education continues to grow with no signs of letting up. It grew at an annualized rate of almost 20 percent from fall 2002-fall 2009, according to the annual Sloan Surveys of Online Learning [2], and there is no indication that its growth is about to taper off and plateau. If this trend continues, a majority of higher education students will take at least one online course by the 2013-2014 academic year. Even if future growth is cut in half to 9.7 percent per year (the lowest annual rate of increase since the first Sloan Survey in 2002), this benchmark will be reached by the 2017-2018 academic year—less than seven years from now.

This scenario is highly plausible because of several factors conducive to continued growth:

There are plenty of short-term and long-term pressures on higher education to grow, such as the current economic downturn, government and foundation initiatives to increase retention and graduation rates, and the growth in lifelong learning. Since online education has been growing for the past seven years at ten times the rate of higher education, it only makes sense that pressures to grow are most likely to support expanded adoption of online education, drawing more attention, energy, and resources to this area. For instance, three-quarters of academic leaders reported increased demand for online courses in fall 2009 due

to the economic downturn [2], and the proportion of academic leaders who reported increased demand in fall 2008 was highest at those institutions which have the most online enrollments and the highest growth (public institutions and large institutions) [19].

Online education is higher education's chief engine of growth. The expansion in higher education in the last century was achieved by building extensive physical infrastructure (campuses, buildings, etc.) and hiring full-time faculty, both of which have become expensive, in many cases prohibitively so. Current funding patterns and competition pressures create disincentives against growth for a large proportion (estimated at 20 percent or more) of colleges and universities; instead, they simply become more selective with their applicant pool, and usually more expensive [20]. For-profit institutions are the only type of higher education institutions which have operated from a growth imperative and which have a growth rate comparable to online education [21]. Not surprisingly, much of the growth has happened in the form of online education; for example, in at least half of the 14 publicly traded for-profit institutions, which includes many of the largest ones, more than 50 percent of students are enrolled in exclusively online courses [22].

Online education enables higher education to scale rapidly while maintaining its broad array of offerings. Institutions have created large-scale online education programs where none existed previously by building on their existing strengths, such as faculty-led interactive instruction and well-established outreach and continuing education programs, and by developing new capacities such as replicable course development practices and pedagogy-focused faculty development [5]. Online education also enables higher education to scale relatively cheaply compared to other available options. By contrast, for-profit institutions know how to grow rapidly but not necessarily cheaply, as their tuition rates are far higher on average than those charged by public community colleges [20], and their array of program offerings and services provided are much more limited than non-profit higher education institutions [23].

The effects of compounding growth can already be seen in mature online programs which have reached full scale. For instance, over 55 percent of all students at the University of Illinois Springfield are taking an online course during the fall 2010 semester [18]. Annual online course registrations at the University of Central Florida have grown from fewer than 6,000 enrollments to 66,000 enrollments over the past ten years (1999-2000 to 2009-2010). Over the first five years of that period, UCF's online enrollment grew by about 23,500 students; over the last five years, it grew by over 37,300 students [24]. Colorado Community Colleges Online (CCCO) has grown from 109 enrollments (336 credit hours) in spring 1998 to 22,270 projected enrollments (73,000 credit hours) for the 2010-2011 academic year. Over the past two years, CCCO has grown at an annualized rate of 25 percent; as a result, about 80% of currently enrolled Colorado community college students have taken an online course [25]. The result is that many mature, larger enrollment online programs such as UIS, UCF, and CCCO are experiencing increased enrollment growth in numerical terms even when their growth rate has decreased, thanks to compounding growth and attaining large scale.

B. The mainstreaming effect: familiarity breeds attempt

Although there is considerable turnover in higher education as students graduate and new students enroll, there are several important effects resulting from more students taking more online courses:

- A higher percentage of students who are currently experiencing online courses
- More students who now have experience with taking online courses
- More students who are taking online courses who have previous experience taking them
- More students who know other students who have taken or are taking online courses
- More students who know other graduates who have completed online courses or programs

The net effect is that online education is now part of the U.S. collegiate experience. College students are aware of it even if they do not experience it directly. They may be dimly aware of it the way that liberal arts majors are dimly aware of the engineering building on their campus, but online education has become an accepted part of the landscape.

Familiarity is also important from the faculty perspective. The common belief that teaching or developing an online course requires more time and effort relative to a comparable face-to-face course is the most important barrier to teaching and developing online programs; quality and institutional support concerns are also important barriers. Once faculty have actual experience with developing or teaching an online course, however, these concerns tend to diminish, and online learning gains acceptance [26].

C. The acceptance effect: a worthy alternative

Acceptance extends not just to students and faculty but also to a sizable proportion of administrators, as evidenced by Sloan survey findings which indicate that online education is now an accepted part of the landscape in most sectors of higher education [2]. Online education has demonstrated its effectiveness, achieved actual and perceptual parity with traditional classroom-based education, and demonstrated its superiority to traditional education in many meaningful ways. A substantive body of research has demonstrated the effectiveness of online education [27, 28, 29, 30, 31]. From the Significant/No Significant Difference Phenomenon research [32, 33] to the early ALN Research studies [27] to more recent research and compilations of studies [30, 31, 34], a large body of research has provided strong evidence that online and blended learning are equal or superior to face-to-face instruction. Despite its limitations, the United States Department of Education study [35] seems to have had a strong effect on changing perceptions about online learning as indicated by its frequent citation as evidence that online and blended learning are equal or superior to face-to-face instruction [36, 37]. In addition, online education offers ways to improve teaching and learning which traditional education delivery cannot match, such as improving student access and facilitating richer student discussions among many others [28, 38].

Blended learning has gained even more acceptance as a quality alternative which is often described as the "best of both worlds" [e.g., 39], a perception which was also reinforced by the USDE study findings [35]. Among other qualities, blended learning enables improved teaching and learning by implementing learner-centered pedagogies, enabling initiatives on an institutional scale, and increasing classroom utilization efficiency [24].

This combination—demonstrating parity and effectiveness, reducing the perception of inferior quality, and demonstrating superiority in meaningful ways—is a recipe for continued growth.

D. The diversity effect: models and strategies for attaining scale

1. Established models for scalability

The collective diversity of U.S. colleges and universities has long been regarded as one of its key strengths. Reflecting this diversity, online learning programs which have attained or are in the process of attaining full scale have done so in a variety of ways: for-profit mega-campuses such as the University of Phoenix; public mega-campuses such as the University of Maryland University College; statewide implementations such as the Illinois Online Network, Colorado Community Colleges Online, UMassOnline, and the State University of New York (SUNY) Learning Network; system wide implementations such as San Diego County Community College District; individual institutions such as the University of Central Florida's Distributed Learning Initiative, Thomas Edison State College's entirely online, multi-modal independent study programs, and the University of Illinois-Springfield "mirror campus"; and collaborations such as Western Governors University. Although there are a number of common factors which have contributed to the success of these institutions in attaining large scale [5], the variety of their models for attaining scale strongly suggests that higher education is successfully applying the strength of its institutional diversity to the online education arena.

Although institutions which are fully engaged with large, established online programs have accounted for the bulk of enrollment growth in online education [2], a number of other strategies are emerging which will also help compound growth, broaden familiarity, and increase acceptance of online and blended learning programs in new and perhaps influential ways. Three examples of these strategies are *measured growth*, *supporting sustainability*, and *summer online programs*.

2. Measured growth

One emerging strategy for attaining scale is *measured growth*. Instead of large-scale implementations, numerous colleges and universities have established a significant presence of online and blended courses and programs at their institutions, for instance:

- Virginia Tech had around 22,000 for-credit distance education enrollments in its 2010 fiscal year, a 20% distance learning enrollment increase over the previous year; almost all of Virginia Tech's academic departments (96 percent) have engaged in distance learning over the past ten years, even though the total distance learning enrollments account for a relatively small proportion of total enrollment [40].
- Fort Hays State University has taken a relatively measured approach to developing its online learning program as part of its overall enrollment growth plan, actually restricting its growth by limiting resources devoted to its online programs in favor of its international programs [41]. Nonetheless, Fort Hays State's Virtual College program accounts for about one-third of total enrollment [42], and FHSU's president Ed Hammond projects that online learning enrollment will more than double at Fort Hays State University over the next ten years, accounting for over 40 percent of total enrollments by 2020 and accounting for more than 50 percent of the projected enrollment increase [41].
- Upper Iowa University is a nonprofit, non-denominational private institution in northeast Iowa, which started an online program in 1999 with 36 enrollments and had 2,200 students enrolled in its online programs during the 2009-2010 academic year. One-third of undergraduates and 70 percent of graduate students take one or more online courses during their UIU collegiate career [43].

3. Supporting sustainability

Concern about long-term sustainability has enabled online education to establish a presence at many institutions such as small arts liberal colleges, which historically have been averse to online learning. Many such institutions have used online education to *support* their *long-term sustainability* by expanding their reach and (in the case of some small colleges) by increasing enrollments, for example:

- Online education was a critical part of the strategic plan which Concordia University in Oregon developed in 2001 to ensure long-term sustainability by increasing its enrollment from 1,000 to 1,500 students over a ten-year period. Concordia exceeded its goal, serving a total of 1,900 students (~1,700 FTE) in its 2010 fiscal year, in part by implementing undergraduate online courses and an online Master of Education degree with eight different concentrations. Concordia expects enrollments to increase significantly in the coming fiscal year to 300 or more graduate students, and it is currently developing a second online major with undergraduate and graduate degrees as a collaborative effort between its College of Education and College of Arts and Sciences. Concordia is tentatively projecting that the percentage of undergraduate credit hours delivered online will increase to 25 percent by 2020, and it has also set a goal for 2020 that 100% of undergraduates will complete at least one course online. [44]
- Notre Dame College of Ohio views online education as sufficiently important to merit its own category in NDC's strategic plan. Online education has enabled NDC to increase enrollments and fulfill its mission to expand its reach to a valued target audience: single working mothers. NDC also sees online education as an important competitive advantage in a market with a very high concentration of small liberal arts colleges. Since its online education program started in 2006 with the conversion of off-campus teacher education licensure program courses to online courses, NDC's online course enrollment has grown consistently, currently accounting for about 30% of NDC's enrolled credits [45]. NDC has developed other graduate online programs and 15 undergraduate general education courses, and several other fully online degree programs are in development. NDC's integration of the Moodle learning management system into all of its courses [46] has accelerated its adoption of blended learning [45].
- Upper Iowa University's online program has been fully self-supporting for the past five years, returning a surplus to the campus and helping ensure institutional long-term viability [5, 43].

4. Summer online programs

Summer online programs provide another avenue for institutions which otherwise might resist online education to try out online education until it gains acceptance. For example, Emmanuel College started a summer online program in 2007 with seven courses; three years later, the college offers two online degree programs which are now offered year-round. Emmanuel's summer online program enrollment increased over 150 percent between summer 2007 and summer 2010, from 155 to 397 students; the summer online program helps Emmanuel student maintain the connection with the college community over the summer while allowing the college to retain tuition revenue which otherwise would flow to other institutions [47, 48]. Summer offerings have also been an important part of Notre Dame College of Ohio's online programs since its inception. All of its fully online programs include a summer session, generating increased summer enrollments which is crucial for enrollment-dependent schools such as NDC [46].

Although individually the enrollment numbers are not massive at small liberal arts colleges, a form of scale results from the cumulative presence of numerous institutions with online programs or a mix of online and blended courses among their offerings.

E. The Wildcard effect: growth from unpredictable sources

Some of the growth in online education has come from relatively predictable sources. For instance, community colleges have embraced online education, and community college enrollments have risen in past economic downturns, so it's not surprising that the most recent economic downturn has increased demand for online courses at community colleges [2]. But some sources of growth are essentially impossible to predict; for example, no one predicted the increase in online education enrollments as the result of the oil price shock of 2007-2008, during which the price of oil more than doubled from $62 to $125 per barrel [49]. From July through September 2008, University of Illinois Springfield professor Ray Schroeder's "Fueling Online Learning" blog chronicled how rising gas prices increased interest in online and blended learning. Summer enrollments in online courses surged at many institutions as commuting students sought ways to reduce the strain on their finances. Although it was next to impossible to determine how much of the increase in enrollment was directly attributable to high gas prices, Schroeder's blog contains numerous reports of booming summer online enrollments, with anecdotes from students who reported that high gas price was a major reason, often the sole reason for their enrollment [50].

Although by definition they are impossible to predict, two other candidates for "wildcards" which could cause a spike in the growth of online education are worth watching: 1) the current initiatives to improve retention and graduation rates, and 2) the potential need for an emergency response to a devastating natural or man-made hazard. The Obama Administration's American Graduation Initiative calls for an additional five million Americans to earn degrees and certificates from community colleges in the next decade [51]. This initiative is being complemented by foundation initiatives such as the Lumina Foundation's Goal 2025, which aims to increase the percentage of Americans with high-quality degrees and credentials to 60 percent by the year 2025 [52], and the Gates Foundation's Completion by Design program, which aims to help boost community college graduation rates [53]. Simple math indicates that attaining these ambitious targets will require extraordinary measures. Although these initiatives are likely to spur new approaches to delivering education, they are also likely to help spur the growth of online education as an established method for increasing higher education enrollments and thus an indispensible part of the overall strategy required to reach this goal.

If the effort to increase graduation rates is receiving lots of attention at the moment, the potential need for an emergency response to a devastating natural or man-made hazard is, by comparison, being overlooked. In 2005, the twin disasters of Hurricanes Katrina and Rita provided an example of how natural disasters could devastate educational delivery. The "Sloan Semester" was one initiative which helped mitigate the effect by providing free online courses to students impacted by the storm, but the experience demonstrated the need for higher education institutions to adopt strategies to prepare for future disasters [54]. Since then, although there have been relatively isolated episodes which have required individual institutions to respond to a natural or man-made disaster, there has been nothing on the scale of Hurricanes Katrina and Rita—yet. The H1N1 virus scare of 2009 turned out to be a false alarm in terms

of its effects on higher education. Still, relatively few colleges and universities are prepared to maintain academic continuity when—not if—the next disaster strikes [55]. When it does, it is highly likely that online education will be an essential part of the solution.

A proactive response to this prospect would be to adopt a "bricks and clicks" strategy for educational delivery, in which every course and program offering is available through multiple delivery modalities—online as well as classroom. A few institutions have already adopted this strategy or are prepared to do so [e.g., 56]. More likely, this will happen as a reactive response—that is, it will take one (or perhaps more) devastating disasters to persuade higher education institutions to adopt this strategy, perhaps after seeing one or more institutions cease to exist as the result of failing to recover from a disaster. If they do, however, the inevitable outcome will be another large spike in the adoption of online education.

IV. CLOUDS ON THE HORIZON?

Despite the compelling evidence that online education's growth will continue and that there are no specific signs of a slowdown, many observers see some "clouds on the horizon" [57] which might result in sluggish future growth or even a downturn in enrollments:

The current economic slowdown is accelerating demand, so online learning growth will taper off when the economy eventually improves [2, 57];

Budget pressures in the large public institutions which are fueling most of the enrollment growth will ultimately hamper further growth due to lack of available resources to meet demand [2, 57, 58, 59];

New federal rules on financial aid and student recruiting may negatively impact enrollments [2, 57];

Online education's reputation, and thus its growth, is under threat of contamination by its close association with for-profit higher education whose reputation is currently under close scrutiny; an

A shortage of trained faculty will slow down the ability to meet demand and possibly also drive up hiring costs.

None of these factors can be dismissed out of hand; indeed, one or more of them might also become a wildcard which slows the juggernaut of online learning growth or even stop it altogether. However, such a scenario is unlikely for several reasons:

- It is unclear that the economic slowdown is in fact accelerating demand. Sloan survey report statistics indicate that online enrollment growth grew at a high rate when the economy was relatively strong (over 20 percent annually from fall 2002 to fall 2006) [2]. Even if the economic slowdown is accelerating demand, it is more likely that online enrollment growth will return to "historic" levels when economic conditions recover. Even historically low growth levels (i.e., the 9.7 percent growth rate reported between fall 2005 and fall 2006) will yield a majority of higher education students taking online courses within seven years.
- The argument that budget pressures will hamper rather than fuel online learning growth seem to be based on lack of infrastructure [58] which leads to lack of capacity to meet student demand [59]. However, it is unclear that "student demand" is an actual driver in the online education context any more than it is in the rest of higher education. Concerns about lack of infrastructure may also indicate that online education could grow even faster than it has been if the infrastructure were in place. The arguments that budget pressures will fuel rather than hamper online learning growth [e.g., 58, 60] are at least as plausible.
- Online enrollment growth has been particularly strong at for-profit institutions, which reportedly comprise 27 percent of all online enrollments in higher education [58]. However, given that the bulk of enrollment growth is happening at two-year and large public institutions [2], a slowdown or even decline in for-profit online enrollments would not be large enough to slow the growth rate down completely or even considerably. The reported slower growth rates of larger, fully engaged institutions [2] can be deceptive; as the UIS, UCF, and CCCO examples show, institutions with large enrollments

experience larger numerical increases even as their internal growth rates slow, and these large increases contribute disproportionately to the total increase in online learners nationwide.

- To the extent that "reputation contamination" is an actual threat, it is one of perception similar to the one which online higher education faced in the early years of its existence. The battle of public perception can be won just as it has been within most sectors of higher education.
- Faculty at all levels of experience are about equally likely to teach online [26], thus faculty who will teach online in the future are just as likely to come from the existing ranks—faculty who have taught online previously, or who want to increase their online faculty workload, or who want to try it because their colleagues have—as they are from a pool of adjunct faculty. Preparing faculty to learn how to teach online is a serious professional development challenge, but most institutions with large online enrollments have created their own internal faculty preparation programs, Other available offerings such as the Sloan-C Certificate program are also helping to meet the demand for preparing faculty to teach online.
- Many of the frequently cited barriers such as perceived quality or faculty concerns about level of effort and support have been reported consistently for years, and online learning growth has proceeded nonetheless. Why should the future be any different?
- The target metric being used (number of higher education students who enroll in online courses) is not near its saturation level relative to the current penetration rate of 30 percent. Growth rates will naturally slow as the maximum is neared, but the potential unreached audience remains huge.

The far more likely scenario is that the pressures and incentives to grow far outweigh the obstacles to growth and will overcome them. Online and blended education provide long-term opportunities for higher education to grow, enabling institutions to expand student markets beyond traditional local, regional and state markets into the national and international realm [60].

V. THE DISAPPEARANCE OF DELIVERY MODE

Intriguingly and ironically, online education will also attain full scale by disappearing into the background as it becomes fully integrated and thus essentially indistinguishable from mainstream education. This will happen for several reasons.

First, the proliferation of blended learning is blurring the distinction between online and classroom education through its wide range of course design possibilities which utilize both delivery modalities. Good blended learning course design focuses on using each modality for its maximum benefit, but the resulting courses are increasingly difficult to characterize by delivery mode since they integrate online and classroom education in an ever expanding variety of ways. Many classroom courses use online technologies for purposes other than teaching and learning such as access to learning resources, communication of information, and learning management, further blurring the distinction.

Second, emerging online technologies are getting ever easier to integrate with classroom-based learning. In the early days of online education, it was customary to think of the technologies used (online discussion software, learning management systems, assessment software, etc.) primarily in terms of delivery mode, that is, as online technologies distinct from those used in classroom-based education. Increasingly, however, technologies are known and used primarily for their affordances rather than by their delivery mode. One example is student creation of wiki textbooks: students use an online technology (wikis) to create content for textbooks in classroom courses by working online or in person; other online technologies such as specialized software for writing wiki textbooks also facilitate other aspects of the process such as assessment and peer review [61, 62, 63]. Podcasting enables students to listen to recorded lectures or other content, and to (co-)create content for course assignments, review sessions, or other purposes [64]. Another example which has become a well-established practice is the application of learning resources developed for online courses to classroom courses. Once an unanticipated benefit, online education resources are now being intentionally developed for use in multiple modalities, as online resources such as the OER Commons illustrate [65].

Mobility makes "online education" a moving target. Users can listen to podcasts online using a desktop computer or mobile device with wireless access - or they can download the podcasts on to a mobile device and listen to it anywhere. Emerging practices in mobile learning ("mLearning") also blur the distinction between "online" and other forms of education. For instance, the California State University, Monterey Bay's Wireless Education and Technology Center (WeTEC) web site describes a variety of diverse mLearning projects where "educators conduct wireless interactive webconferences with local K-12 and high school classrooms and teachers by sharing images and data," conduct field archaeology with Internet connectivity to a classroom via a satellite dish, and do field geology using GPS & GIS (Geographic Information Systems)-equipped Tablet PCs as digital field notebooks [66].

Online education is also going offline. Emerging "portable cloud computing" initiatives such as Thomas Edison State College's FlashTrack project are making it much easier for students and instructors to work offline. This initiative enables on-the-go students to keep up with their online studies using a variety of mobile devices, including laptops, Netbooks, gaming devices, and mobile phones. Entire courses can be stored on an inexpensive USB flash drive which contains content, productivity applications, and even a basic course management system. The course is essentially self-contained; no installation onto a computer is necessary, and nothing is left on the computer or other device after it is used, which eases security concerns. Instead of being tethered to a computer, students can do their work offline, only going online to send assignments or receive updates [67, 68]. Given the continuing trend toward ever greater storage capacity in ever smaller devices as exemplified by currently available USB flash drives and wrist bands with considerable storage capacities (2-16GB) at low cost ($15-50), it may soon become necessary to start talking about "offline education."

The distinction between online and classroom education is also blurred by introducing the element of choice, as exemplified by courses where students choose the delivery mode. Early examples included Ohio State University's "buffet" style calculus course [69], which allowed students to select a delivery mode at the beginning of the course, and Virginia Tech's Math Emporium, where students can choose whether to do assignments online in a computer lab, access the course materials from their dorm computers, receive 'on-the-spot' one-on-one tutoring, or attend a small group tutoring session [70]. A more recent example is San Francisco State University's "HyFlex" (hybrid + flexibility) course design, which enables students to choose between online and in-class participation modes [71]. In effect, each student creates his own individualized delivery mode mix in such courses; increasingly, "online," "blended," or "classroom" describe choices rather than courses.

VI. WHY FULL SCALE ONLINE EDUCATION IS IMPORTANT

Online learning has taken hold in higher education because it improves access for all learners and provides new access for previously underserved learners. Online education will continue to be well-suited to fulfill these roles, and the need and demand for education is likely to continue to grow. Thus full scale online education is important because it represents the realization of the dream to provide greater educational access.

Blended learning, and the integration of online learning into mainstream education, both enable online technologies to be effectively used for teaching and learning in ways that previously were impossible. If the first era in the history of online education was focused on providing access, the second era has the potential to be defined by improving quality, and stakeholders are turning their attention to this area [72]. Full scale online education is also vitally important not just to address current concerns about its perceived quality, but also as a means for improving the quality of all education in the foreseeable future.

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EDUCATIONAL TRANSFORMATION THROUGH ONLINE LEARNING: TO BE OR NOT TO BE

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ABSTRACT

The purpose of this article is to examine online learning at the macro level in terms of its impact on American K-12 and higher education. The authors draw on six years of data that they have collected through national studies of online learning in American education as well as related research to do a critical and balanced analysis of the evolution of online learning in the United States and to speculate where it is going. Their collection of data represents some of the most extensive research examining online learning in the totality of K-20 education. Issues related to the growth of online learning, institutional mission, student access, faculty acceptance, instructional quality, and student satisfaction are explored. Of particular importance is an attempt to determine if online learning is in fact transforming American education in its essence and to speculate on the future.

KEYWORDS

online learning, blended learning, distance learning, asynchronous learning, transformation, computer-mediated learning, computer-mediated communications, learning styles, instructional design, instructional technology

I. INTRODUCTION

For the past two decades, online learning has made significant inroads in American education. Whether or not online learning is actually transforming or appearing to transform education is a key question in need of clarification. According to Webster's 3rd New International Dictionary as well as the Free Online Dictionary, the word "transform" has two basic meanings: (one) to change completely or essentially in

composition or structure, and (two) to change the outward form or appearance. In the United States, as well as in many other countries, there have been clarion calls for education to transform in light of new technology especially as afforded by online learning. Some observers claim that this is already occurring and within the next several years education will be completely "disrupted" experiencing a transformation in its nature and structure [1].

In 1988, the U.S. Congress's Office of Technology Assessment (OTA) conducted a national study on the uses of computer technology for instruction in primary and secondary schools. Extensively researched and documented, the study provided one of the first glimpses of the investment that schools in all parts of the country were making in instructional technology. Millions of microcomputers costing billions of dollars had been purchased in the 1980s, and almost every school in the country had acquired some form of computer technology. This study was frequently cited in professional journals as evidence of the "revolution" under way in the schools. The study showed that a major new thrust in instructional computing was indeed occurring [20].

In 1983, the student-per-microcomputer ratio in all K-12 public schools was approximately 125:1; by 2004 it was 4:1, where it has stayed for the past half-dozen years. American K-12 public schools spent approximately $2 billion per year on computer technology in the 1980s. Presently, schools are spending closer to almost $10 billion per year on technology [26]. Based on the number of machines purchased and the dollars invested, one might assume that computer technology has become an integral part of instruction in our nation's schools and has indeed revolutionized K-12 education. This is debatable. Larry Cuban (2000, 2001), professor of education at Stanford University, posited that computers were "oversold and underused" and that many teachers at all levels remained occasional users or nonusers. Furthermore, those who were regular users seldom integrated the machines into core curricular or instructional tasks [2, 3]. In a national survey conducted for *Education Week* in 2004, many teachers considered themselves beginners in the use of technology in their classes and only 63% of the 4th grade students surveyed reported using a computer at least once a week in school [4]. To add to this issue is the basic question whether or not technology improves learning. In 2007, the National Center for Education Statistics issued a report based on a series of experimental and quasi-experimental studies on the use of a number of different reading and mathematics educational software products across thirty-three districts, 132 schools, and involving 439 teachers. The major findings indicated that test scores in treatment classrooms that were randomly assigned to use the software products did not differ from test scores in control classrooms that used traditional instructional methods [24]. This study was followed up in 2009 and resulted in the same findings [25]. The conclusion is that although schools continue to invest significant resources in technology, educators are cautious and concerned about its impact and much instruction continues to rely heavily on traditional face-to-face modes.

In 2008, Clayton Christensen, a professor at the Harvard Business School and the best-selling author of *The Innovator's Dilemma,* published a book with Michael Horn, and Curtis Johnson entitled *Disrupting Class: How Innovation Will Change the Way the World Learns* [1]. Christensen, Horn, and Johnson present a compelling rationale for changing education in a way that makes far greater use of online technology to provide more student-centered and individualized instruction. The book's call for change is being cited by many educators as an important consideration for policymakers when looking at the future of American education. Among the most provocative aspects of this book are the predictions that about one-quarter of all high school courses will be online by the year 2016 and that about one-half of all high school courses will be online by the year 2019. In Chapter 4, Christensen et al provide the bases for their predictions and among other citations refer twice to one of these authors' studies published in 2007. Christensen et al are among the clarions that foresee transformation in education occurring driven by online learning technology. It has been projected that over the next five or six years, the K-12 enrollment in online courses will approach 5-6 million students which represents about ten percent of the total K-12 student population [5, 6].

In American higher education, the picture is somewhat different. Online learning in colleges and universities started earlier than in K-12 environments and is more established with approximately 4.6

million or twenty-five percent of college and university students enrolled in at least one fully online courses in 2008. These enrollment figures are celebrated by some as indicative of a revolution or "transformation" that is occurring in higher education because of online learning technology. [7,8,9] This too is debatable. Practically all American colleges and universities have acquired some form of course management (CMS) or learning management systems (LMS) raising several legitimate questions: Why aren't more students--the other eighty percent--enrolled in fully online courses. Can we consider a twenty percent penetration a "transformation," especially when many of these students are also enrolled in traditional face-to-face courses at the same time? Also, are the students enrolled in online learning really experiencing new pedagogical approaches afforded by the new technology or have the traditional face to face pedagogies simply been transferred?

Another factor that needs to be considered is the use of online technology in less than fully online courses. Blended, hybrid, mixed-mode and web-enhanced courses are surely evolving and increasing in popularity in education at all levels. Unfortunately there are very little reliable data across institutions on blended or hybrid online learning models. Problems of definition make collecting such data especially difficult. One institution's "blended" course is another's "web-enhanced" course, and the amount of actual online activity that would represent or reflect significant change is almost impossible to determine. While there have been a number of studies and articles on blended and hybrid models, these have tended to report what has happened in a single course, program, or institution. This is especially true in American higher education where course content and pedagogy is normally determined by individual academic departments and even individual instructors within departments. If it were assumed that blended and web-enhanced models represent a significant percentage of instructional delivery, these models may or may not be considered as "transforming" education. Perhaps they are changing it incrementally or perhaps just on the surface but not in its essence. These are questions that need further exploration.

The purpose of this article is to examine online learning at the macro level in terms of its impact on American K-12 and higher education. Issues related to the growth of online learning, student access, faculty acceptance, instructional quality, and student satisfaction are explored. Of particular importance, is an attempt to determine if online learning is in fact transforming American education in its essence and to speculate on the future.

II. BRIEF REVIEW OF THE RESEARCH

The authors are drawing extensively on six years of data that they have collected from national studies of online learning in American education to do a critical and balanced analysis of how online learning has evolved in the United States and to speculate on where it is going. This collection of data represents some of the most extensive research examining online learning in K-20 education that currently exists. A review of the findings is appropriate. Copies of all reports are available as free downloads at: http://www.sloanc.org/publications/survey/index.asp

A. K-12 Online Learning

In a 2007 national study of school district administrators, the number of students enrolled in online or blended courses in American K-12 schools was estimated at 700,000 [5]. In a 2009 follow-up study, the estimate was 1,030,000, a 47 percent increase in two years [6]. This substantial increase is not derived from a few highly-successful large virtual schools but the result of students taking either online or blended courses in three quarters of all school districts (74.8 %). Approximately another 15 percent of the districts are planning to introduce them over the next three years. Respondents in this study anticipated that the number of students taking online courses will grow by 22.8 percent and that those taking blended courses will grow even more over the next two years. It also appears that the number of school districts offering online courses is accelerating. One of the questions asked in the follow-up study of respondents who were offering online or blended learning courses, was: In what year did any student

in your district ***first*** take a fully online or blended/hybrid course? Figures 1 and 2 provide line diagrams illustrating the responses to this question. They show that online and blended learning have been on an upward trend for the past eight years with more and more districts adopting these approaches in recent years. The data in these charts support the upward growth estimates discussed above. In 2007, the authors' original study predicted that over the subsequent five or six years, the K-12 enrollment in online courses would easily approach several million students. The data collected in the later study support that prediction and it is conceivable that by 2016 online enrollments could reach between 5 and 6 million K-12 (mostly high school) students.

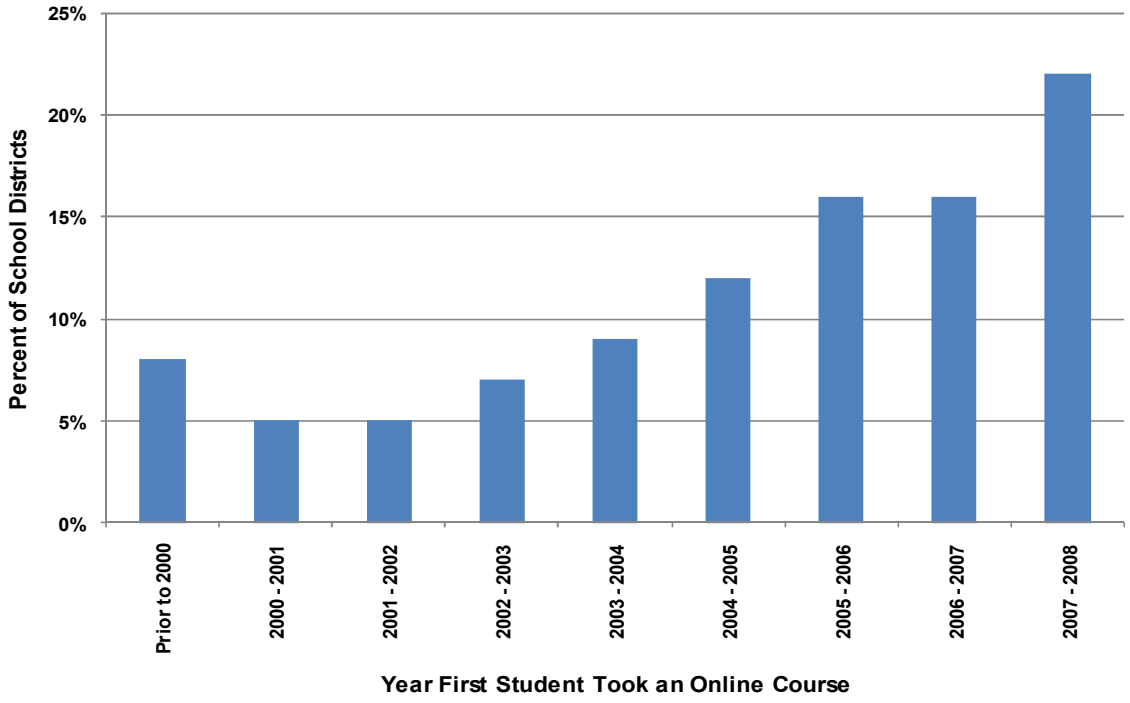

Figure 1. School Districts Reporting Year in which the First Student took a Fully Online Course

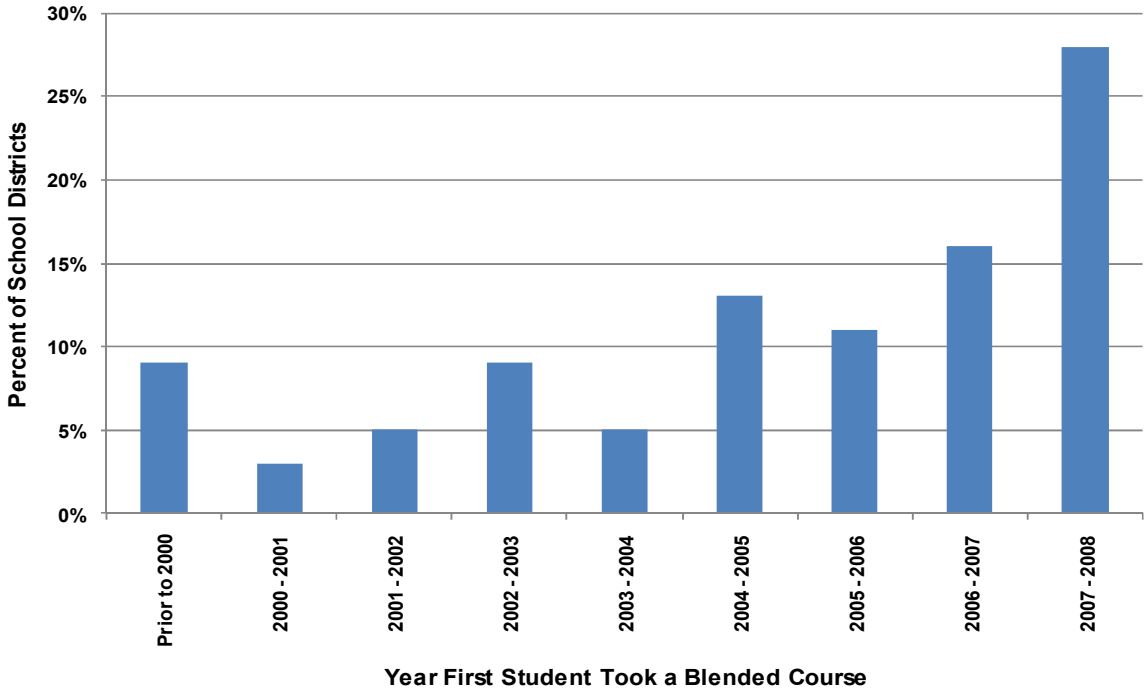

Figure 2. School Districts Reporting Year in which the First Student took a Blended Course

Figure 3 illustrates that school district administrators see a real value in online and blended learning in their schools. The basic reason K-12 schools are offering online and blended learning is to meet the special needs of a variety of students. Large percentages of respondents, in excess of 60 to 70 percent, perceive the importance of online learning as related to:

- Meeting the needs of specific groups of students
- Offering courses not otherwise available at the school
- Offering Advanced Placement or college-level courses
- Permitting students who failed a course to take it again
- Reducing scheduling conflicts for students

It should also be mentioned that rural school districts in particular expressed a serious need for online learning to offer courses that otherwise would not be available in their schools. This will be discussed further later on in this article.

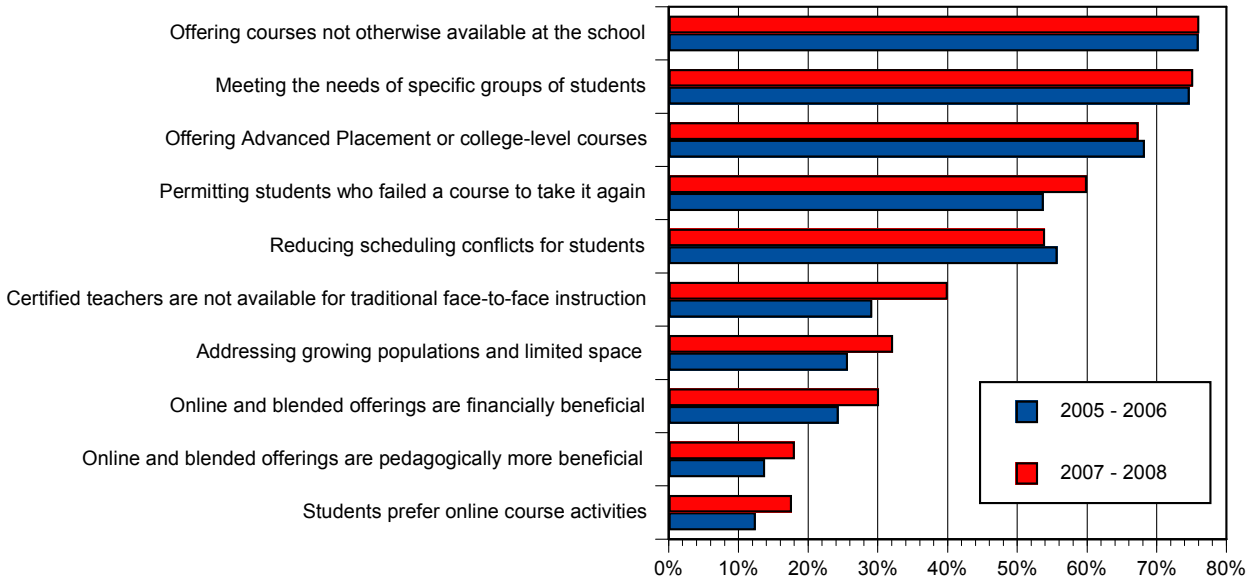

Figure 3. Summary of Responses to: How important do you believe the following reasons are for a school district to offer fully online or blended learning?

The data discussed above leave little doubt that online and blended learning environments are on the ascent and have important roles to play in American K-12 education. However, while these numbers are important, perhaps even impressive, it would be unwise to present a picture of unbridled enthusiasm for online learning in the K-12 schools. One million students in a total population in excess of 50 million students cannot be considered a transformation. Furthermore, there are important issues reported in the findings of both 2007 and 2009 studies that could slow its growth (see Figure 4). Concerns continue to be expressed by approximately 40-50 percent of respondents about the quality of online courses, development costs, and the lack of funding policies.

While resolvable, these issues need to be addressed and are not simply the responsibility of the schools and districts. Large city school systems, state education departments, and the federal government have roles to play. States such as Michigan (Merit Curriculum) and Alabama (Alabama Connecting Classrooms, Educators and Students Statewide) have initiated major new policies regarding online learning in secondary education. The Florida Virtual School is perhaps the most successful example of state policy supporting an online program that is meeting the needs of tens of thousands of students. Consortial arrangements such as the Virtual High School Global Consortium and blendedlearning.net provide quality services at reasonable costs. Lastly, colleges and universities, the primary providers of online learning for K-12 students, have developed a good deal of expertise in designing and developing online programs and increasingly are becoming willing partners in assisting K-12 schools to develop online learning opportunities. However, more can and needs to be done before online learning evolves into a readily acceptable alternative in primary and secondary school education and before we can agree that a transformation is occurring in K-12 schools.

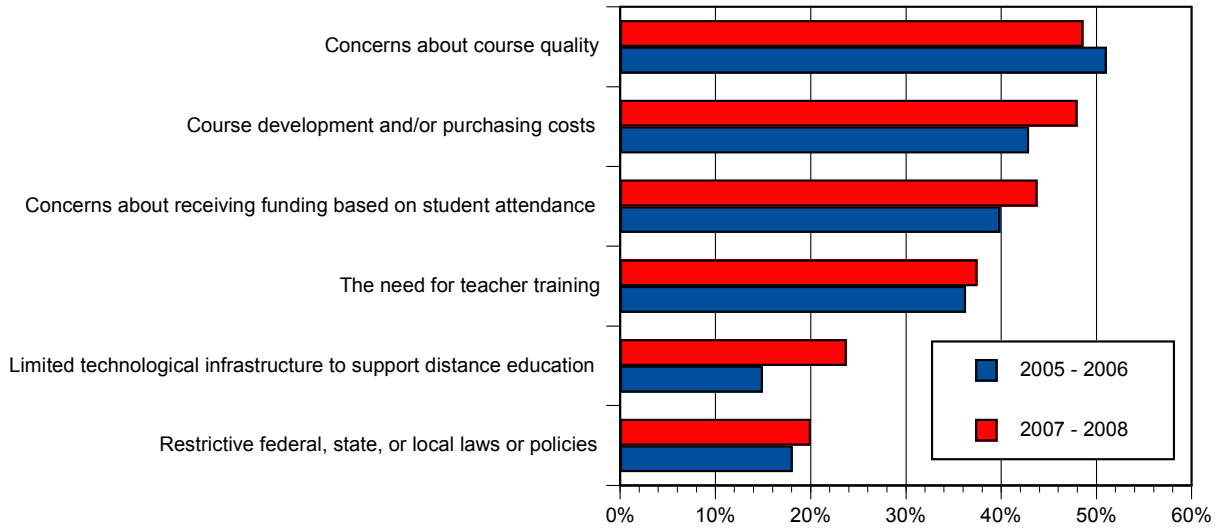

Figure 4. Summary of Responses to: How much of a barrier the following areas would be (or are) in offering fully online or blended learning courses?

B. Online Learning in Higher Education

The extent and nature of online learning in American higher education has progressed more extensively than in K-12 schools. Figure 5 shows approximately 4.6 million out of a total population of 18 million students are enrolled in at least one online learning course in American colleges and universities [10]. As indicated earlier, online learning has had much more of an impact on American higher education than on its K-12 counterparts. Six years of data indicate that there has been a steady rise in the number of students enrolling in online courses.

	Total Enrollment	Annual Growth Rate Total Enrollment	Students Taking at Least One Online Course	Annual Growth Rate Online Enrollment	Online Enrollment as a Percent of Total Enrollment
Fall 2002	16,611,710	NA	1,602,970	NA	9.6%
Fall 2003	16,911,481	1.8%	1,971,397	23.0%	11.7%
Fall 2004	17,272,043	2.1%	2,329,783	18.2%	13.5%
Fall 2005	17,487,481	1.2%	3,180,050	36.5%	18.2%
Fall 2006	17,758,872	1.6%	3,488,381	9.7%	19.6%
Fall 2007	17,975,830	1.2%	3,938,111	12.9%	21.9%
Fall 2008	18,199,920	1.2%	4,606,353	16.9%	25.3%

Figure 5. Total and Online Enrollment in Degree-granting Postsecondary Institutions, Fall 2002 through Fall 2008

While online learning in higher education has progressed for a number of reasons, the most important by far has been its ability to meet student needs for flexible access [10]. Most college students in the United States attend college while engaged in other activities related to work and family. Gone are the days when "traditional" students in American higher education could be considered full-time, residential students between the ages of 18-22 who depended upon their parents for their financial support. A recently completed study by Public Agenda funded by the Bill and Melinda Gates Foundation found that:

- among students in four-year schools, 45 percent work more than 20 hours a week;

- among those attending community colleges, 60 percent work more than 20 hours a week, and more than a quarter work more than 35 hours a week;
- just 25 percent of students attend traditional residential colleges;
- twenty-three percent of college students have dependent children [11].

Online learning affords a more flexible schedule to these students who combine higher education, employment and family responsibilities into incredibly busy days and nights.

Another important finding from the data on higher education is that online learning is not distributed evenly among all segments of American colleges and universities (see Figure 6). Over 50 percent of all online students are currently enrolled in two-year institutions offering associate's degrees. This pattern has been consistent for the past six years. The tendency has been for public colleges, especially community colleges, whose missions include providing higher education opportunities to wider ranges of students to place greater importance on online learning as part of their strategic planning and overall program offerings [10].

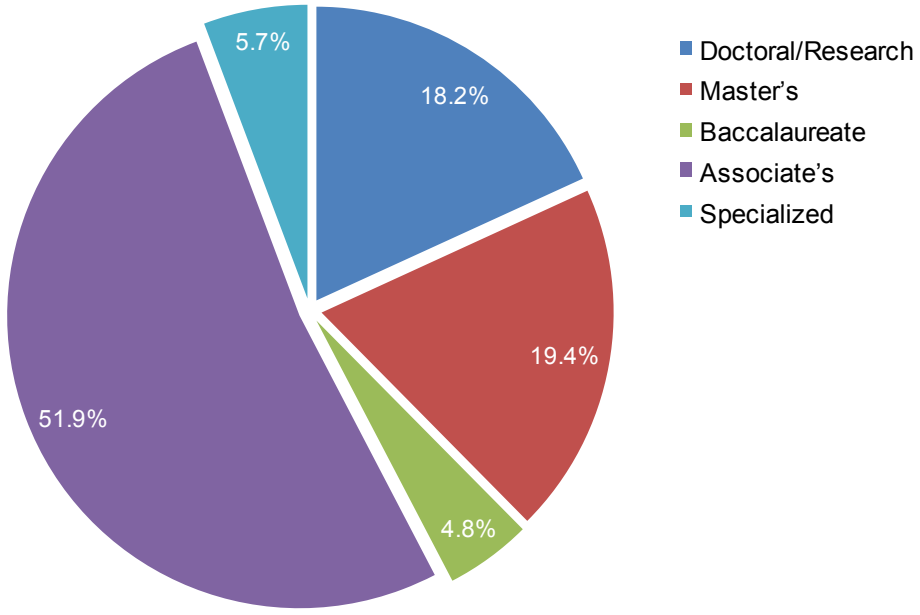

Figure 6. Online Enrollments by Institutional Type – Fall 2007.

Colleges and universities that engaged in online learning see it as an important part of their strategic planning. While these institutions cite increasing their regional reach by introducing online courses and programs, the data indicate that the majority of their online students live within 50 miles of the institution's campus.[10] Except for the very smallest of institutions (those with fewer than 1,500 total enrollments); the majority of institutions of all sizes believe that online education is critical to their long-term strategy [10]. However, barriers to development of online learning in higher education continue to be of concern. Figure 7 provides a summary of responses made by chief academic officers asked to rate the importance of possible barriers to the widespread adoption of online learning. Eighty percent of the chief academic officers indicated that students needed more discipline to succeed in online courses. In addition, lack of acceptance by faculty (61%), low retention rates (58%), and cost (58%) represented other major issues that go to the heart of the academic enterprise.

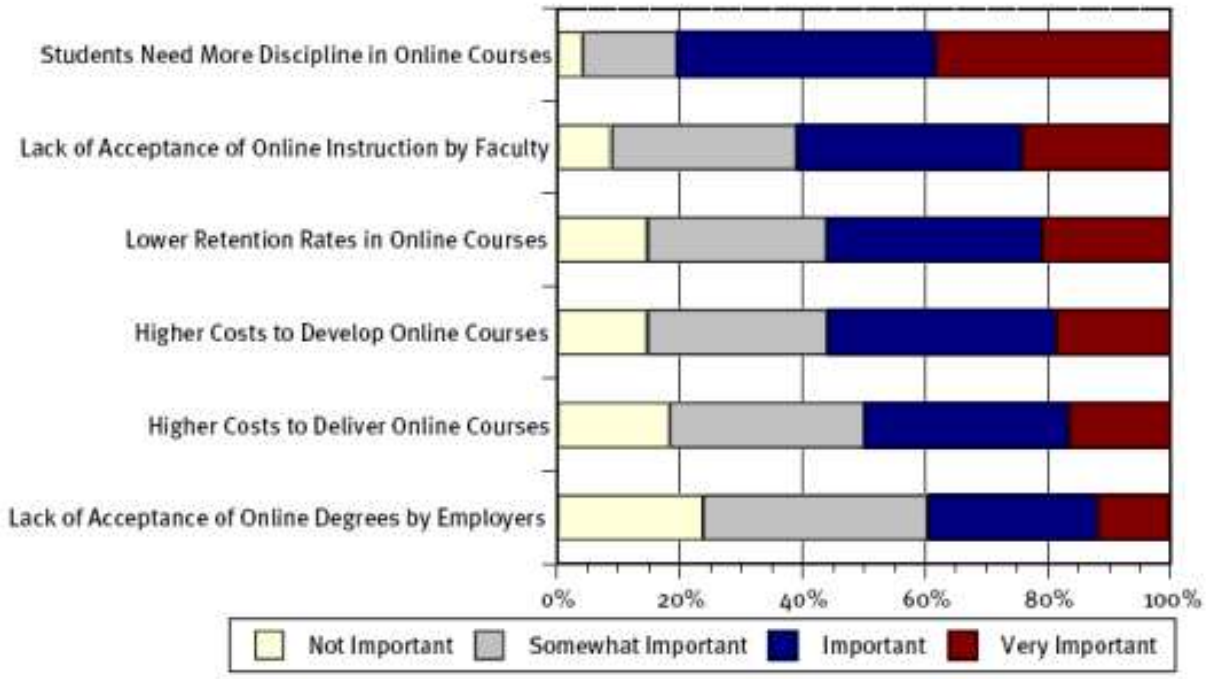

Figure 7. Barriers to Widespread Acceptance of Online Learning – Fall 2006.

C. Faculty and Issues of Course Quality

The issue of quality in online courses should be a major consideration for those who contend that a transformation has or will be occurring soon in the way education is delivered. If the perception among senior educational leaders is that online courses are not of the same quality as face-to-face instruction, it is unlikely that large-scale change can or will occur in the near future. To examine the quality of online learning further it would be helpful to consider the views of faculty on this issue since they are the ones who ultimately grade and judge the quality of student performance in a course. In a survey of college faculty (N= 10,720) at sixty-nine colleges, Seaman examined a number of issues related to faculty attitudes including their perception of the quality of online learning [13]. Figure 8 is a summary of their responses on this issue.

	HAVE YOU TAUGHT AN ONLINE COURSE?		HAVE YOU DEVELOPED AN ONLINE COURSE?		TOTAL SAMPLE
	Yes	No	Yes	No	Total
Inferior to face-to-face	16.7%	40.8%	16.8%	40.3%	32.3%
Somewhat inferior to face-to-face	31.3%	41.3%	31.1%	41.1%	37.7%
The same as face-to-face	37.2%	15.2%	37.2%	15.6%	23.0%
Somewhat superior to face-to-face	12.4%	2.2%	12.2%	2.5%	5.8%
Superior to face-to-face	2.4%	0.5%	2.6%	0.4%	1.2%

Figure 8. Faculty Opinions of Learning Outcomes of Online Courses

Figure 8 shows that among all faculty respondents, whether they have taught online or not, 70% view online learning as inferior or somewhat inferior to face-to-face learning. While there are surely differences between faculty who have taught online and those who have not, relatively small percentages view online learning as superior. An interesting paradox found in this study is that while faculty express

concern about the quality of online courses, most (56%) of them admit to recommending online courses to their students. This indicates that faculty have mixed feelings and while they might consider online courses inferior, they see value in students taking them. Reasonably interpreted, faculty believe that it is more important to provide students with the opportunity to have access to courses even if they are perceived to be of less quality.

In addition to course quality, this study provided important insights into several other faculty issues with regard to online course development. For example, the popular thesis of digital immigrant v. digital native that posits that older faculty are reluctant to change their teaching approaches, especially with regard to technology and online learning, was not supported. This study found that the most experienced faculty (those with more than 20 years of teaching experience) are teaching online at rates equivalent to those with less teaching experience. This finding indicates that age has had little to do with determining who will develop and teach online. Furthermore, this implies that there will not likely be any surge of online course or program development as younger faculty are hired and replace older faculty.

The time and effort required to teach and develop online courses was also an important issue among faculty in this study. Nearly 64 percent of faculty said it takes "somewhat more" or "a lot more" effort to teach online compared to a face-to-face course. The results for online course development are even more striking: Over 85 percent of the faculty with online course development experience said it takes "somewhat more" or "a lot more" effort [13]. This is an important implication for faculty who work in institutions where scholarship is viewed more importantly for career advancement (e.g., promotion, tenure) than teaching. Faculty in disciplines and academic departments that put a priority on research and grantsmanship would be hesitant about spending additional time on teaching that could better be spent on scholarly activities.

Before concluding this section on course quality, it needs to be mentioned that perceptions and attitudes about student outcomes are not the same as actual student outcomes. There are few cross institutional studies of actual student outcomes in online courses. The U.S. Department of Education (2009) recently conducted a meta-analysis of studies completed since 2004 that compare student outcomes in online, blended and face-to-face studies in both K-12 and higher education institutions. The meta-analysis yielded 51 usable contrasts. The main finding was that blended environments combining face-to-face and online elements had better outcomes than purely face-to-face instruction or purely online instruction. However, variables related to time on task also had a significant effect on student outcomes and the results do not demonstrate that online learning (whether blended or not) is superior as a medium [14].

D. Student Satisfaction

The constituency that may be most important with regard to whether online learning is ushering in a transformation in teaching and learning is the students. There have been a plethora of studies of online learning student satisfaction since the mid-1990s. While most of these studies have been at the course, program, or school level, there have been enough with large sample sizes to conclude that most students who complete an online course or program perceive online learning as beneficial. Readers may refer to the bodies of research that exist on student satisfaction at the Research Initiative for Teaching Effectiveness at the University of Central Florida (http://www.rite.ucf.edu/), the Research Center for Educational Technology at Kent State University (http://www.rcet.org/), and the Sloan Consortium (http://www.sloan-c.org). Typically, student satisfaction studies examine a range of issues. Charles Dzuiban, Director of the Research Initiative for Teaching Effectiveness at the University of Central Florida, in a presentation in 2009, summarized his views on the subject:

> …there are 3 reasons students take online courses- convenience, convenience, and convenience! Although this is a major factor in a student's decision to participate in online courses and thus their satisfaction with it, there are other reasons to consider [also]. These include reduced logistic demands …increased learning flexibility, technology enhanced learning, and reduced opportunity cost for getting an education. These items all result in higher student satisfaction. Satisfaction curves for students in online courses are always very high once they get comfortable with the

> change in format, resulting in a curve that starts very low and increases as the course goes on. There are also dimensions that can negatively influence a student's satisfaction curve. Such influences include reduced face to face time, technology problems, reduced instructor assistance, sense of overwhelming, increased workload, and increased costs for education [19].

The authors agree with Dzuiban that for many students their satisfaction is tied to the flexibility and access to an education that online learning affords. Furthermore, as education, especially higher education, becomes more "market" or "customer" driven, students increasingly are able to influence academic program offerings including mode of delivery. This bodes well for transformation. However, one complication related to student satisfaction is the higher rate of student attrition in online courses.

There have been a number of studies that indicate that college student attrition is higher in online courses and programs [15,16,17,18]. Considering the nature of the students who enroll in online courses, it is not surprising that the attrition is higher. The students who are most attracted to online learning are likely balancing several major activities (education, jobs, and families) in their busy daily lives. Their personal circumstances will influence their decisions to continue in a course or not. If we accept the assumption that these students are more at risk of dropping out and that they are more likely to enroll in online courses, then it is not surprising to see higher attrition in online courses. A recent study sponsored by Public Agenda (cited earlier) was based on a survey of more than 600 individuals aged 22 to 30. The study compared those who started a college education but did not complete it with those who received a degree or certificate from a two- or four-year institution. The top reason the dropouts gave for leaving college was that it was just too hard to support themselves and go to school at the same time. The time, effort, and logistics of working while attending college had overwhelmed them. Since they could not afford to quit or reduce their work, they dropped out of college.

A number of issues raised in this study are pertinent for this article. Of particular interest are the responses to a question:

"How would the following help someone whose circumstances are similar to yours ... in getting a college degree?"

The top three responses were:

- Allow part-time students to qualify for financial aid – 81%
- Offer more courses in the evenings, on weekends or in the summer so people can work while attending school – 78%
- Cut the cost of attending college by 25 percent – 78%

The three lowest responses were:

- Improve teaching so the classes are more interesting and relevant – 67%
- Put more classes online – 57%
- Make the college application process easier – 50% [11]

With regard to the benefits of online learning, these responses can be viewed positively or negatively. While fully half of the students felt that online learning would help them complete a degree, there were a number of other things related to their decision to stay or leave college that were somewhat more important.

III. TRANSFORMATION OR ENHANCEMENT

Earlier in this article, Webster's 3rd New International Dictionary and the Free Online Dictionary were cited in defining the word "transform": (one) to change completely or essentially in composition or structure, and (two) to change the outward form or appearance. There has been very little cross institutional research on whether or the nature of the transformation because of online learning at any level of American education. What does exist are studies at the course, program or individual institution level that attempt to show that online and/or blended learning are changing the way teachers teach and

students learn. Whether large-scale "transformation" is occurring across institutions or whether incremental or modest changes are occurring is not easily determined. It is a given that many instructors and teachers at all levels of education are increasingly using software such as CMS/LMS to enhance and expand what is being done in their courses and classrooms. It is not at all clear that they are radically changing how they teach or just transferring face-to-face techniques to online activities. More simply put, adding technology without changing the pedagogy does not necessarily result in any major change to teaching and learning. As an example, Graham & Robinson examined blended learning by conducting a study at Brigham Young University [7]. Using a mixed quantitative and qualitative research design, they surveyed 1600+ faculty at the university regarding their use of online technology in their courses. The survey was followed up by interviews with selected faculty who appeared to be the most prolific users of online technology. In doing their analysis, a taxonomy of three different types of blended learning environments was established based on the scope, purpose and nature of the blended learning course. These three types of environments were identified as:

- transforming blends
- enhancing blends
- enabling blends.

Transforming blends represented large scope projects that were designed to improve pedagogical practice especially with regard to movement toward active learning environments. Their findings and conclusion were:

> We found that there has been wide spread adoption of blended learning [technologies] across the campus. However, we also discovered that much of the blended learning …has not dramatically changed the pedagogical strategies being used in the class but rather is being implemented as enhancements to the traditional on-campus, lecture oriented pedagogy. It remains to be seen whether there is an evolution from smaller scale enhancing blends to more transformative blends [7, p. 108].

It should be mentioned that Graham & Robinson have written extensively on the topic of online learning environments and have generally been viewed as proponents of the new technologies. Their findings in the above study are honest, important, and surely question whether the new online technologies are transforming instruction or simply enhancing it.

One legitimate question with regard to the Graham & Robinson study is whether their definition of transformation is appropriate. Surely transformation involves change that is occurring on a large scale. The improvement of pedagogy also seems appropriate. However, the emphasis on active learning environments might be questioned because "active learning" comes in different forms. Graham & Robinson referenced the work of Roschelle et al (2000) that established four characteristics of active learning environments as:

1. Active engagement
2. Participation in groups
3. Frequent interaction and feedback
4. Connections to real-world contexts [22].

While it is possible to question these four characteristics, they do represent a basic, legitimate definition of active learning. One possible addition to these characteristics might be student-centered learning in which instructional activities are developed to appeal to a variety of learning styles. Multimodal learning approaches are evolving that include multiple techniques in order to accomplish this [23]. Regardless, the characteristics of active learning as cited by Graham & Robinson were viewed as appropriate for their study and acceptable for the purposes in this article.

How do we incorporate the findings in a study such as Graham & Robinson's at the macro level? Surely there are many cases in which online technologies are being used in innovative pedagogical ways to

create active learning environments. Are these instances occurring on a large scale and transforming education or are they isolated cases that reflect changes to a modest number of courses and programs. Or, are these instances any more common than the rate of innovative new approaches are being developed for face-to-face courses? This is not easy to determine and perhaps impossible, but we can speculate based on the authors' work referenced earlier that surveyed K-12 school district administrators and higher education chief academic officers. If we accept that a fundamental aspect of transformation is to improve pedagogical practice, most senior-level administrators responding to the authors' surveys did not view this as a goal or objective for online learning. Instead they were attempting to meet the needs of special students (K-12) and to improve access (higher education) [5,6,10]. In addition, while improving pedagogy was not the major reason or rationale for engaging in online learning, these administrators expressed concerns about online instruction related to questions of academic quality, faculty acceptance, student readiness, and retention. This leads us to assume that instructors and instructional designers are still experimenting with and exploring the use of online technology to develop pedagogical practice but that change on a large scale has not happened yet and has not been recognized by senior administrators.

IV. TRANSFORMATION: TO BE OR NOT TO BE

Having examined some of the current research on online learning, it is now appropriate to speculate on the future.

A. The Future of Online Learning in K-12

Online learning is still in its nascent stages in K-12 education and a good deal more study is needed before it can be determined if a foundation for a transformation is taking place or will be taking place in the near future (five to seven years). K-12 online learning started in earnest with the new millennium and presently there are more than 1 million students enrolled in online or blended learning courses. This approximation represents two to three percent of the K-12 student population. These enrollment levels cannot be seen as a transformation in the making. While a number of states have established virtual schools, some of which are quite successful, they serve more as models rather than as evidence of a major penetration of online learning into K-12 schools. In the limited research that does exist, several major issues are apparent.

First, the issue of the quality and appropriateness of online learning for K-12 students is real and has to be further studied and addressed. While there has been a modest home-school movement in the United States, the vast majority of K-12 students attend and will continue to attend brick and mortar public schools. The typical public schools do not simply provide instruction but are incredibly important socializing agents that nurture and provide social and emotional support to young people helping them to mature and contribute to society. Instruction in these schools is integrated with the nurturing role and there is skepticism, perhaps justifiable so, as to how well online learning can perform both functions. It is not surprising that the majority of existing K-12 online learning is conducted at the secondary level where students are older and beginning to come into their own socially and emotionally. Online learning surely has a role to play for some of these students, but it is not likely to be in the form of fully online programs but a blended approach that makes available courses and parts of courses to students who otherwise meet in fully face-to-face places we call schools.

Second, the enrollment of K-12 students in online courses, while partially driven by student needs, has also begun to take root in a number of rural school districts [5,6]. In these districts, online learning is not simply an attractive alternative to face-to-face instruction but increasingly is becoming a lifeline to a basic quality education. Shortages of teachers in high-demand secondary school subject areas such as science, mathematics, and foreign languages, as well as modest property tax bases and the lowest per pupil expenditures compared to their urban and suburban counterparts have forced rural school districts to use their financial resources as wisely and effectively as possible. Online learning provides these districts with a cost beneficial method of providing courses that otherwise would require hiring teachers, many of

whom would be uncertified in their subject areas and who would not have enough students to justify their salaries. This is true not only for electives and enrichment subjects but increasingly for advanced required courses as well. These districts will continue to invest in and promote online technology because they are beginning to rely on it to deliver basic components of their academic programs. While these school districts enroll modest numbers of students compare to their urban and suburban counterparts, if a transformation does take root, it will likely start in rural America.

Third, in K-12 education, academic programs and planning including pedagogical practice are closely aligned if not coupled with public policy, much of which exists at the state and local levels. The early research indicates that policy and funding issues in particular need more attention before the foundation for a transformation is established.[5,6] A number of states do not have educational policies in place that provide for the establishment and funding of online learning at the K-12 level. For example, some states fund education based on daily (physical) attendance in classes. However, while it is too early to tell, it appears that the U.S. Education Department, may be preparing to propose major incentives for states that promote and support policies conducive to the development and sustenance of online learning technology in K-12 schools.

B. The Future of Online Learning in Higher Education

While a foundation for a transformation is still evolving at the K-12 level, it is our opinion that the foundation for a transformation in American higher education is in place. However, such a transformation is not inevitable and considerable additional development needs to be done before an actual transformation can be realized. Whether this transformation will occur in a relatively finite amount of time, say five to seven years, or a gradual evolution that takes fifteen to twenty or more years depends upon a number of factors.

First, understanding the nature of institutions supporting online learning is critical to speculating whether the new technology will usher in a transformation of teaching in higher education. Six years of data have consistently indicated that public colleges and universities, especially community colleges, are the major providers of online learning courses and programs [27]. In addition, there are a small number of successful for-profit colleges (e.g., University of Phoenix, Devry, Kaplan, Cappella) that have developed and successfully marketed online learning.

Two important classes of higher education institutions have resisted or have not become major providers of online learning. Private four-year liberal arts colleges have shown very little interest in online education in any form. Research-based universities do report that online is a critical part of their long term strategy, but often it is relegated to non-core academic areas, such as their continuing education departments. The mission of these institutions is not one of broadening access as much as selecting the brightest, typically higher income, and often legacy (students of alumni) students for enrollment. These two sectors are perceived by students, parents, and faculty as the “elite” institutions and the “best” of American higher education. It follows then that the nature of their educational programs, which continue to be based on face-to-face instructional activities, continue to be perceived of higher quality. In actuality this may not be true. Research universities emphasize the research and scholarship missions of their academic programs more than teaching. Faculty are hired and promoted based on their research, grantsmanship, and scholarship not because they can teach well. At many of these institutions, large portions of teaching responsibilities fall to graduate assistants rather than full-time “scholars”. Most private four-year liberal-arts colleges that consider themselves “elite” have been reluctant to invest significantly in online teaching and learning because it could jeopardize the social aspect of their programs. Parents who spend $50,000 or more annually for tuition and fees would likely question the worth of their investment if a significant portion of the academic program was delivered online. These colleges appeal to students whose parents are looking to provide their children with the “best college experiences that money can buy”. The perceived quality and reputation of the liberal arts colleges among parents, students, faculty and educators slow the possibility of a higher education transformation since it is not likely that a major investment to online learning will occur at these colleges in the foreseeable

future.

Any educational transformation that may occur will be in the non-research-oriented public university systems, community colleges, and for-profits that seek to provide access and enroll as many students as possible. However, in many of these institutions, especially the public four-year colleges, many faculty are hired and promoted based on their scholarship as much as for their teaching. This too may slow any transformation that is based strictly upon pedagogical practice and teaching. Of particular concern is the fact that in recent years, states and localities have been limiting if not reducing their financial support of public higher education. If this trend continues, publicly-funded colleges will be more aggressive in hiring faculty for their research and grantsmanship skills rather than for their teaching ability.

A second important consideration is that online learning was often ushered into higher education through the alternative (e.g., distance, adult, continuing) education units of colleges and universities rather than by mainstream academic departments. Alternative programs that emerged as highly successful online learning providers such as the University of Maryland University College, the Penn State World Campus, and SUNY's Empire State College were not coupled closely with their institutions' mainstream academic programs. These alternative operations, while providing an enormously important service to students, especially older, part-time students, did not always receive the respect that they deserved from their mainstream colleagues. They were seen in many cases as "cash cows" that were expected to be self-sufficient or preferably to turn a profit for the good of the entire institution. They currently represent a significant portion of higher education online student enrollments. The lessons learned and the approaches pioneered in online learning by the faculty in these alternative operations were initially viewed with suspicion by administrators and faculty in mainstream academic departments. While this has changed considerably in recent years, vestiges of suspicion still remain.

A third critical factor is faculty attitude to online learning. Even among those faculty who have developed, taught, and continue to teach online, the quality of online learning is perceived to be of a lesser caliber than face-to-face instruction. Part of this perception may be related to the experiences and comfort levels that have developed among faculty whose initial teaching experiences were in face-to-face environments. However, part of this perception may be based on objective observation that online learning as a mode of instruction is still evolving and that what constitutes good teaching online is likewise evolving and has not reached the level of face-to-face instruction.

The Seaman study referenced earlier also provided critical evidence that the opinion among faculty is that developing and teaching online takes more time and effort [13]. This too becomes important in trying to determine whether a transformation will take place. Technology has been sold for decades on the promise that it is faster, easier, and more efficient than traditional ways of doing things. This is true for high-transaction processing such as airline reservations, banking, and inventory control applications but it may not be the case for intense human relationship activities related to education. The attitude, and possibly the actuality, that online learning takes more time and effort combined with the perception that online learning is of lesser quality, results in a situation that will delay if not significantly prevent any transformation from occurring. One possible approach that might alleviate the problems associated with quality and effort is combining face-to-face with online instructional activities in a blended or hybrid model. The U.S. Department of Education study gives some credence to the quality of blended approaches but much more research in this area needs to be conducted [14].

Lastly, student access issues may be the most important forces driving a transformation of higher education through online technology. Higher education institutions that see students as customers who drive their academic programs will have to adjust to the demands of the market and increasingly provide courses and programs that meet the needs of incredibly busy individuals who combine work, family, and higher education. These student customers clearly see higher education as important for entering certain fields or advancing careers and seek certification or credentials that allow them to apply for new positions, promotions, and salary rewards. The anytime, anyplace nature of online learning has a certain appeal to these students and is generally accepted by them, not necessarily because of the quality of the program but because of the convenience. Garrett in a study of 2,000 potential students concluded that

"interest in online learning appears to be dominated by notions of convenience, and is seen to imply a quality tradeoff" [28]. In sum, a transformation based on access and convenience has begun to occur in institutions and programs that have traditionally emphasized professional preparation (e.g., business administration, education, health services) and may see its way into other academic programs.

V. CONCLUSION

The purpose of this article was to examine online learning at the macro level in terms of its impact on American K-12 and higher education. Data were provided from cross-institutional research to establish a baseline of information on the extent and nature of online learning in American K-12 and higher education. An attempt was made to determine if online learning is in fact transforming American education. Our review of the research leads to several major conclusions.

First, online learning in K-12 schools is in its beginning stages and a good deal more public policy development at all governmental levels (federal, state, local) needs to be done in order for online learning to take a strong foothold upon which transformation can take place. Furthermore, blended approaches that combine online with face-to-face instruction whether at the program, course, or module level will likely be more readily accepted than fully online programs.

Second, in American higher education, a foundation has been established upon which a transformation can occur. However, much of this foundation exists in specific segments of the higher education enterprise, namely publically-funded university systems, community colleges, and select for-profit institutions addressing a specific subset of students. A sizable minority of higher education institutions continue to either ignore online education, especially in the four-year private liberal arts schools, or to relegate it to the peripheral of their activities. These institutions show no signs of embracing online learning in the future. For an overall transformation to occur in American higher education online education will need to be embraced by the full range of institutions. This will demand fundamental changes in some very strongly-held beliefs among particular schools; an unlikely prospect.

Lastly, issues regarding the quality of online learning and the level of effect required to develop and teach online courses continue to be of concern at all levels of education leading to the conclusion that more developmental work needs to be done. As Christensen et. Al. and others have stated, there needs to be a cultural shift in pedagogical approaches that takes advantage of the newer online technologies. Only then can a widespread transformation occur.

VI. ABOUT THE AUTHORS

Anthony G. Picciano is a professor and executive officer of the Ph.D. Program in Urban Education at the Graduate Center of the City University of New York (CUNY). He is also a professor in the graduate program in Education Leadership at Hunter College, the doctoral program in Interactive Pedagogy and Technology at the Graduate Center (CUNY), and the interdisciplinary program in Communication and Culture at the CUNY School of Professional Studies. He has forty years of experience in education administration and teaching, and has been involved in a number of major grants from the U.S. Department of Education, the National Science Foundation, IBM, and the Alfred P. Sloan Foundation.

In 1998, Dr. Picciano co-founded *CUNY Online*, a multi-million dollar initiative funded by the Alfred P. Sloan Foundation that provides support services to faculty using the Internet for course development. Currently he serves on the Board of Directors of the Sloan Consortium. His major research interests are education policy and leadership, Internet-based teaching and learning, and multimedia instructional models.

Dr. Picciano has authored numerous articles and eight books including *Data-Driven Decision Making for Effective School Leadership* (2006, Pearson), *Educational Leadership and Planning for Technology*, 4th Edition (2005, Pearson), *Distance Learning: Making Connections across Virtual Space and Time*

(2001,Pearson), and *Educational Research Primer* (2004, Continuum). His most recent book was co-edited with Chuck Dzuiban and is entitled, *Blended Learning: Research Perspectives* (2007, Sloan Consortium). He also has just completed editing a special edition of the Journal of Asynchronous Learning Networks (JALN) on blended learning. In 2007 and 2008, Dr. Picciano completed national studies with Jeff Seaman on the extent and nature of online learning in American school districts. They are among the first studies to collect data on fully online and blended learning in primary and secondary schools. He is currently collecting data on a study of online learning in American high schools.

Jeff Seaman currently serves as the Survey Director for The Sloan Consortium and as Co-Director of the Babson Survey Research Group. Dr. Jeff Seaman has worked in education information technology for his entire career, and holds degrees in Demography/Statistics, Sociology, Electrical Engineering, and Housing, all from Cornell University. He has taught social science, information technology and statistics at several colleges and universities, including Cornell University, the University of Wisconsin, the University of Pennsylvania's Wharton School, and Babson College.

Dr. Seaman created and ran the Computing Resource Center and served as Associate Vice Provost for Computing for the University of Pennsylvania and as Chief Information Officer for Lesley University. His industry experience includes serving as Chief Technology Officer at HighWired.com where he led the development of an online learning system used by thousands of US high schools and as the Vice President of Engineering for Vista Associates where he did functional design work and led the engineering team in building course management systems. He has served on academic technology advisory boards for a number of information technology companies including Apple Computer, IBM, and Microsoft.

Dr. Seaman has been conducting research in the impact of technology on higher education and K-12 for over a decade, beginning with comprehensive national studies of technology use in U.S. Higher Education in 1991. His most recent work includes the annual Sloan Consortium surveys on the state of online learning; *Charting the Course: Online Education in the United States, 2008, Making the Grade: Online Education in the United States, 2006, Growing by Degrees: Online Education in the United States, 2005*, *Entering the Mainstream: The Quality and Extent of Online Education in the U. S. 2004 and 2004*, and *Sizing the Opportunity: The Quality and Extent of Online Education in the United States, 2002 and 2003*.

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A QUALITY SCORECARD FOR THE ADMINISTRATION OF ONLINE EDUCATION PROGRAMS: A DELPHI STUDY

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ABSTRACT

As the demands for public accountability increase for the higher education, institutions are seeking methods for continuous improvement in order to demonstrate quality within programs and processes, including those provided through online education. A six round Delphi study was undertaken with 43 seasoned administrators of online education programs who agreed upon 70 quality indicators that administrators should examine within their programs to evaluate quality. A method for scoring was also developed. The original set of quality indicators from the Institute for Higher Education Policy study, *Quality on the Line: Benchmarks for Success in Internet-Based Distance Education* (2000) were used as a starting point and determined still valid in 2010, with modifications. The study resulted in a quality scorecard for the administration of online education programs.

KEYWORDS

Online Education, Online Education Administration, Online Education Assessment, Online Education Programs

I. INTRODUCTION

The development of the Internet has forever changed higher education and distance learning programs. Prior to its arrival, distance education, also called distance learning or distributed education, used varied methods for course delivery such as mail correspondence, telecourses, or satellite delivery, and was clearly on the periphery of higher education. When course delivery using the Internet became an option—creating the new phrase *online education*—it wasn't long before enrollments began to rapidly increase and online education became firmly entrenched within higher education. In fact, numerous studies cite tremendous growth in online education, which has outpaced that of traditional higher education with the majority of accredited institutions now offering distance learning courses [1, 2].

While some institutions willingly responded to the increased student demand for flexibility and convenience, others grudgingly responded because of the increased competition for student enrollment. However, after experiencing success with a few online courses, many institutions developed full degree programs to be offered completely online. While the online programs were expected to increase student access and increase enrollment, both administrators and faculty expressed concern regarding quality [3], how should it be measured, and what evaluation methods should be used for continuous improvement strategies and accreditation requirements. Today, in light of the public call for accountability, quality assurance of educational programs is still one of the greatest challenges in higher education today [4, 5, 6].

II. BACKGROUND OF THE STUDY

Like many industries in the 21st century, higher education is finding that demands for accountability [7] along with increased competition, stimulate a need for developing quality improvement strategies. In fact, a research study by Rice and Taylor [8] found that 88% of the colleges and universities surveyed affirmed

they were engaged in some form of continuous improvement strategy and striving toward increased quality in all areas of the institution, including distance and online learning programs. The much talked about rapid growth of online education programs may be the reason that the regional accreditors began to look closely at online programs and their claims of quality.

Interestingly, many institutions advertise using the word "quality" with online education programs because they believe it creates public interest and market advantage. However, quality online education is still difficult to define [9] and many have recognized the need for a more comprehensive system for evaluation [10]. Unlike industry recognized quality stamps for corporations, such as the Total Quality Management criteria for excellence or the Malcolm Baldrige National Quality Award, an instrument is yet to exist for online education for measuring quality programs, and facilitating strategic planning and program improvement. However, because of the tremendous growth in online education, higher education could benefit from an instrument comprised of industry standards endorsed by online education administrators.

Several rubrics do exist for measuring quality online course materials, such as University of Maryland's Quality Matters, California State University-Chico's rubric for online instruction, and Blackboard's Exemplary Course rubric. In fact, the Quality Matters program is an industry recognized quality seal for online course materials and used by many programs in both the United States and other countries. Online education administrators could greatly benefit from a quality indicator tool for program administration to not only determine program quality but also assist with future goal setting and strategic planning. Online education administrators must take the issue of quality seriously because students may go elsewhere in search of quality educational programs [11].

A research study by the Institute for Higher Education Policy (IHEP) cited a significant need for improved research for distance learning programs and quality standards [12]. Commissioned by the National Education Association and Blackboard, Inc., the IHEP followed with a second study that identified 24 separate quality indicators chosen by various respected online education leaders of higher education institutions out of the original 45 indicators provided by a literature search. The latter report, *Quality on the Line: Benchmarks for Success in Internet-Based Distance Education* [13], is still abundantly referenced throughout the literature today.

III. PURPOSE OF THE STUDY

This study sought to determine if experts in the administration of online education of various types of higher education institutions believe the original 24 indicators of quality online education identified by the Institute for Higher Education Policy study [13] are still relevant today and if additional indicators are needed to identify quality online education programs. The central purpose was the development of a scorecard to measure and quantify elements of quality within online education programs in higher education that may also support strategic planning and program improvements. The following questions guided the research:

- Are the standards identified in the IHEP study in 2000 still relevant in 2010 for indicating quality in online education programs in higher education?
- What additional standards should be included that address the current industry in 2010?
- If additional standards are suggested, will they fall into the already identified themes or will new themes emerge?
- What values will be assigned to the recommended standards that will ultimately yield a numeric scorecard for measuring quality online education programs from an online education administrator's perspective that could also support strategic planning and program improvements?

IV. LITERATURE REVIEW SUMMARY

A review of the literature of quality evaluation of online education programs reveals several commonalities among each article or research study [14, 15, 16, 17, 18, 19, 13, 20, 10, 21, 22, 23, 24, 25]. The institutional commitment, support, and leadership theme and the teaching and learning theme were the most used when determining standards for online education programs. The literature focused on the quality of teaching and pedagogy far more than the overall quality of programs. Early in the literature, it was the overall design of the course that most authors wrote about since courses moved online before complete programs. Faculty support was the second most identified theme in quality evaluation. For success in teaching online, faculty require support, training, motivation, compensation, and policy. Student support and course development were the third most cited themes in the analyzed studies. It is interesting that student support was not cited as much as learning effectiveness. Students require the same support services that traditional students need; however, it is often more challenging to find ways to deliver those services and support in an online environment.

Technology, organizational/institutional impact, and evaluation were identified in only 6 of the 14 articles and studies reviewed. Technology is foundational to the infrastructure of online education and should be considered a critical component to quality and success. Cost effectiveness and management and planning were only identified three times in the studies and faculty satisfaction, student satisfaction and student retention only listed twice out of the 14 examined. A rubric for determining the quality of online program administration could not be located within the literature.

V. RESEARCH DESIGN AND METHODOLOGY

A. Method

The Delphi Method, developed by the Rand Corporation in the early 1950s by Norman Dalkey and Olaf Helmer [26], was the methodology utilized for this study. While considered suspect by some, many researchers have employed the Delphi Method to gain consensus from experts on a given topic because "it replaces direct confrontation and debate by a carefully planned, anonymous, orderly program of sequential individual interrogations usually conducted by questionnaires" [27]. In fact, according to Day and Bobeva, "The Delphi is founded upon the use of techniques that aim to develop, from a group of informants, an agreed view or shared interpretation of an emerging topic area or subject for which there is contradiction or indeed controversy" [28].

The Delphi Method was selected as the appropriate research method to develop the quality scorecard because of its ability "to seek out information which may generate a consensus on the part of the respondent group and correlate informed judgments on a topic spanning a wide range of disciplines" [29]. Topics or decisions considered to be subjective usually do not have a single correct solution. The "affective, emotional, and expressive dimensions of a problem often subordinate the objective, analytical quality of a decision" [30]. Because the topic of this study, the quality of online education programs, is so subjective, the researcher believes the Delphi process for reiteration improved the overall outcome of the quality scorecard and achieved a greater strength of consensus and buy-in from the members of the expert panel.

B. Study Population, Sample Frame and Sampling Plan

According to Rossman and Eldredge, "A key factor in any Delphi Study is the qualification of the population selected to receive the questionnaires" [31]. The study population consisted of online education administrators in higher education who were considered experts in the respective field. According to Ziglio [32], if the Delphi panel of experts is selected by personal preference of the researcher, the overall validity of the study could decrease. Therefore, the sampling frame was identified by the Sloan Consortium (Sloan-C), an organization highly respected for its work with quality online

education initiatives. For this study, potential panel members were first identified by Sloan-C as recognized experts in the administration of online education who met the following criteria:

- Five or more years of experience as an administrator of online program in higher education
- Identified by the Sloan Consortium as a respected expert in the field of online education (having published or presented)
- Work at one of the various types of higher education institutions:
    - Community College
    - Public University
    - Private College or University
    - Faith-based College or University
    - For-Profit Institution.

For this study, 76 experts were invited and 43participated as panel members in the first survey round. Table 1 shows the institutional classification for the members of the expert panel. It is important to note that more than 83% of the panel members had nine or more years of experience in the administration of online education programs. Of the 43 panel members, 56% were from large public institutions.

Institutional Classification	Type	Size	Total
Public (4 year)	Non-profit	Large	24
Public Community College (2 year)	Non-profit	Large	2
Private (4 year)	Non-profit	Large	4
Private (4 year)	For-profit	Large	1
Private Faith-Based (4 year)	Non-profit	Large	1
Public (4 year)	Non-profit	Medium	2
Private (4 year)	Non-profit	Medium	3
Private Faith-based (4 year)	Non-profit	Medium	3
Public (4 year)	Non-profit	Small	1
Private (4 year)	Non-profit	Small	2

Table 1. Institutional Classification for Expert Panel Members Who Participated

C. Instrumentation and Data Analysis

The majority of Delphi studies use an open-ended questionnaire for collecting data in the initial phase [34, 35]; however, since the IHEP quality standards [13] already existed before this study, judgment of the 24 quality standards identified by the IHEP study occurred in Delphi Round I. Respondents were also invited to suggest additional quality indicators they believed to be relevant for measuring quality in online education programs. Therefore, a combination of open-ended and closed questions was used for each survey round.

For this research study, descriptive statistics were formulated and reviewed for each survey using a five-point Likert-scale:

1 = Definitely Not Relevant

2 = Not Relevant

3 = Slightly Relevant

4 = Relevant

5 = Definitely Relevant.

Mean and median scores along with standard deviation and mode analysis may be used in Delphi studies to determine consensus as well as percentage of responses [34, 36, 37]. Many Delphi studies suggest that when 60-80% of panelists agree with a survey item, this signifies consensus [38, 39, 40] with a level of 70% being the most commonly chosen [38]; however, a clear guideline for consensus still did not exist in the literature [35]. According to Hsu and Sandford [36], mean and mode analysis are the most favorably used in the literature.

The Delphi Round I survey encouraged the expert panel to validate and revise existing IHEP quality standards and add new items to indicate quality for inclusion in the Delphi Round II survey. The Delphi Round II survey was developed by including all items from the Delphi Round I survey achieving a mean score of 4.0 or above and a panel member agreement of 70% or more along with the revision of the existing quality standards, and additional quality indicators suggested by the panel of experts. The Delphi Round III survey was developed to include items from the Delphi Round II survey that achieved a mean score of less than 4.0 but selected by 70% of panel members. The Delphi Round III survey included those items for further review by the panel of experts. It also invited panel members to suggest further quality indicators they felt were missing from the previous round. The Delphi Round IV survey was developed to include all items from the Delphi Round III survey that achieved a mean score of less than 4.0 but selected by 70% of the panel of experts. The Delphi Round IV survey also requested members of the expert panel to suggest possible scoring methods for the quality standards in order create the quality scorecard. The Delphi Round V survey was developed to include the scoring methods suggested in the Delphi Round IV survey. Those items that did not achieve a mean score 4.0 or better or 70% consensus level were fed back to the members of the panel for a re-vote. In Delphi Round V, panel members were asked to vote on the best method of scoring, based on their perceptions as administrators for its accuracy in evaluating a quality online program. The Delphi Round VI survey was developed to include those items from the Delphi Round V survey that were selected by 70% of the panel members as possible scoring methods for the quality scorecard but had not yet reached consensus. The Delphi study concluded with a fully developed scorecard for quality online education as perceived by online education administrators.

D. Expert Panel Participation

Seventy-six prospective panel members were identified by the Sloan Consortium as meeting the criteria for this research study and were solicited for participation in the study. Forty-three experts in online education administration participated in the first survey round. Typical for the Delphi process, 59% of the original panel members completed all six rounds of the Delphi survey process. As confirmed by the literature, it is difficult to keep a panel of experts fully engaged for 18 weeks. However, the participation rate of 86.8% - 97.7% for each round is well above the 70% per round rate that was recommended by Hasson, Keeney, and McKenna [34] and Sumsion [42].

E. Description of Delphi Rounds

1. Delphi Round I

The Delphi Round I results revealed that the members of the expert panel believed that 23 of the 24 IHEP quality indicators were still relevant in 2010; however, each indicator received numerous suggestions for revisions for the wording of the text. Mean scores ranged from M = 4.00 to M = 4.97. The IHEP quality indicator #15 that was not believed to be relevant, "*Students are provided with hands-on training and information to aid them in securing material through electronic databases, interlibrary loans, government archives, news services, and other sources*" had a mean of 3.74, a standard deviation of .912, and 66.2% consensus. This did not meet the guidelines for relevance in this study; however, there were 22

additional comments and suggested revisions from the panel for this particular quality indicator, and seven of those specifically addressed the phrase "hands on" as being questionable. Only the suggested revisions were provided in the next survey round since #15 was not determined relevant. The suggested revisions for each quality indicator were fed back to the panel in Delphi Round II for further analysis with an option to keep the original statement without revisions for all but IHEP #15.

In addition to the 24 IHEP quality indicators being evaluated, the members of the expert panel used two open-ended questions in Delphi Round I to provide additional categories of quality indicators and individual quality indicators they believed were not included in the original 24 IHEP list of indicators. Twenty-nine panel members provided additional comments and suggestions for additional quality indicators that were not addressed by the original IHEP 24 standards. The data were examined for content analysis and duplicate elements were removed during the data reduction phase. Of the 29 narrative responses (most responses contained several suggestions), 80 potential quality indicators were derived after all responses were coded and placed into the original IHEP categories until additional categories had been approved by the panel.

Nineteen responses were provided by panel members in response to the request for additional categories of quality indicators although not all responses included suggestions for additional categories. From the 19 responses, 20 additional categories were suggested. Included in these qualitative responses were suggestions to change the Institutional Support category to Institutional and Technology Support and also a suggestion that these should be two individual categories. This decision was fed back in the next survey round.

2. Delphi Round II

A total of 38 expert panel members (95.5% response rate) completed the survey in Round II. Delphi Round II fed back to the panel of experts the results from Delphi Round I in an attempt to gain consensus on all of the IHEP indicator revisions, newly suggested categories, and potential quality indicators.

The first question addressed the *Institutional Support* category question from Delphi Round I: Should the word *Technology* be added to the title, making it *Institutional and Technology Support*, or should the category remain titled *Institutional Support*, or if *Technology Support* should become a standalone category. The majority of responses were split between the following two options: Institutional and Technology Support (40% of the panel agreed) or separating them into two categories, Institutional Support and Technology Support (40% of the panel agreed) with some written feedback regarding the type of technology support was academic or educational.

Each of the additional 20 categories that were suggested by the panel in Delphi Round I was rated in Delphi Round II using the same Likert-scale and a possible additional rating of *Not a Category/Theme but should be a quality indicator*. Only three of the categories received 70% of the panel votes to be returned in Delphi Round III: Social and Student Engagement (Mean = 3.81, 70% panel agreement); Accessibility (Mean = 4.60, 62.5% panel agreement); and Instructional Design (Mean = 4.03, 60% panel agreement).

Consensus was not reached in Delphi Round II on the original 24 IHEP indicators or suggested revisions, presented in questions #3 - #26. In fact, six additional revisions were suggested to the original IHEP indicators through qualitative responses and were added to Delphi Round III survey for five of the 24 IHEP Indicators. Revisions that did not receive 70% of the panel vote were eliminated and not included in Delphi Round III.

Fourteen of the 80 additional quality indicators suggested by the panel in Delphi Round I were approved with a mean of 4.0 or and met the established parameter of having 70% or more of the panel in agreement. Of the remaining quality indicators that were previously suggested by the panel, eight were eliminated due to receiving low response from the panel (less than 70% of the panel members believed they were relevant). The remaining indicators that received 70% of the panel vote were returned for another vote in Delphi Round III.

3. Delphi Round III

Thirty-three expert panel members completed the survey in Round III. In Delphi Round I, the panel suggested that the category of Institutional Support should address those standards with the scope of support provided by the institution and the Technology Support category should become a standalone category. Consensus was achieved by 81.3 for the category to become two distinct categories: Institutional Support and Technology Support.

Three additional categories from Delphi Round II were presented. Two of the three categories received consensus in this round: Social and Student Engagement with M = 4.04 and 70.8% consensus and Instructional Design with M = 4.27 and 86.7% consensus. Because there was no clear distinction between Instructional Design and the already existing Course Development category, the category was renamed to Course Development and Instructional Design. The Accessibility category decreased in Mean from 4.60 in Delphi Round II to 3.86 in Delphi Round III (a quality indicator addressing accessibility in the Student Support category was approved in Delphi Round II).

Fifteen of the original IHEP Indicators were approved with revisions (#1, #2, #6, #9, #10, #12, #13, #14, #15, #16, #17, #20, #21, #23, #24). The expert panel determined that the IHEP indicators #18, *Technical assistance in course development is available to faculty, who are encouraged to use it* and #19, *Faculty members are assisted in the transition from classroom teaching to online instruction and are assessed during the process*, should be combined into one quality indicator—*Technical assistance in course development and assistance with the transition to teaching online is provided*.

Also in Delphi Round III, the panel of experts, with 72.7% consensus, determined that the IHEP indicator #10, *Before starting an online program, students are advised about the program to determine (1) if they possess the self-motivation and commitment to learn at a distance and (2) if they have access to the minimal technology required by the course design*, should be divided into the following two quality indicators: *Before starting an online program, students are advised about the program to determine if they possess the self-motivation and commitment to learn at a distance* and *Before starting an online program, students are advised about the program to determine if they have access to the minimal technology required by the course design*. The panel of experts also determined that the two new indicators should be moved from the Course Structure category to the Student Support category.

Thirteen additional quality indicators suggested by the panel were approved with a mean of 4.0 or and met the established parameter of having 70% or more of panel agreement. Seven suggested quality indicators were eliminated due to receiving low response from the panel. The remaining indicators that received 70% of the panel vote were returned for another vote in Delphi Round IV.

4. Delphi Round IV

Delphi Round IV addressed the remaining IHEP indicators (#3, #4, #5, #7, #8, #11, and #22) that the panel had yet to reach consensus on, the suggested indicators remaining without consensus, and invited the panel to suggest their ideas for potential methods for scoring the quality scorecard. Each of the remaining seven indicators achieved consensus with either a revision to the statement or it was left in its original form.

IHEP #4, *Guidelines regarding minimum standards are used for course development, design, and delivery, while learning outcomes—not the availability of existing technology—determine the technology being used to deliver course content,* reached consensus with 89.7%. However, the revision suggested by the panel was to divide the original indicator into two separate indicators: *Guidelines regarding minimum standards are used for course development, design, and delivery of online instruction* and *Technology is used as a tool to achieve learning outcomes in delivering course content*. The context of the original indicator remained the same in context with there being a need for course development guidelines and that learning outcomes should drive the course development process, not technology.

Of the 31 suggested quality indicators returned to the panel of experts in Delphi Round IV, 17 achieved consensus and were moved to the quality scorecard. Fourteen suggested indicators did not reach consensus and were retired.

Delphi Round IV invited the panel of experts to suggest potential methods for scoring the quality scorecard. Fifteen of the 30 panel members suggested a total of eight possible methods, identified as Methods A, B, C, D, E, F, G, and H (Table 2). The most popular suggestion, Method C, which received votes from five panel members, was to allow ten points for each category of quality indicators, thereby making the scorecard worth a total of 90 points.

5. Delphi Round V

A total of 28 panel members completed the survey in Round V. Consensus was not reached for the scoring method, therefore, an additional Delphi round was needed to select a scoring method. Eight methods for scoring the quality scorecard were suggested by the panel of experts in Delphi Round IV (Methods A, B, C, D, E, F, G, and H). Not one of the scoring methods was agreed upon by 70% of the panel. The results of each scoring method, in order of popularity, are: Method C and F received six votes of from panel members, which equaled 21.4% of the vote, respectively; Method E received five votes from panel members, which was 17.9% of the total vote; and Method A received four votes from panel members, which was 14.3% of the total vote. Methods A, C, E, and F received 75% of the total vote from panel members and were fed back to the panel of experts to gain consensus in Delphi Round VI. The following scoring methods were retired because they did not receive votes from 70% or more of the expert panel members: Methods G and H both received 3 votes, which were 10.3% of the panel vote; Method B received 1 vote, which was 3.6% of the panel vote; and Method D received 0 votes.

Suggested Scoring Method	Frequency of Suggestions in Round IV	Percent of Panel Votes in Round V	Frequency of Votes in Round V
A. One point per quality indicator	4	14.3%	4
B. Five points per quality indicator	1	3.6%	1 (Retired)
C. Each category equals a total of 10 points	5	21.4%	6
D. Each category equals one point for each	1	0%	0 (Retired)
E. Each indicator equals one point but has 3 possible options: Does not meet standard (0 points). Partly meets standard (.5 point). Meets or exceeds standard completely (1 point). Quality programs must achieve 85% of possible points	1	17.9%	5
F. Each indicator has 3 possible points (0 - not observed, 1 - insufficient, 2 - moderate use, 3 - completely meets criteria), then each area must have a certain percentage of the	1	21.4%	6

	points to consider itself worthy of meeting the goals of that area			
G.	Each Indicator has 3 options: Below Acceptable Standards (0 points), Meets Expected Standards (1 point) and Exceeds Standards (2 points)	1	10.7%	3 (Retired)
H.	A simple Likert scale with anchors to improve reliability	1	10.7%	3 (Retired)

Table 2. Results of Suggested Scoring Methods of Delphi Round V

6. Delphi Round VI

A total of 26 panel members completed the survey in Round VI. Consensus was reached on the method of scoring and two of the final six quality indicators were deemed relevant and included in the quality scorecard. Consensus was achieved with Method F, *Each Indicator has 3 possible points (0 - not observed, 1 - insufficient, 2 - moderate use, 3 - completely meets criteria), then each area must have a certain percentage of the points to consider itself worthy of meeting the goals of that area*, receiving 73.1% of the total vote (19 of 26 expert panel members selected this method as the best for scoring a quality scorecard for online education programs). This round ended the data collection process as a quality scorecard for the administration of online education programs was developed with 70 quality indicators and a scoring method of up to a possible three points per indicator, with a total score of 210 points.

VI. RESULTS

The following results are organized by the appropriate research question.

Are the standards identified in the IHEP/NEA study in 2000 still relevant in 2010 for indicating quality in online education programs in higher education?

The expert panel determined that 23 of the 24 indicators were still relevant today in 2010. Only one of the IHEP original standards was not determined relevant; however, the panel agreed upon a revised version of the standard to still be included in the quality scorecard. For each original IHEP standard, panel members provided revisions to improve relevancy. These suggestions were fed back to the expert panel in subsequent rounds to determine whether the original version should still be used as a quality indicator or were the suggested revisions more relevant. This resulted in only one of the 24 IHEP standards not being revised (IHEP #3), and one more that only had one word change (IHEP #8). The remaining 22 standards were slightly-to-moderately revised including two standards being divided into two additional standards. IHEP #4 was only slightly changed with the second indicator focusing technology as a tool for achieving learning outcomes. IHEP #10 was moved from the Course Structure category to the Student Support category but only slightly changed aside from being split into two indicators.

Table 3 displays the indicators that originated from the IHEP (2000) study and the resulting revision the panel determined relevant for today. The most significant revisions were to IHEP #11 and #22. For #11 (*Students are provided with supplemental course information that outlines course objectives, concepts, and ideas, and learning outcomes for each course are summarized in a clearly written, straightforward statement*), the panel of experts specified that all course information including the syllabus should be available to the student at the time of registration. Table 3 also summarizes the differences in each of the revised standard from the original IHEP standards.

Original IHEP Indicator (2000)	Revised Indicator (2010)	Differences Addressed

Institutional Support		
#1. A documented technology plan that includes electronic security measures (i.e., password protection, encryption, back-up systems) is in place and operational to ensure both quality standards and the integrity and validity of information.	1. A documented technology plan that includes electronic security measures (e.g., password protection, encryption, secure online or proctored exams, etc.) is in place and operational to ensure quality standards, adherence to FERPA and the integrity and validity of information.	1. Online exams and adherence to FERPA guidelines
#2. The reliability of the technology delivery system is as failsafe as possible	2. The technology delivery systems are highly reliable and operable with measurable standards being utilized such as system downtime tracking or task benchmarking.	2. Measurable standards are in place for technology performance
#3. A centralized system provides support for building and maintaining the distance education infrastructure.	3. A centralized system provides support for building and maintaining the distance education infrastructure. (Unchanged)	3. Unchanged
Course Development		
#4. Guidelines regarding minimum standards are used for course development, design, and delivery, while learning outcomes—not the availability of existing technology—determine the technology being used to deliver course content.	4a. Guidelines regarding minimum standards are used for course development, design, and delivery of online instruction 4b. Technology is used as a tool to achieve learning outcomes in delivering course content.	4a. Split into two statements 4b. Technology is a tool
#5. Instructional materials are reviewed periodically to ensure they meet program standards.	5. Instructional materials, course syllabus and learning outcomes are reviewed periodically to ensure they meet program standards.	5. Course syllabus and learning outcomes are reviewed
#6. Courses are designed to require students to engage themselves in analysis, synthesis, and evaluation as part of their course and	6. Courses are designed so that students develop the necessary knowledge and skills to meet learning objectives at the course and program level.	6. Focus is on learning outcomes along with student engagement

program requirements.	These may include engagement via analysis, synthesis and evaluation.	
Teaching And Leaning		
#7. Student interaction with faculty and other students is an essential characteristic and is facilitated through a variety of ways, including voice-mail and/or e-mail.	7. Student-to-Student interaction and Faculty-to-Student interaction are essential characteristics and are facilitated through a variety of ways.	7. Student to Student and Faculty to Student interaction was specified
#8. Feedback to student assignments and questions is constructive and provided in a timely manner.	8. Feedback *on* student assignments and questions is constructive and provided in a timely manner. (one word change)	8. Just one word changed "on"
#9. Students are instructed in the proper methods of effective research, including assessment of the validity of resources.	9. Students learn appropriate methods for effective research, including assessment of the validity of resources and the ability to master resources in an online environment.	9. Student learn instead of Students are instructed; resources in an online environment were added
Course Structure		
#10. Before starting an online program, students are advised about the program to determine (1) if they possess the self-motivation and commitment to learn at a distance and (2) if they have access to the minimal technology required by the course design.	10a. (Was in Course Structure) Divided into two: 1) Before starting an online program, students are advised about the program to determine if they possess the self-motivation and commitment to learn at a distance. 10b. Before starting an online program, students are advised about the program to determine if they have access to the minimal technology required by the course design.	10a. Divided into two statements. 10b. Divided into two statements
#11. Students are provided with supplemental course information that outlines course objectives, concepts, and ideas, and learning outcomes for each course are	11. The online course site includes a syllabus outlining course objectives, learning outcomes, evaluation methods, textbook information, and other related course information, making	11. Specifies syllabus available at time of registration which includes all course requirements

summarized in a clearly written, straightforward statement.	course requirements transparent at time of registration.	
#12. Students have access to sufficient library resources that may include a "virtual library" accessible through the World Wide Web.	12. The institution ensures that all distance education students, regardless of where they are located, have access to library/learning resources adequate to support the courses they are taking (SACS statement).	12. Adequate support was specified
#13. Faculty and students agree upon expectations regarding times for student assignment completion and faculty response.	13. Expectations for student assignment completion, grade policy, and faculty response are clearly provided in the course syllabus.	13. The word agree was removed; expectations are provided, not agreed upon
Student Support		
#14. Students receive information about programs, including admission requirements, tuition and fees, books and supplies, technical and proctoring requirements, and student support services.	14. Students receive (or have access to) information about programs, including admission requirements, tuition and fees, books and supplies, technical and proctoring requirements, and student support services prior to admission and course registration.	14. Access to needed information is provided prior to admission and registration
#15. Students are provided with hands-on training and information to aid them in securing material through electronic databases, interlibrary loans, government archives, news services, and other sources.	15. Students are provided with access to training and information they will need to secure required materials through electronic databases, interlibrary loans, government archives, new services and other sources.	15. Hands On was removed; access to training was added
#16. Throughout the duration of the course/program, students have access to technical assistance, including detailed instructions regarding the electronic media used, practice sessions prior to the beginning of the course, and convenient access to	16. Throughout the duration of the course/program, students have access to appropriate technical assistance and technical support staff.	16. Removed instructions for electronic media and practice sessions

technical support staff.		
#17. Questions directed to student service personnel are answered accurately and quickly, with a structured system in place to address student complaint.	17. Student support personnel are available to address student questions, problems, bug reporting, and complaints.	17. Problems and bug reporting was added
Faculty Support		
#18. Technical assistance in course development is available to faculty, who are encouraged to use it.	18/19 Combined: Technical assistance in course development and assistance with the transition to teaching online is provided [for faculty].	18. Combined with #19
#19. Faculty members are assisted in the transition from classroom teaching to online instruction and are assessed during the process.	18/19 Combined: Technical assistance in course development and assistance with the transition to teaching online is provided [for faculty].	19. Combined with #18
#20. Instructor training and assistance, including peer mentoring, continues through the progression of the online course.	20. Instructors are prepared to teach distance education courses and the institution ensures faculty receive training, assistance and support at all times during the development and delivery of courses.	20. Instructors are prepared
#21. Faculty members are provided with written resources to deal with issues arising from student use of electronically-accessed data.	21. Faculty receive training and materials related to Fair Use, plagiarism, and other relevant legal and ethical concepts.	21. Training was added; Fair Use, plagiarism, and legal and ethical were specified
Evaluation and Assessment		
#22. The program's educational effectiveness and teaching/learning process is assessed through an evaluation process that uses several methods and applies specific standards.	22. The program is assessed through an evaluation process that applies specific established standards.	22. Education effectiveness and teaching and learning not specified, program assessment is more general, and it should be against established standards
#23. Data on enrollment, costs,	23. A variety of data (academic	23. Variety of data

and successful/innovative uses of technology are used to evaluate program effectiveness.	and administrative information) are used to regularly and frequently evaluate program effectiveness and to guide changes toward continual improvement.	including academic is frequently used to guide changes
#24. Intended learning outcomes are reviewed regularly to ensure clarity, utility, and appropriateness.	24. Intended learning outcomes at the course and program level are reviewed regularly to ensure clarity, utility, and appropriateness.	24. Program level outcomes were added

Table 3. Final Results of the Original IHEP 24 Indicators

What additional standards should be included that address the current industry in 2010?

After the six Delphi survey rounds, the panel of experts suggested a total of 80 potential quality indicators and determined that 45 of those suggested indicators were relevant for a scorecard for quality assessment of an online education program. Table 4 reports the results for each quality indicator suggested by the panel.

INSTITUTIONAL SUPPORT CATEGORY	Round II Result	Round III Result	Round IV Result	Final Action
1. The institution provides documented processes and procedures that enable distance learning.	M=3.19 65% Retired	--	--	Retired
2. Underlying learning managements systems are flexible enough to support emerging technologies, e.g. social networking tools, mobile devices, Web 2.0, etc.	M=3.65 84%	M=3.35 Retired	--	Retired
3. Institutions must provide guidance to faculty and students on use of unsupported technologies.	M=3.19 65% Retired	--	--	Retired
4. The institution makes bookstore services available to students.	M=3.39 72%	M=3.55	M=3.62 Retired	Retired
5. The institution has defined the strategic value of distance learning to its enterprise and to its relevant parts.	M=3.59 76%	M=3.87	M=4.03 Consensus	Consensus

6. The tech plan also needs to consider and address vended relationships and, especially, support via cloud computing. It needs to ensure end to end operability of all systems that support distance learning. Also, "security measures" are generally handled for all campus enterprise systems through an LDAP server which authenticates users.	M=3.05 62% Retired	--	--	Retired
7. Policy for Copyright ownerships of course materials exists.	M=4.16 95% Consensus	--	--	Consensus
8. The institution has put in place a governance structure to enable effective and comprehensive decision making related to distance learning.	M=4.11 92% Consensus	--	--	Consensus
INSTITUTIONAL SUPPORT CATEGORY cont.	Round II Result	Round III Result	Round IV Result	Final Action
9. Policies are in place to authenticate that students enrolled in online courses, and receiving college credit are indeed those completing the course work	M=4.11 95% Consensus	--	--	Consensus
10. Sustainability and Scalability: A stable support mechanism/financial model to reduce recreating the same course multiple times for example if an instructor leaves the university and there is no agreement governing the intellectual property that would allow the continued use of the course materials.	M=3.66 82%	M=3.29 Retired	--	Retired
11. Students ensured all they need for degree is offered in program before enrolling,	M=3.45 70%	M=3.52	M=3.90 Retired	Retired

TECHNOLOGY SUPPORT	Round II Result	Round III Result	Round IV Result	Final Action
12. Appropriate policies are developed, reviewed, and disseminated to all stakeholders. (moved to Technology Support for Round IV)	M=3.84 84%	M=3.91	M=3.99 Retired	Retired
13. Faculty, staff, and students are supported in the development and use of new technologies and skills. (moved to Technology Support for Round IV)	M=3.74 79%	M=3.75	M=4.15 Consensus	Consensus
14. Institution maintains system for backup for data availability. (moved to Technology Support)	M=4.03 90% Consensus	--	--	Consensus
15. The course delivery technology is considered a mission critical enterprise system and supported as such. (moved to Technology Support for Round IV)	M=3.89 84%	M=4.35 Consensus	--	Consensus
COURSE DEVELOPMENT/ INSTRUCTIONAL DESIGN	**Round II Result**	**Round III Result**	**Round IV Result**	**Final Action**
16. There is consistency in course development for student retention and quality	M=4.11 95% Consensus	--	--	Consensus
17. Instructional design is provided for creation of effective pedagogy for synchronous sessions.	M=3.55 79%	Retired Duplicate	--	Retired
18. Curriculum development is a core responsibility for faculty.	M=3.32 74%	M=3.45	M=4.03 Consensus	Consensus
19. Learning objectives describe outcomes that are measurable.	M=3.82 79%	M=4.32 Consensus	--	Consensus
20. Development of online course materials takes into account the changing context of media delivery	M=3.55 84%	M=3.75	M=3.93 Retired	Retired

21. Selected assessments measure the course learning objectives and are appropriate for an online learning environment	M=3.92 84%	M=4.32 Consensus	--	Consensus
22. Course objectives provide opportunity for student interaction.	M=3.84 78%	M=3.77 Retired	--	Retired
23. Course design promotes both faculty and student engagement.	M=4.16 86% Consensus	--	--	Consensus
24. Student-centered instruction is considered during the course-development process.	M=4.03 92% Consensus	--	--	Consensus
25. Instructional design is provided for creation of effective pedagogy for both synchronous and asynchronous class sessions.	M=3.84 84%	M=3.84	M=4.24 Consensus	Consensus
26. Current and emerging technologies are evaluated and recommended for online teaching and learning.	M=3.87 92%	M=3.91	M=4.10 Consensus	Consensus
TEACHING AND LEARNING	Round II Result	Round III Result	Round IV Result	Final Action
27. Students are provided access to library professionals and resources that help them to deal with the overwhelming amount of online resources.	M=3.39 79%	M=3.58	M=4.00 Consensus	Consensus
28. Course material presented in a variety of ways	M=3.42 82%	M=3.52	M=3.82	Retired
29. Interactive elements such as video and flash graphics to help engage the students' understanding of key learning objectives	M=3.30 76%	M=3.42	M=3.46	Retired

30. Students are provided access to library professionals and resources that help them to deal with the overwhelming amount of online resources.	M=3.11 69%	Duplicate Retired	--	Retired
31. Online courses/programs use one course management platform, creating a single delivery model, and students receive an online instructional orientation to the course management platform.	M=3.66 79%	M=3.81	M=3.86	Retired
COURSE STRUCTURE	Round II Result	Round III Result	Round IV Result	Final Action
32. Instructors use specific strategies to create a presence in the course.	---	Presented Round VI	M=4.12 Consensus Round VI	Consensus
33. Opportunities/tools provided to encourage student-student collaboration (i.e, web conferencing, instant messaging, etc).	M=3.50 76%	M=3.81	M=4.14 Consensus	Consensus
34. Honor code used to enable a culture of accountability	M=3.39 76%	M=3.19 Retired	--	Retired
35. Links or explanations of technical support are available in the course.	M=3.95 87%	M=4.29 Consensus	--	Consensus
36. Instructional materials are easily accessible and usable for the student.	M=4.26 89% Consensus	--	--	Consensus
37. The course adequately addresses the special needs of disabled students via alternative instructional strategies and/or referral to special institutional resources.	M=4.29 95% Consensus	--	--	Consensus
38. Optional synchronous sessions with faculty are offered and archived to be available asynchronously as well, to allow students access to faculty	M=3.11 68%	Retired	--	Retired

39. Documents attached to modules are in a format that is easily accessed with multiple operating systems and productivity software (PDF, for example).	--	Presented Round VI	M=4.32 Consensus Round VI	Consensus
40. Each course includes an orientation module.	--	Presented Round VI	M=3.64 Retired Round VI	Retired
41. Students have at least some choice in their activities/assignments.	--	Presented Round VI	M=2.92 Retired Round VI	Retired
42. Course modules are designed for visual appeal as well as clarity and consistency (use of white space, color, well-chosen fonts, no gimmicky graphics/animations that have no real purpose.	--	Presented Round VI	M=3.60 Retired Round VI	Retired
43. Institution branding is evident in every part of each course.	--	Presented Round VI	M=3.08 Retired Round VI	Retired
STUDENT SUPPORT	Round II Result	Round III Result	Round IV Result	Final Action
44. Students are provided relevant information: ISBN numbers, suppliers, etc. and delivery modes for all required instructional materials: digital format, e-packs, print format, etc. to ensure easy access.	M=3.50 76%	M=3.94	M=4.14 Consensus	Consensus
45. While technologies may not be supported centrally (like available in the cloud or openly), there needs to guidance on how these tools will be supported and the ramifications to students.	M=3.05 71%	M=3.35	M=3.31 Retired	Retired

46. Student support services are provided for outside the classroom such as academic advising, financial assistance, peer support, etc.	M=4.05 89% Consensus	--	--	Consensus
47. Program demonstrates a student-centered focus rather than trying to fit service to the distance education student in on-campus student services.	M=3.79 79%	M=3.81	M=4.07 Consensus	Consensus
48. Automated support tools are available for faculty to provide early intervention to support student success.	M=3.51 81%	M=3.55	M=3.69	Retired
49. Efforts are made to engage students with the program & institution	M=3.58 79%	M=3.84	M=4.07 Consensus	Consensus
50. Students are instructed in the appropriate ways of communicating with faculty and students	M=3.68 82%	M=3.87	M=4.21 Consensus	Consensus
51. Students are instructed in the appropriate ways of enlisting help from the program.	M=3.50 74%	M=3.71	M=4.33 Consensus	Consensus
52. Support services designed to build communication and affiliation among the online student population	--	--	M=3.63 Retired	Retired
53. Students agree and understand the expectations of the program and courses	M=3.66 79%	M=3.90	M=3.97 Retired	Retired
54. Students should be provided a way to interact with other students in an online community	M=3.42 74% Duplicate Retired	--	--	Retired
55. The institution provides guidance to both students and faculty in the use of all forms of technologies used for course delivery	M=3.44 71%	M=3.77	M=4.21 Consensus	Consensus

56. Students have access to effective academic, personal, and career counseling	M=3.82 87%	M=4.19 Consensus	--	Consensus
57. Tutoring is available as a learning resource.	M=3.89 92%	M=3.94	M=4.07 Consensus	Consensus
58. Minimum technology standards are established and made available to students.	M=3.97 82%	M=4.13 Consensus	--	Consensus
59. Policy and process is in place to support ADA requirements.	M=4.16 87% Consensus	--	--	Consensus
SOCIAL AND STUDENT ENGAGEMENT	Round II Result	Round III Result	Round IV Result	Final Action
60. Students should be provided a way to interact with other students in an online community.	M=3.61 79%	M=3.94	M=4.07 Consensus	Consensus
FACULTY SUPPORT	Round II Result	Round III Result	Round IV Result	Final Action
61. New learning skills for online teaching and learning are identified.	M=3.30 76%	M=3.50	M=3.62 Retired	Retired
62. Review of web.2.0 tools and emerging technologies and faculty.	M=3.14 73%	M=3.35	M=3.31 Retired	Retired
63. Workshops are provided for keeping faculty updated in selection and use of tools.	M=3.57 81% Duplicate Retired	--	--	Retired
64. Faculty are provided ongoing professional development related to online teaching and learning.	M=4.16 87% Consensus	--	--	Consensus
65. Faculty workshops are provided to make them aware of emerging technologies and the selection and use of these tools.	M=3.50 76%	M=3.77	M=4.03 Consensus	Consensus
66. Clear standards are established for faculty engagement and expectations around online teaching	M=4.05 84% Consensus	--	--	Consensus

EVALUATION AND ASSESSMENT	Round II Result	Round III Result	Round IV Result	Final Action
67. Online learning should be robustly evaluated using tools widely available, so that faculty and students know what students perceive about the efficacy of online learning and so the institution knows how they compare and how they can improve.	M=3.42 71%	M=3.55	M=3.71 Retired	Retired
68. A process is in place for the assessment of faculty and student support services.	M=3.97 87%	M=4.26 Consensus	--	Consensus
69. Course and program retention is assessed. Results of course evaluations are used as part of faculty/instructor performance evaluations.	M=3.84 84%	M=4.19 Consensus	--	Consensus
70. Recruitment and retention are examined and reviewed	M=3.55 76%	M=4.06 Consensus	--	Consensus
71. Evaluation should include evaluation by potential employers.	M=2.76 55% Retired	--	--	Retired
72. Course evaluations collect student feedback on quality of content and effectiveness of instruction.	M=4.03 89% Consensus	--	--	Consensus
73. The relationship between online education programs and institutional mission must be included as a measure.	M=3.32 71%	M=3.48	M=3.41 Retired	Retired
74. Program demonstrates compliance and review of accessibility standards (Section 508, etc.).	M=3.82 84%	M=4.29 Consensus	--	Consensus
75. Student evaluations of course/instructor/program are made available.	M=3.43 70%	M=3.86	M=3.86 Retired	Retired
76. Course evaluations are examined in relation to faculty performance evaluations.	M=3.68 82%	M=4.00 Consensus	--	Consensus
77. Aggregation of data to ensure each class is being taught well.	M=3.21 66% Retired	--	--	Retired

78. Faculty performance is regularly assessed.	M=3.84 79%	M=4.39 Consensus	--	Consensus
79. Alignment of learning outcomes from course to course exists.	M=3.63 79%	M=4.26 Consensus	--	Consensus
80. Online learning should be robustly evaluated using tools widely available, so that faculty and students know what students perceive about the efficacy of online learning and so the institution knows how they compare and how they can improve. The credentials of the distance education support staff and administration, in terms of years of professional experience and education level as well as type of degree earned (educational technology or general education verses non-education).	M=2.84 57% Retired	--	--	Retired

Table 4. Suggested Quality Indicators

If additional standards are suggested, will they fall into the already identified themes or will new themes emerge?

The majority of the additional standards suggested by the experts did indeed fall naturally into the existing seven IHEP Categories: Institutional Support, Teaching and Learning, Student Support, Faculty Support, Course Structure, Course Development, and Evaluation and Assessment. It is important to point out that in the original IHEP list of quality indicators, the Institutional Support category primarily addressed technology support standards and not necessarily those related to institutional support such as mission and strategic planning; therefore, the panel of experts determined two categories were necessary: Technology Support and Institutional Support. The existing IHEP indicators in the Institutional Support category were moved to the Technology Support since their focus was technology support provided by the institution.

Aside from dividing the *Institutional Support* and *Technology Support* categories, the panel of experts suggested an additional 20 categories but only 2 of those suggestions achieved consensus: *Instructional Design* and *Social and Student Engagement*. The researcher combined Instructional Design with the Course Development category, now called Course Development and Instructional Design, because there lacked clear distinction for identifying quality indicators for either category. After all panel voting had concluded, the Technology Support and Social and Student Engagement category were the only two new categories added to the Scorecard; however, it is interesting to note there was only one quality indicator in Social and Student Engagement category that achieved panel consensus.

At the conclusion of the study, nine categories of quality indicators existed: Institutional Support, Technology Support, Faculty Support, Course Structure, Course Development and Instructional Design, Teaching and Learning, Student Support, Social and Student Engagement, and Evaluation and Assessment.

What values will be assigned to the recommended standards that will ultimately yield a numeric scorecard for measuring quality online education programs from an online education administrator's perspective that could also support strategic planning and program improvements?

Eight potential scoring methods were suggested in Delphi Round IV. After voting in Delphi Round V concluded, four of the methods were removed for lack of consensus. Only those selected by 70% of the

panel were reviewed again by the panel of experts. The panel of experts determined that each quality indicator should be worth a potential three points for a total of 210 points. Each quality indicator will be scored in the following manner: 0 points - not observed, 1 point - insufficient, 2 points - moderate use, 3 points - completely meets criteria. The panel had also suggested that a parameter or a minimum score be established for each category of the scorecard (a certain percentage of the points) to establish a goal; however, the panel did not make a suggestion as to what the minimum score for each category should be.

VII. IMPLEMENTATION AND NEXT STEPS

The quality scorecard is versatile enough to be used to demonstrate the overall quality of online education programs, no matter what size or type of institution. The following steps for use and implementation are suggested that will yield a measurable result:

1. The online education administrator examines the online program for evidence of each of the 70 quality indicators. Based upon the level of evidence observed, the administrator chooses one of the following values: 0 points - not observed, 1 point - insufficient, st2 points - moderate use, 3 points - completely meets criteria.
2. For each indicator, the online education administrator should provide examples of the observed evidence. For example, the first indicator listed in the Institutional Support category is: *The institution has put in place a governance structure to enable effective and comprehensive decision making related to distance learning.* To substantiate the score for this indicator, evidence should be documents such as digital copies of organizational charts, reporting structures, and advisory committee minutes demonstrating how a decision is processed.
3. The online education administrator totals the score for each indicator and then determines the level of quality observed:

   A perfect score = 210 points.
   90-99% = 189-209 - Exemplary (little improvement is needed)
   80-89% = 168-188 - Acceptable (some improvement is recommended)
   70-79% = 147-167 - Marginal (significant improvement is needed in multiple areas)
   60-69% = 126-146 - Inadequate (many areas of improvement are needed throughout the program)
   59% and below = 125 points and below - Unacceptable

The quality scorecard tool resulting from this research study is available on the Sloan Consortium (Sloan-C) website at http://sloanconsortium.org/quality_scoreboard_online_program. It is the intent of the author and Sloan-C to make the scorecard interactive so that administrators of online education programs may use the scorecard tool to demonstrate program evaluation. An ancillary handbook for use and implementation of the quality scorecard is being developed to better guide the administrator in its use. Each of the seventy quality indicators will be defined with more depth and examples and best practices will be provided to better demonstrate the level of quality that may be reached with each indicator. A community of practice website has been developed by Sloan-C that provides a forum for notes and queries to be shared regarding the scorecard and process for program evaluation.

VIII. CONCLUSION

The purpose for this study was the development of a scorecard to measure and quantify elements of quality within online education programs in higher education. Quality is a perception that varies within industries, including that of higher education whose traditional indicators for quality are changing. In fact, Pond observed,

> It is quite clear that education in the 21st century presents challenges to quality assurance that were unimaginable just a quarter century ago. E-learning in particular, with its ability to render time and place irrelevant, requires that we abandon traditional indicators of

> "quality" such as "contact hours," "library holdings," and "physical attendance" among others in favor of more meaningful measures. [43]

As we abandon the traditional indicators we have used for so long, higher education needs a method to identify and assess quality within online education programs that could provide a method of benchmarking and a path to improvement. This study provides just such a process by creating a scorecard for the administration of quality online education programs. The study also extends further validity to the original 24 IHEP indicators [13], in spite of it being a decade later. The original IHEP research study identified a strong base of quality indicators that, for the most part, have withstood the test of many changes throughout the field of online education. The original indicators are all included in the quality scorecard, although, all but two were revised without the primary focus being changed.

While there are rubrics being used to assess quality in online course materials, until now, there was not an industry agreed upon instrument being used to evaluate online education programs. Many institutions prolifically advertise they offer quality online education but have not had a way to quantify or benchmark their programs. How do students know they are enrolling in a quality program? The scorecard developed as a result of this research study provides an instrument that could identify strengths and weaknesses of an online education program and be used as a benchmarking tool for evaluation against other like programs in the industry.

The identification of quality online education programs satisfies a great need in our field and has been requested by many online education administrators as a tool for program improvement. The assessment of quality online education has never been more important as fierce competition from for-profit programs as well as many non-profits programs continues to increase and students all over the world are clicking to find a respectable degree program. Quality online education really does matter as the ultimate impact is to our students.

IX. ABOUT THE AUTHOR

Kaye Shelton is the Dean of Online Education at Dallas Baptist University whose program now facilitates the delivery of 54 programs and majors fully online. Teaching online since 1999, Mrs. Shelton holds a certification in Online Teaching and Learning instruction. Her education includes an M.S. in Education emphasizing Online Teaching and Learning from California State University East Bay and a Ph.D. in Educational Leadership (Higher Education) from the University of Nebraska-Lincoln. She has published and presented on the best practices for teaching online, quality online course development, and the development of online education programs including a book entitled *An Administrator's Guide to Online Education*. She has also served as an advisor and consultant regarding online education programs for several peer institutions.

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MENTORING FOR INNOVATION: KEY FACTORS AFFECTING PARTICIPANT SATISFACTION IN THE PROCESS OF COLLABORATIVE KNOWLEDGE CONSTRUCTION IN TEACHER TRAINING

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ABSTRACT

This paper presents data about the successful use of the Mentored Innovation Model for professional development for a group of Hungarian teachers (n=23, n=20 in two iterations), which was employed in the CALIBRATE project in order to enhance their ICT skills and pedagogical competences needed for participation in a multicultural, multilingual educational innovation process. This model relied on the three basic constituents of an online community of inquiry: cognitive, social and teaching presence. Satisfaction regarding the model was explored through the observation of perceived (subjective) values provided by the participating respondents in order to identify the role of the virtual learning environments employed, activities of the facilitator and the participants' self-perceived social presence in the success of the training process. Mentoring was identified as a key factor of success in the in-service training process.

KEYWORDS

In-service teacher training, Online mentoring, Collaborative knowledge construction, Participant satisfaction, Perceived learning

I. INTRODUCTION

CALIBRATE (http://calibrate.eun.org, 2005-2008) was a European project supported by the Information Society Technologies (IST) Programme in which eight Ministries of Education, linked their national digital learning content repositories, investigated new intelligent search functions like curriculum mapping of resources and established a new multicultural and multilingual open source web community for finding, authoring and sharing learning resources. The process of developing the European Learning Resource Exchange (LRE) is currently continuing in the MELT project [1].

In Hungary, the *Mentored Innovation Model* (MIM) was employed to work together with teachers in piloting the first federated European digital learning resource repository, the LRE. In this paper, we analyse results regarding the efficacy of the MIM employed in two virtual learning environments in preparing teachers for performing the sophisticated innovation activities of piloting the LRE. Identification, retrieval, adaptation for classroom use and pilot teaching with international digital content and the evaluation of this process in collaborating groups required highly reflective behaviour related to the teachers' traditional pedagogical practices. Work with the LRE included providing constructive feedback and intensive engagement in the long-term co-development of learning resources. The collaborative processes were facilitated and moderated by e-moderators [2] – in the first phase one in each of the domain-specific groups, in the second phase one e-moderator in the larger group of in-service teachers. They provided professional mentoring i.e. scaffolding the knowledge creation of teachers by peers, e-moderators or facilitators in an e-learning environment to

support innovative practices. The e-moderators were also of Hungarian nationality and had been previously trained for the facilitation of online processes in the MIM in a uniform manner. They were experienced in online teaching and learning processes and delivering teacher professional trainings. The preparatory session for the facilitators aimed at harmonizing their teaching philosophies with those of the training participants and the aim of the mentoring scenarios. The MIM relied on the three basic constituents of the online community of inquiry: cognitive, social and teaching presence [3].

II. MENTORED INNOVATION MODEL: FACILITATING COMMUNICATION AND SCAFFOLDING LEARNING

The MIM is based on trialogical learning theory, which is elaborated during another European research project, *Knowledge Practice Laboratories, KP-Lab* [4]. Trialogicality refers to the processes involved when "shared objects of activity are collaboratively formulated and developed by using mediating tools, signs, and (conceptual and material) artefacts" [5]. In the current context, technology provides for *flexible tool mediation* so as to facilitate knowledge-creation processes. However, beyond collaborative activities, the trialogical learning theory also emphasizes the importance of the activity of individuals as part of the collective. Thus, interaction between personal and social levels, the elicitation of individual and collective agencies, and the development through transformation between various forms of knowledge and practices are the activities characteristic of this learning framework [6].

While the traditional (dialogical) model for innovation elevates researchers and training staff to the role of knowledge providers who organize learning experiences for teachers, who are supposed to acquire and (slightly) adapt an elaborated set of educational methods and content, MIM is based on the collaboration of peers working on a boundary object: an innovative educational program. While the dialogical collaboration model is linear, MIM has a spiral structure where cycles of exploration, learning and creation of new knowledge are iterated on higher levels. In the framework of a design-based research experiment, MIM is integrated with school practice, teachers, educational researchers and trainers are equal partners who may alter shared knowledge objects profoundly if educational practice requires different approaches.

MIM is aimed at changing the professional self-concept, educational strategies and teaching methodology of teachers. It is a professional development experience as well as a competence enhancement process, which combines innovation with training in the following steps:

a. Problems are identified and elaborated separately by teams of teachers and researchers.
b. A common research and development agenda is negotiated, with the involvement of local community stakeholders (policy makers, parents etc.,).
c. Supporting structures to solve complex pedagogical problems are provided by researchers and training experts (mentoring).
d. Shared objects of activity are identified and developed (mentored innovation).
e. Cognitive tools are employed to promote scaffolding through structuring inquirers' activities in a way that facilitates complex problem solving.
f. Design-based research in the form of school experiments is performed in several iterations to test problem-solving strategies, refine shared pedagogical objects (teaching programs and aids, evaluation instruments, social involvement campaign strategies etc.).
g. Local and national level dissemination of results is organized through a wide variety of channels (ranging from community campaigns to educational conferences).
h. Teachers redefine professional self. Both teachers and participating educational researchers (who collaborate with teachers) act as innovators and mentors for new adaptors of teaching programs.

MIM is rooted in theories of social learning - more precisely it is strongly related to Vygotsky's [7]

ideas on *social mediation* and Engeström's [8] principles on *activity theory* .

The concept of social mediation encompasses both social mediation of individual learning and participatory knowledge construction [9]. Active *social mediation of individual learning* refers to the most fundamental social mode of learning in which an individual is helped by another one or a group of individuals. Scenarios such as a teacher teaching reading and writing; parents correcting children's misuse of words; a master guiding his apprentices; children working together on solving a task in Maths all underpin the general idea that in order to create a better system for learning a facilitating social agent is brought in who helps to meet the conditions [9]. *Social mediation as participatory knowledge construction* entails less the socially mediated knowledge acquisition but it rather means that cognition and learning products (jointly created) are distributed over the individuals and their social context (and not being preserved by the individuals) [9]. Thus, learning is seen as a participation in a social process of knowledge construction, and is located in the relations and activities of the participation.

When addressing the issue of mediation Kozulin and Presseisen suggest focusing on the role of the other individual as a mediator of meaning since as they argue "the meaning of one's own activity is formed by mediation through another individual" [10]. In this context Salomon and Perkins refer to various features that characterize social mediation, including intensive interaction, rapid feedback, highly personalized and situationally contingent guidance, encouragement, and the elicitation of responses from the student in the form of explanations, suggestions, reflections etc., [9], which in the MIM are undertaken by the facilitators.

The spiral structure of the MIM (especially the first five steps) incorporates the cycles Engeström [8] refers to in the process of expansive learning. Expansive learning ideal-typically evolves through the following stages: (1) the conflictual questioning of the existing practice; (2) the analysis of culminated contradictions; (3) modelling the new solution; (4) formation of the new model i.e. new pattern of activity; (5) the implementation of the new model in practical action; (6) reflection and evaluation of the process; and (7) consolidation of the new practice [11].

Paavola and Hakkarianen claim that this model provides "a basis for his [Engeström's] well-articulated interventional tools that allow an individual or a community to reflect on its practices and deliberately bring about changes so as to overcome tensions and disturbances of the prevailing activity system" [5]. Accordingly, the MIM that is rooted in theories of social learning including the concept of social mediation and elements of Engeström's [8] model, has been employed in educational settings in order to facilitate the change of in-service teachers' professional self-concept, educational strategies and teaching methodology. Crucial to this process are the e-moderators i.e. facilitators who provided *professional mentoring* i.e. scaffolding the knowledge creation of teachers in an e-learning environment to support innovative practices. Professional mentoring is undertaken in the form of knowledge-building discourse "whose aim is progress in the state of knowledge: idea improvement" [12]. Knowledge-building discourse can (1) focus on problems and depth of understanding; (2) be decentralized, open knowledge environments for collective understanding; and (3) productive interaction within broadly conceived knowledge-building communities [13]. Thus, in the process of knowledge building focus is on problems (rather than on categories of knowledge), "engagement is at the level of how things work, underlying causes and principles, and interrelatedness of ideas explored over lengthy periods" [13]. Further it is to be understood as a decentralized, open knowledge building with a view on collective knowledge. This process involves complex interactions that aim at engaging the participants, distributing work within the group, sustaining inquiry, and monitoring advances.

Knowledge-building interactions and mentoring carried out by the facilitators in the MIM relied on the online community of inquiry [3]. The community of inquiry (CoI) is based on the many combinations of interaction among agents of the online learning but it is more than a magnitude of interaction among participants: it is a model that maps and defines educational presence [14]. Educational presence is composed of social, teaching and cognitive presence, thus the CoI considers these three presences, and integrates social, teaching and cognitive elements that exceed social exchanges and low-level cognitive interaction [15].

Social presence or the "illusion of nonmediation" [16] is defined as the ability of learners to project

themselves socially and emotionally [17], which means the extent to which a person is perceived as a "real person" in mediated communication [18, 19]. It supports both cognitive and affective objectives. The former ones by instigating, sustaining, and supporting critical thinking, the latter ones by making group interactions engaging and intrinsically rewarding [20]. Two concepts are associated with the concept of presence: (1) intimacy and (2) immediacy [18]. Social presence, seen from this perspective refers to the degree to which a communication medium contributes to intimacy, while immediacy entails the distance between the communicator and the object of his/her communication [19]. Thus, similarly to Short et al.'s [19], in our view as well, social presence characterizes the medium, the communicators, and their presence in the interactions. Teaching presence refers to the role of the online instructor "to design and integrate the cognitive and social elements of a community of inquiry for educational purposes" [3]. Interactions (both social and content-related) need to have clearly set parameters and focus, which is done by the instructor. Accordingly, teaching presence is "the design, facilitation, and direction of cognitive and social processes for the purpose of realizing personally meaningful and educationally worthwhile learning outcomes" [15]. Therefore, teaching presence, according to Anderson et al., begins before the course commences since the teacher plans and prepares the course, and it is maintained throughout the course as the teacher facilitates the interactions and collaborations [21]. The third pillar of the CoI framework, cognitive presence is defined as the extent to which learners are able to construct and confirm meaning through reflection and discourse [22, 23, 24]. It was operationalized as a practical inquiry model consisting of four phases: (1) triggering event (issue or dilemma emerges and is identified), (2) exploration (treatment of the issue through reflective discourse by using techniques such as brainstorming, questioning, and so on), (3) integration (meaning is constructed), and (4) resolution (application of new knowledge to educational contexts).

III. METHODOLOGY

A. Sample – Teachers participating in the first and the second phase of the CALIBRATE project

In the first phase of the implementation and evaluation of international learning resources, (March-May 2007), 23 Hungarian in-service teachers worked in collaboration with their colleagues, pupils, facilitators and educational researchers. The second phase took place between October 2007 and January 2008, during which 20 in-service teachers collaborated. The two cohorts were not identical. The community of in-service teachers searched and evaluated this repository and identified *learning objects* (LO-s, simple elements to be used flexibly in different cultural contexts) and *learning assets* (complex learning materials that are curriculum-related and may contain cultural characteristics to be adapted or accepted) useful for teaching practice. Instead of only evaluating digital tools and learning materials – the usual assessment method for ICT-based educational innovations – teachers were asked to form discipline-based educational innovation communities and associate educational methods best suited to the resources they found in the LRE in the form of lesson plans (uploaded through a template) or freely described user stories.

	Male	*Female*	*Primary school*	*Secondary school*	*Not from the capital*	*From the capital*	*Mathematics Informatics*	*Science*	*Foreign languages*	*Humanities*	*TOTAL*
March –May 2007	3	20	9	14	16	7	5	7	7	4	23
October 2007 – January 2008	4	16	5	15	9	11	10	5	2	3	20

Table 1 Basic information on the Hungarian participants

Evaluation was carried out in seven countries, including Hungary. Basic issues of European educational policy making were addressed: is it realistic to expect teachers to make regular and effective use of an international set of learning resources and assets in foreign languages, developed

for use in a different educational system? Are they able to retrieve, adapt and – after a brief observation or an in-depth test in the classroom – evaluate learning materials developed by their peers in other countries? Three approaches were used to answer these questions:

A. Participant observation and testing: a core group of pioneer ICT teachers followed the work of software developers, tested beta versions and offered practice-related feedback.
B. School based case studies that focused on problems of LRE and LeMill introduction and use in the pilot validation phase.
C. In vivo experiments with novice users during National Evaluation Days in seven countries that included training teachers to act like reflective practitioners – researchers of their own practice.

Successful use however, required preparation of piloting teachers for work in collaborative knowledge building communities. Pilot teachers were mostly high-level ICT users, the pre-tests of ICT performance and educational strategies revealed that they belonged to the category of innovators and early adopters [20, 25]. However, Hungarian teachers had modest experience of using federated search in linked digital content repositories. Significant differences in foreign language skills and motivation to take part in a collaborative educational innovation enterprise were also revealed.

B. Virtual learning environments used

In the first phase, activities were hosted in the virtual learning environment (VLE) Future Learning Environment (FLE3), which is an asynchronous groupware system designed for supporting collaborative knowledge building and progressive inquiry in educational settings. It is the third version of a web based, open source software developed by the Learning Environments for Progressive Enquiry Research Group of the University of Industrial Arts Helsinki (http://fle3.uiah.fi). In the second phase, the community platform and social software LeMill, newly developed for the support of the federated repository, was used for sharing knowledge and pedagogical practices, adapted or self-developed contents (www.lemill.net). It may be used for finding, authoring and sharing learning resources, but may also be utilized as a site for international professional co-operation among members of an international community of teachers. Both VLEs played a crucial role, both in the collaborative processes and the mentoring events, since they served as an appropriate platform of learning and sharing ideas, materials and practices within the community that consisted of in-service teachers located in different parts of the country. Thus, communication and exchange of information was carried out exclusively on these platforms. However, besides establishing flexible tool mediation in regard to collaborative work, the VLEs also proved an effective tool for providing help in the research and data analysis processes.

C. Research context, research questions, survey instrument and procedure

The integration of teachers' online learning groups and professional communities into teacher training and teachers' professional training plans has been widely accepted [26, 27, 28]. In Hungary, enhancing teachers' personal knowledge and giving space to their professional growth are crucial in transforming the educational system into a more adaptive learning system. Involving teachers in educational research projects as active collaborating members could be one step towards the research-based teacher training and teachers' professional training [29]. In the current study, the instructional context for the research-based training of in-service teachers' communities was the MIM in the framework of the CALIBRATE project.

According to our hypothesis mentoring is a key factor of success in the in-service training process, and that mentoring failure (lack of scaffolding and effective online communication within the community etc.) can lead to lack of collaboration and a high number of drop-outs in virtual courses. With the presented survey instrument and series of analyses our aim was to investigate the participating in-service teachers' satisfaction with the model, to identify the role of the VLE and the facilitator in the success of the mentoring process and the participants' self-perceived development. Based on the above foci we formulated the following research questions:

1. What are the elements that influence participant satisfaction and self-perceived learning success in the online mentoring process in the CSCL environment?

2. How are these elements interrelated?
3. What is the position of the facilitator among the elements of the MIM?

The survey instrument used for assessing participants' perceptions of the MIM, and developing a model of participant satisfaction consisted of 25 Likert-type items [30]. The items used a 4-point response scale (strongly disagree, disagree, agree and strongly agree), and respondents were asked to consider their ratings in the context of the online mentoring model. Accordingly, satisfaction regarding the MIM was explored by relying on the perceived (subjective) values provided by the participating respondents.

Previous to the questionnaire development process, a survey of the literature on the evaluation of online mentoring models and participant satisfaction was carried out [15, 31, 32, 33, 34, 35, 36]. Those items were adapted that were considered to be relevant in the presented pedagogical scenario as regards the experiential information about the respondents in obtaining their rankings of their satisfaction with the mentoring events.

Four criteria of the MIM were in the centre of the investigation: (1) participants' global satisfaction, (2) the facilitator's activity, (3) the online communication in the VLEs (LeMill and Fle3), and (4) the participants' perceived social presence. We obtained four separate variable groups on the basis of the above areas. Each variable group contains one dependent and various independent variables.

Not all the independent variables had significant impact on the dependent variables thus exclusively the ones with significant impact are reported. This in the case of the first iteration means 3 variables concerning "global satisfaction", 2 variables for the "facilitator's role" and another 2 in the case of "social presence". As for the dependent variable "satisfaction with the online communication in the VLEs" 3 independent variables were reported. In the second iteration the number of those having significant impact grew to 3. In the case of the other three dependent variables the same independent variables proved to have significant effect. (The dependent and independent variables within each variable group in both iterations are presented in Table 2, Table 3, Table 4 and Table 5)

Instead of employing statistical means and relying on normal distributions for further analyses, multi-regression data analysis was used so as to depict the *perceived importance* of the four dependent variables and the independent variables that have an assumed impact on participant satisfaction. In the first phase of the regression analyses, we focused on investigating the extent to which the independent variables affect significantly the dependent variable.

The following procedure was carried out in the case of all the four criteria of the model. The 4-scale ratings were converted to a 0-100 scale in order to yield single scores for each variable (dependent and independent). Regression analyses were computed and significant items were indicated – with the respective importance values. *Importance value* is used to calculate satisfaction indices that measure the quality of the mentoring process by incorporating the participants' judgement in a weighted form. Variables of the MIM with significant impact affect satisfaction proportionate to their importance. On the basis of the importance values, global indexes were calculated referring to the four criteria. In the second phase of regression analyses when an *explanatory model* was created we employed these indexes. Since it was intended to create an explanatory model in which all the four dependent variables (that are the criteria for evaluating the MIM) are present, R^2 values were calculated for each of the four criteria.

Explanatory models are outputs of categorical regression by optimal scaling (CATREG) provided by the statistical software SPSS. Important to the series of multi-regression analyses and model building are the following values. *Adjusted* R^2, or *total variance* refers to the explanatory power of the model. It is a value ranging between 0 and 1, it is proportionate to the part of variance of the dependent variable that is explained by the independent variables. It is claimed that the higher the R^2, the "stronger" the explanatory power of the model. *Beta-coefficient (β)* refers to the extent any of the independent variables impacts the dependent variable. A higher β corresponds to a higher impact. *Importance* is the most easily interpretable coefficient of the independent variables that equals the part of R^2 explained by an independent variable. *Contribution* or *overall importance* relates to the effective importance (impact) of any independent variable on the dependent variable. It is calculated by multiplying the R^2 by the importance value.

IV. ANALYSES

A. In-service teachers' global satisfaction

In the first phase (March – May 2007) we found four variables to have a significant impact on the in-service teachers' global satisfaction (with the mentoring process in general and the online collaborative work in the VLE) (Table 1): 'benefits' (affective rather than cognitive nature) ($p = .000$); the 'experience gained by participating the mentored innovation model – the usefulness of the experience' ($p = .000$) and the 'quality of learning' ($p = .000$). The two variables (describing the affective dimension) focusing on the experience and benefits gained in the collaboration and the mentoring events were considered to be almost equally important (values 69 and 70).

We found similar results concerning the in-service teachers' global satisfaction with the added participants' data of the second phase (October 2007 – January 2008) (Table 2). This time again the same three variables showed significant impact on the participants' global satisfaction however, the importance values changed slightly. The 'benefits' gained ($p = .000$) influenced the most global satisfaction, i.e., the importance value of this variable was also the highest. The 'usefulness of the experience' ($p = .000$) and the quality of learning ($p = .000$) impacted global satisfaction as a criterion of the mentored innovation to a different extent however, their satisfaction indexes were the same (74-74).

Among the satisfaction indexes related to the three variables, the one referring to 'the quality of learning' was the highest (72 and 76), in other words the participants were the most satisfied with the quality of learning (pedagogical innovation transmitted by the project) that took place in the VLEs.

Components of the model	*Beta*	*DF*	*F*	*Significance*	*Importance after transformation*	*Importance*	*Index of satisfaction (0-100)*
Phase I. (n = 23) Participants' global satisfaction *($R^2 = .71$) ($\alpha = .86$)*							
benefits gained	.427	3	12.85	p = .000	.43	.30	69
usefulness of the experience	.326	2	7.85	p =.000	.30	.22	70
quality of learning	.349	2	1.83	p =.000	.26	.19	72
Phase II. (n = 20) Participants' global satisfaction *($R^2 = .81$) ($\alpha = .78$)*							
benefits gained	.457	3	12.85	p = .000	.45	.37	74
usefulness of the experience	.366	2	7.81	p =.000	.33	.27	74
quality of learning	.393	2	14.84	p = .000	.28	.23	76

Table 2 The results of the survey on in-service teachers' global satisfaction

B. The facilitator's role

Regarding the evaluation of the facilitators' role, two variables showed significant impact in the first phase: feedback provided by the facilitator ($p < .002$), and the help offered by the facilitators ($p = .000$) contributed to the self-perceived knowledge advancement. In our project in the case of the in-service teachers the strong impact of giving feedback was supported and the aspect of professional scaffolding (help provided by the facilitator) was also added. Thus, feedback provided by the facilitators within the mentoring process on the participants' activity in the VLE proved to be just as important as the constant help i.e., the professional scaffolding offered by them. As regards the participants' satisfaction with the facilitator's role, both variables were rated with the same values (78-78) i.e., the participants were satisfied with the feedback provided by the facilitators and the professional scaffolding offered by them to the same extent (Table 3).

Components of the model	*Beta*	*DF*	*F*	*Significance*	*Importance after transformation*	*Importance*	*Index of satisfaction (0-100)*

Phase I. (n = 23) The facilitator's role *(R^2=.64) ($\alpha = .95$)*

Facilitator's feedback	.355	2	7.36	p < .002	.38	.25	78
Help provided by the facilitator	.534	2	16.61	p = .000	.61	.40	78
Phase II. (n = 20) The facilitator's role *(R^2=.83) (α = .89)*							
Facilitator's feedback	.374	3	9.59	p = .000	.43	.26	75
Help provided by the facilitator	.650	3	18.77	p = .000	.75	.46	78
Facilitator created a feeling of online community	.247	2	4.89	p < .010	.18	.11	76

Table 3 The results of the survey on the facilitator's role

In the second phase a third variable 'the facilitator created a feeling of online community' referring to the facilitator's role as a social director was added to the two previously mentioned ones (p < .010). The importance values of the two other variables increased: the 'feedback provided by the facilitator' (p = .000) and the 'help offered by the facilitator' (p = .000). As regards the satisfaction indexes, we detected an interesting transformation: the variable 'help offered by the facilitator' (which had the same satisfaction index as the 'feedback provided by the facilitator') now had a higher satisfaction index (78); the participants were more satisfied with the facilitators' role as social director (76) than with the feedback provided by them (75). Since the in-service teachers were located in different parts of the country and worked purely online, the facilitator's role as social director was of high importance. Thus, the process of creating a sense of online community must be carefully planned in advance and scaffolded by ice-breaking or socializing activities.

C. Social Presence

In respect to the perceived social presence two variables proved significant: 'participants' point of view was acknowledged by the facilitator' (p = .000) and 'distinct impressions of the group members were created' (p < .001). The residual percentage in the case of social presence is high (75%). However, this phenomenon can be considered as normal from the research methodological point of view, since only little is known about the characteristics of the form, the content and the effects of social presence as articulated by Lombard and Ditton [16].

The structure of the variables and their impact on the social presence constituent changed with the added participants' data from the second phase. The variable 'distinct impressions of the facilitator' (p < .016) also had a significant impact on participants' satisfaction regarding social presence. As for satisfaction, the variable 'participants' point of view was acknowledged by the facilitator' has the highest index (80) (Table 4). By having a third significant variable the residual part has decreased to 59% but this value is still high.

A person is perceived as 'real' in mediated communication if they fail to realize the existence of a medium in their communication and interact as if it were not there. What is highly important in this context is that in a VLE the concept of presence manifests itself through the interactions among the participants and the instructor and is thus a social phenomenon. Accordingly, this variable needs to be further elaborated since the participants' and the facilitators' perceived social presence (which can be grasped and made visible in the form of online interactions within the mentoring process in the VLE) is crucial to the success of online pedagogical scenarios alike. As Picciano puts it, "students who feel that they are part of a group or 'present' in a community will wish to participate actively in group and community activities" [34].

Components of the model	*Beta*	*DF*	*F*	*Significance*	*Importance after transformation*	*Importance*	*Index of satisfaction (0-100)*
Phase I. (n = 23) Social presence *(R^2=.25) (α = .77)*							
Participant's point of view was acknowledged by the facilitator	.475	2	12.07	p = .000	.64	.16	81
Distinct impressions of the group members were created	.355	3	6.72	p < .001	.35	.09	73
Phase II. (n = 20) Social presence *(R^2=.41) (α = .82)*							

Participant's point of view was acknowledged by the facilitator	.349	2	11.13	p = .000	.43	.18	80
Distinct impressions of the group members were created	.234	3	4.65	p < .005	.26	.10	76
Distinct impressions of the facilitator were created	.251	2	4.34	p < .016	.31	.13	73

Table 4. The results of the survey on social presence

D. Online communication in the MIM

The following three variables proved to have significant effect on the participants' satisfaction with the online communication: 'feeling comfortable with participating in online knowledge-building discussions' (p = .000), 'individual opinions acknowledged by group members' (p = .000) and 'feeling comfortable conversing with the facilitator through the online surface' (p = .000). With the added participants' data collected in the second phase, satisfaction with the online communication and the importance values of the variables changed: the importance of the variable 'feeling comfortable with participating in online knowledge-building discussion' grew slightly (p = .000); the impact of the variable 'individual opinions acknowledged by group members' decreased considerably (p < .007); while the variable 'feeling comfortable conversing with the facilitator through the online surface' grew (p = .000). The drastic decrease of the importance of the second variable can be explained by the fact that the variable referring to the facilitator's role as a social director now had an impact on the satisfaction with the facilitator criterion; in the case of social presence, the variable 'distinct impressions of the facilitator' influenced the participants' satisfaction. Since the two new variables are associated with the "activity" of the decreased variable, it is assumed that the values were transformed and rearranged. This rearrangement of values is directly linked to the increase of the residual part from a low value of 22% to a relatively high one of 42% in the case of the online communication criterion of the MIM.

The satisfaction index is high in the case of all the three variables (74-77-76) (Table 5), but the participants were the most satisfied with the experience that group members acknowledged individual opinions. Fostering a supportive and fertile learning environment, facilitating and scaffolding collaborative work are important tasks of the mentor (facilitator). In the MIM, help and feedback provided by the facilitators and their openness towards the participants' previous professional experience, practice and knowledge are indispensable conditions of in-service teachers' acting efficiently in knowledge-building communities. They are expected to have an attitude of collaborating with the teachers as a community of professionals rather than simply 'test dummies' with mainly receptive skills in the process of pedagogical innovation.

Components of the model	*Beta*	*DF*	*F*	*Significance*	*Importance after transformation*	*Importance*	*Index of satisfaction (0-100)*
Phase I. (n = 23) Online communication in the MIM *(R^2=.78) (α= .83)*							
Participating in online discussions	.489	3	32.94	p = .000	.44	.34	75
Individual opinions acknowledged by the group members	.477	1	37.87	p = .000	.34	.27	78
Conversing through the VLE	.328	2	15.68	p = .000	.21	.14	74
Phase II. (n = 20) Online communication in the MIM *(R^2=.59) (α= .84)*							
Participating in online discussions	.539	3	32.04	p = .000	.64	.38	74
Individual opinions acknowledged by the group members	.134	1	3.20	p < .007	.05	.03	77
Conversing through the VLE	.298	2	10.15	p = .000	.31	.18	76

Table 5. The results of the survey on online communication in the MIM

E. Relationship between the components of the MIM

In the second phase of regression analyses, the relations between the four components of the MIM that were described by using four variable groups were mapped (Figure 1). Thus, potential relations and effects were investigated between the participants' global satisfaction, the facilitator's activity, the perceived social presence and the online communication in the MIM. In this phase, in the first round of the analyses the participants' global satisfaction was considered as the dependent variable, and its potential relation to the other three constituents was analyzed. The only component that had statistically significant impact on the participants' global satisfaction was 'the online communication in the MIM' with an extremely high importance value demonstrating a strong explanatory power (p = .000) (.94). Accordingly, in the cases *Calibrate 1* and *Calibrate 2* it was found that online communication in collaborations maintained in the framework of the MIM moderated by a facilitator directly impacted participants' satisfaction and the success of the online mentoring process. In the present evaluation framework, claiming that in-service teachers' satisfaction was significantly impacted by the online communication component refers to satisfaction with the participation in on-task discussions, the experience of individual opinions being acknowledged by the fellow group members and the comfortable way of conversing through the medium.

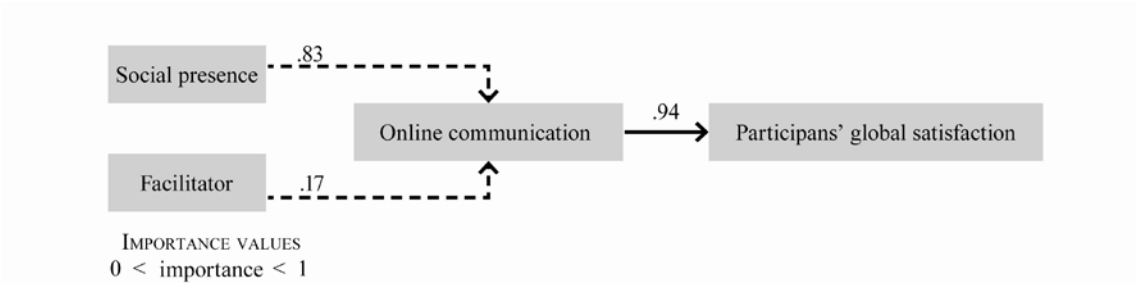

Figure 1 Explanatory model for the Calibrate 1 and Calibrate 2 cases

In the next round of regression analyses (when the online communication component was considered as the dependent variable), we found that the other two components (individually) – facilitator's activity (p < .013) (.17) and perceived social presence (p = .000) (.83) – had statistically significant influence on the participating in-service teachers' online communication and through it on the global satisfaction. Consequently, we claim that the facilitator's activity (their teaching presence) and social presence directly impacted online communication in the CSCL environment in the mentoring process**.** However, between the two components (social presence and facilitator's role) there were not any significant relations detected. Hence, the facilitator's influence on participants' social presence was not confirmed by the analyses. (For the detailed results see Table 6.)

Components of the model	*Beta*	*DF*	*F*	*Significance*	*Importance after transformation*	*Importance*
1st step: Course satisfaction as dependent variable *(R^2= .78)*						
Facilitator's role (independent variable)	.12	2	1.64	p < .210	-	.07
Social presence (independent variable)	-.04	3	.20	p < .901	-	-.01
Online communication (independent variable)	**.86**	**3**	**110.06**	**p = .000**	**.734**	**.94**
2nd step: Online communication as dependent Variable *(R^2=.77)*						
Facilitator's role (independent variable)	**.21**	**2**	**4.88**	**p < .013**	**.135**	**.17**
Social presence (independent variable)	**.75**	**2**	**63.28**	**p = .000**	**.641**	**.83**
3rd step: Social presence as dependent variable *(R^2=1)*						

Facilitator's role (independent variable)	-	-	-	-	-	-

Table 6. Data on the second phase of regression analyses

V. DISCUSSION AND CONCLUSION

As indicated by the research context, the purpose of this study was twofold. On one hand, the aim was to integrate communities of Hungarian in-service teachers in research-based training activities, which the EU funded large-scale research project allowed for. On the other hand, to evaluate and identify key factors of success of the applied instructional context, the MIM.

With the reported participant activity analyses, an extensive number of variables of the participating in-service teachers' satisfaction with the MIM were revealed, focusing specifically on four major issues: global satisfaction, the facilitator's activity, perceived social presence and online communication. Our analyses identified statistically significant values and showed variables of the four basic criteria of the online mentoring processes. The results of this study showed that out of the four components of the MIM the participants were satisfied with the *facilitator's role* and the *social presence experience* in the CSCL environments to an equal extent (global indexes: 78-78). These two are immediately followed by the *online communication* component (75). Thus, according to the survey, the participants were highly satisfied with the vibrancy of discussions and interactions that took place in the online environments facilitated by the e-moderators.

The facilitator's activity or their *teaching presence* [21] as a crucial component of the MIM was investigated through numerous variables focusing on their three main areas of responsibility: (1) course design and organization, (2) facilitating discourse, and (3) direct instruction. Components of the latter two areas of responsibilities were also pinpointed by the variables constituting the 'facilitator's role' variable group. The results showed that the *pedagogical role* [37] or *instructor role* [38] of the facilitator (as a consultant, guide and resource provider) was highly relevant. This role encompasses professional scaffolding offered to the online participants in their growing understanding of the (course) content, and the facilitation of their knowledge building in order to complete assignments and reach learning aims set prior to the process [38, 39, 40]. This is maintained by initiating questions and provoking responses from the participants, and focusing discussions on crucial points so that discussions progress beyond info sharing to knowledge construction, weaving together different concepts and assisting participants in connecting content with prior knowledge [21, 38, 41]. Significant results concerning the online communication component of the MIM, more precisely the independent variable 'participation in on-task discussions' (which covered the above referred activities and strategies employed by the facilitator) revealed that facilitating discourse and skilful direct instruction have a strong explanatory power concerning participants' satisfaction with the online communication that took place in the MIM. Accordingly, online communication is a strong indicator of satisfaction. Providing useful and creative feedback and evaluating contributions are both effective techniques applied by the online instructor maintaining the pedagogical or instructor role [2, 21] and preserving teaching presence. Especially in online environments timely informative feedback is critical as compared to face-to-face settings since learners may feel isolated due to the characteristics of the communication medium [38]. Significant results showed that participants of the present survey were highly satisfied with the quality of the feed-back offered by the facilitator and the help (professional scaffolding) provided by the facilitator which both had a strong explanatory power in the variable group investigating the facilitator's activity.

Satisfaction regarding the quality of the teaching and learning experiences in the MIM – as an indicator of perceived *cognitive presence* that is the extent to which participants were able to construct and confirm meaning through reflection and discourse – received the highest rate in the variable group concerning the participants' global satisfaction. Accordingly, participants were the most satisfied with the quality of learning that took place in the CSCL environments in the framework of the MIM. Based on these significant results (even if self-perceived cognitive presence was surveyed), we can claim that in the presented scenarios effective online communication contributed to the participants' growing understanding of the content, and managed to contribute to the facilitation of their knowledge building so that discussions progressed beyond info sharing to knowledge construction.

The facilitator's *social presence* [17] or the *social director role* [37, 38] that involved the establishment and facilitation of personal relationships within the collaborating community was also identified (indicators of it are pinpointed in the online communication and social presence constituents of the MIM). Beyond the facilitators' activities linked to its professional scaffolding, the participant's ability to create distinct impressions of the facilitator was revealed as being of high explanatory power in the evaluation of their role. Thus, evolving social presence, the "illusion of nonmediation" [16] is also essential to developing teachers' satisfaction with the online experience. Establishing a comfortable and effective work-relationship between group and mentor, acting authentically both as a reliable human being and a professionally competent colleague, is likewise a must in online collaborations and mentoring events.

Significant results revealed that the variable 'individual opinions acknowledged by group members' had a strong explanatory power within the online communication variable group. However, the social presence variable group became tangible to a limited extent. Despite the fact that the participants managed to form distinct impressions of each other and the facilitator, and felt that their opinions were acknowledged both by the facilitator and their peers, a fundamental part of the social presence-element has not been made visible yet. What is however leading in this direction are the significant results concerning the explanatory power of the variable (within the online communication variable group) indicating that the in-service teachers felt comfortable conversing through the medium (in the presented scenarios the VLEs), and the relevant indexes showing a high degree of participant satisfaction. Thus, the "illusion of nonmediation" as Lombard and Ditton [16] characterized the concept of social presence, i.e., interacting as if we were not using a digital medium of transmitting information, was successfully maintained. Participants perceived each other and their facilitators as a "real person" in the mediated communication [18, 19], communication through the medium contributed to the intimacy among the communicators and eventually reduced the distance between the participants.

Statistically, the referred independent variables are part of various variable groups (see Cronbach-alfa measures for the four variable groups in Table 2, 3, 4 and Table 5) but in real-life online mentoring events online communication cannot be considered without the facilitator's activity (teaching presence), the participants' social presence and the communication medium. This is supported by the above reported results, which clearly demonstrated that there is a statistically significant relation among the components, and also an indirect impact of them on the participants' global satisfaction.

With reference to the use of research-based training activities in teachers' professional training, we found that an innovation process which involved both the transformation of individual and social practices and technical innovation evolved in the communities of in-service teachers who shared common teaching philosophies and methodological concerns. LeMill, the technical innovation which allowed for mediating online experiences was acknowledged as having the potential to become a central tool for initiating teachers' innovative knowledge-building communities. In the participating Eastern European countries such as Hungary, where ICT-supported collaborative scenarios are manifestations of an emerging pedagogical paradigm, the research-based training activities partly catalyzed innovation processes and contributed to the more efficient pedagogical use of digital resources [41]. The MIM as part of the methodological inventory of the training activities also accelerated innovation processes and the transformation of individual and social practices within which the facilitators' role and the online communication components of the model proved the most influential on participating in-service teachers' satisfaction and self-perceived development. Accordingly, the MIM and its adjusted (further developed) form is envisioned to become part of both in- and pre-service teacher training curricula ensuring the acquisition of cutting edge skills and ideas about working in research-based online training activities.

VI. ABOUT THE AUTHORS

Helga Dorner, Ph.D., is the Project Officer of EU and Hungarian Affairs at the Central European University, Budapest. As a junior researcher, she has been member of the validation teams of the EU funded research and development projects eTwinning, CALIBRATE and Knowledge Practices Laboratory project. Her research interests include social aspects of learning in online environments,

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FACULTY ACTIONS THAT RESULT IN STUDENT SATISFACTION IN ONLINE COURSES

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ABSTRACT
This study identified faculty actions which positively influenced student satisfaction in the online classroom at the community college level. The escalating demand for Internet-based, distance education courses has been met by an increased inventory of them. However, while online education has been in existence for over a decade, standardized practices in the online classroom have not been fully identified, developed, and implemented. Data was collected from student evaluations of two web-based courses at two Texas community colleges. Descriptive statistics, bivariate correlations and multiple regressions were used to identify faculty behaviors which affected the satisfaction of students enrolled in these courses. The results of the study indicated that faculty actions within online courses appeared to impact student satisfaction. The identification of faculty actions which impact student satisfaction in online courses will greatly assist colleges and universities in strengthening their abilities to provide quality online experiences for their students.

KEYWORDS
Online Learning, Faculty, Student Satisfaction, Distance Education, Faculty Behaviors, Asynchronous, Learning Environments, Faculty Interactions

I. INTRODUCTION

Distance education, with its flexible scheduling and broader accessibility, is desirable to 84 percent of community college students who must work full- or part-time while balancing personal obligations [1]. While community colleges accounted for the largest enrollment in undergraduate education courses in 2000-2001, serving 1,435,000 students as compared to 566,000 students in public 4-year institutions and 278,000 in private 4-year institutions, undergraduate online education courses also had the highest dissatisfaction rates among participating students [2]. Thirty percent of students enrolled in undergraduate courses reported that they were less satisfied with their online course experiences than with their traditional classroom experiences [2].

Between fall 2000 and fall 2006, enrollment in Texas higher education institutions increased nearly 21 percent [3]. It is anticipated that enrollments in Texas community colleges will increase an additional 17

percent during the next 15 years [4]. In 2009, seeking to clarify trends in distance education, the Instructional Technology Council (ITC) surveyed the 1,200 members of the American Association of Community Colleges across the United States, with 226 responding. Survey results revealed that online enrollments at community colleges increased by 22 percent from fall 2007 to 2008, while overall enrollments at the same colleges increased an average of less than two percent nationally [5]. In the same period, The Sloan Foundation reported a 17 percent growth in distance learning in higher education with a total of 4.6 million online students [6]. Sixty-seven percent of ITC's survey respondents indicated that student demand for distance learning outpaced their abilities to provide services [5].

Education experts agree that faculty are the key element in creating and maintaining a quality online education program [7, 8, 9]. Faculty actions which initiate and maintain interactivity within the online class directly impact the quality of the online education experience. Yang et al. asserted that to ensure quality in online education, "the qualification of instructors should be a first consideration" [9, p. 11].

While attempts to define and measure student success in online education has been met with limited and debated results, researchers agree that student satisfaction within the Internet-based classroom is directly affected by degree and type of interactions between the assigned faculty member and enrolled online students [10, 11, 12, 13]. Shea, Fredericksen, Pickett, and Pelz [12] and Roblyer and Ekhaml [14] further argued that quantity and quality of interactions in the online classroom directly correlated with student satisfaction and learning.

There is limited published research on what students think of Web-based education and how it meets their needs [13, 14, 15]. After reviewing 76 studies detailing attributes and shortcomings of online education research, Tallent-Runnels, Thomas, Lan, Cooper, Ahern, Shaw, and Liu concluded that few studies actually illuminated the teaching-learning experience in the online environment. They encouraged more research be conducted to ascertain types of faculty-student interactions and the impact of such interactions on students in order to identify "effective learning experiences for various kinds of students" [16, p. 119]

The intent of this study was to identify faculty actions which influenced student satisfaction in distance education courses at the community college level. This article reports the methodology, findings and implications of this quantitative study that utilized descriptive, bivariate correlations, and multiple regression statistics to evaluate student perceptions of faculty actions.

II. RELATED LITERATURE

Schlager [17], Duffy and Kirkley [18], and Maguire [19] defined the purpose of online education as multi-level: 1) to increase the accessibility of learning experiences among students who cannot or choose not to attend traditional classrooms; 2) to assemble and disseminate instructional content more cost-effectively and efficiently; 3) to capture a larger share of the educational market; and 4) to reduce educational, training, and retraining costs. Advancements and adoption of digital technology by society coupled with increasing budgetary constraints set forth by legislatures across the nation have resulted in higher education institutions which must evolve to deliver services via the Web to an increasingly digital target audience while demonstrating fiscal efficiency [20].

A. Distance Education and Community Colleges

The mission of the community college coupled with the diverse population it serves positions the two-year institution to be the best provider of distance education opportunities [20, 21].

> The community college has traditionally been referred to as *the people's college*, and it is committed to providing access, opportunity, and a full scope of educational options to those who attend. Because of these attributes, as well as the unique populations they serve, community colleges have emerged as leaders in providing distance education. [20]

Two-year colleges, which make up the largest sector of higher education in terms of enrollments and numbers of institutions, are "often the first to venture beyond predictable and comfortable borders in higher education" [21, p. 93]. During 2006-2007, 97 percent of the 1,000 two-year Title IV degree-

granting institutions offered distance education courses and reached more students than the private and public four-year universities combined [22]. The role of community colleges in distance education was underscored during the reauthorization of the Higher Education Act in 1998 through the creation of the Learning Anytime, Anywhere Partnership (LAAP) program [23]. The Instructional Technology Council determined that community colleges continued to outpace public and private 4-year institutions with numbers of online course offerings and overall online enrollments [5].

Understandably, since the focus of community college practitioners remains centered on teaching and training, very little research examining distance education within the community college has been forthcoming. Studies dedicated specifically to student satisfaction in distance education programs at two-year colleges are virtually non-existent and, when present, are embraced in larger studies similar to that of the SUNY Learning Network by Shea et al. [12]. Of the 76 studies reviewed by Tallent-Runnels et al. [16], two studies clearly involved community college students as research participants.

B. Faculty Role in the Online Environment

One of the greatest challenges for community college faculty will be the shift from "conveyor of information" to "mentor, coordinator, and facilitator of learning" in the online environment [9, 24, 25]. As the educational environment shifts from teacher-centered to learner-centered, instructors become facilitators and intermediaries between the students and the resources they need to be independent learners [24, 26, 27]. The role of the online professor is defined by the needs of learners, including monitoring interactions between students, guiding discussions, and providing interactive online learning activities [27, 28]. Considerations for delivering course content via the online medium include content organization and format, methods of communication and interaction, student engagement in instruction, and assessment [25].

> The role of an instructor in distance education is likely to be somewhat different than in resident instruction and requires some specialized skills and strategies: 'distance education instructors must plan ahead, be highly organized, and communicate with learners in new ways. They need to be accessible to students, work in teams when appropriate, and play the role of facilitator or mentor in their interactions with learners. Finally, they may have to assume more administrative responsibilities than is true in a residential model'. [29, p. 6]

The majority of contemporary online classes focus on transmitting a knowledge base to the student rather than stimulating the process of learning [30]. Rockwell, Schauer, Fritz, and Marx [7] emphasized the importance of faculty, who must recognize and master diverse technologies and incorporate them into online teaching and learning strategies, as the essential elements in the online learning process [31]. Schlager [17] noted that technological challenges for the online classroom are simply a part of the larger pedagogical challenge: to balance differences in student populations, subject domains, and pedagogical preferences which will result in an effectively designed, technologically advanced learning environment.

The greatest challenge to online education is not the technology, but the identification and implementation of strategies and techniques which match the learner with effective learning opportunities. Tobin [29] argued that the most important variable in the online classroom is the instructor's level of interaction with students and the outside world. Yang et al. [9] encouraged faculty to merge theoretically-based learning principles with instructional strategies to customize their individual online courses, eliminating the one-size-fits-all descriptors for online teaching and learning [32]. Online instructors must seriously consider what they can and should do to provide quality online instruction that is real and meaningful for all enrolled students, blending learning theories, new technology, and solid instructional design [28, 33]. Online instructors must engage students and encourage them to be actively involved in class instruction and discussion [32].

Faculty who are successful in the online learning environment are those who e-mail their students frequently, respond to e-mail messages promptly, hold regular online and traditional office hours, and develop personal touches in the online environment [26, 34]. Stewart and Strudler [15] developed a measurement tool for assessing the effectiveness of online classes, noting there are seven dimensions

which affect course quality: the appearance of Web pages, class procedures and expectations, technical issues, hyperlinks and navigation, online applications, content delivery, and instructor and peer interaction. In coordination with engaging students as active learners in the online course, instructors must be prepared to invest more time in daily maintenance of the online class than they traditionally would invest in the campus-based setting [31].

A study conducted by Shea, Picket and Li [35] identified a connection between overall faculty satisfaction in teaching online courses with the levels of interaction they had with students. In a study conducted by Hiltz, Shea and Eunhee [36] of faculty that teach using asynchronous learning networks at one university, they found the top five motivators for faculty to teach online included flexible scheduling, more personal interactions with students, their professional development growth, a more diverse student population, and better overall course management. Faculty identified that in addition to being able to structure the learning process better, the abilities to interact more often and more personally with students was a motivator for them to teach online. The top demotivator identified in this study was that faculty perceived that teaching online was more work. Though not listed as one of the top six demotivators, one group identified that there was a higher expectation of their availability and attention by students in their online courses [36].

C. Student Satisfaction with the Online Experience

Building upon the work of previous scholars seeking to identify the relationship between instructor behavior and student satisfaction in the traditional classroom, Arbaugh [10] correlated "immediacy behaviors" of professors with student satisfaction in the online environment. Arbaugh's study, which surveyed 25 web-based sections in an MBA program at the University of Wisconsin, Oshkosh, concluded that the instructor's use of immediacy behaviors, including prompt feedback, use of humor or emoticons, referring to the student by name in written communication, discussion prompts, and sharing of personal examples, are better predictors of student satisfaction than an instructor's mastery of technology [37].

Drawing upon the work of Chickering and Gamson [38] and Garrison, Anderson and Archer [39], Shea et al. [12] surveyed 935 students engaged in online education via the SUNY Learning Network to clarify variables which would measure the attainment of student satisfaction and learning in the e-learning environment. The study validated the importance of social discourse and contact between university students and faculty, confirming that the quantity and quality of online interaction directly correlated with student satisfaction and learning [40]. Plentiful and instructive interaction resulted in greater satisfaction and learning among enrolled online participants, while decreasing the level of interaction resulted in isolation and increased levels of dissatisfaction. Valenta, Therriault, Dieter, and Mrtek [13] asserted that to be effective in the online learning environment, the online classroom must give participants a sense of community. Roblyer and Ekhaml [40] differentiated between two types of online interaction: interaction and interactivity. Interaction requires overt behaviors within the online course by both students and faculty, while interactivity refers to the capabilities of the existing technology through which course content is delivered.

In addition, a significant correlation exists between the amount of critical thinking involved in creating discussion board responses and student learning and satisfaction. Shea et al. [12] discovered that the expression of clear expectations and timely feedback also directly impacted student satisfaction. As above, increased clarity of expression and timeliness of feedback resulted in increased online student satisfaction. Additional factors, which the researchers identified as positively affecting satisfaction among online students, were low levels of technical difficulties and high quality feedback on assignments.

Stein and Wanstreet [41] applied Garrison et al.'s [39] Community of Inquiry model in a hybrid study of twenty-five undergraduate and graduate learners participating in inquiry-based classes at a large Midwestern university in an effort to match student satisfaction with teaching presence, social presence, and cognitive presence. The researchers validated Garrison's model, noting that regardless of whether a student engages in learning experiences which are totally online or a combination of both on-campus and online experiences, Garrison et al.'s [39] three overlapping lenses must be present in order for the

environment to be effective. They concluded, that if students are given a choice between delivery format of instruction, they will select the format which best suits their individual needs in terms of teaching, social, and cognitive presence, thus gaining satisfaction from the educational experience [41].

Knox, Lindsay, and Kolb [42] sought to link student satisfaction with undergraduate educational experiences to both experiential factors and grade attainment. Using data from *The National Longitudinal Study of the High School Class of 1972* and archived data from the 1,509 undergraduate institutions which respondents attended, the researchers concluded that grade attainment had a more significant influence on student satisfaction in college than classroom experiences. While the experiences identified by the researchers did not parallel interactive behaviors exhibited in the online college classroom, the researchers did effectively argue that college grade attainment was positively correlated to "the odds of reporting that courses were interesting, that one performed well, that one learned a lot, and that one met interesting people" [42, p. 316]. According to Knox et al. [42], grade attainment affected not only student satisfaction with academic courses but student satisfaction with the college experience.

Similarly, Grayson [43] sought to identify variables which impacted student satisfaction using a cohort group of York University students enrolled in traditional classroom experiences. After following the group through the completion of their four-year programs at the commuter campus, the researcher determined that, secondary to professor activities in the classroom, grade achievement played a minor role in determining student satisfaction with academic programs. He also noted that aspects of the student experience improved over time as curriculum became more specialized and course enrollments decreased in size.

Expanding upon research involving traditional classrooms experiences, Summers, Waigandt, and Whittaker [44] compared student satisfaction with classroom experiences and grade variables in parallel online and traditional statistics classrooms. The researchers discovered that, despite the parallel instruction and evaluation procedures used by the same 20-year, veteran professor in both teaching formats, Web-based students were less satisfied with the course as well as with the evaluation and grading techniques than were their campus-based peers. Menchaca and Bekele [45] further examined student and faculty experiences and in a graduate-level, online learning program in the CSU, Sacramento, system. While the qualitative study did not seek to identify predictor variables according to degrees of influence on student success, the results identified the presence of technologic, pedagogic, human, course, and leadership factors which were imperative components of a successful online educational program, including clarity of course materials, course organization, group dynamics, level of feedback, and technical support. The study concluded that "satisfaction was directly related to achievement;" and, specific to this study, "satisfaction positively influenced the sustainability and scalability of the online program," resulting in future, increased enrollments in online education at CSU [45, p. 248].

Kosak, Manning, Dobson, Rogerson, Cotnam, Colaric et al. [33] recognized that while there are absolute, procedural methods for training on instructional technologies, there are no concrete, best-practices for online pedagogy [45, 46]. Hutchins [47] and Summers et al. [44] recommended online faculty seek to blend immediacy behaviors, as originally identified by Chickering and Gamson through the Seven Principles, to enhance student achievement and satisfaction. Due in large part to continually evolving technology, Crumpacker [28] noted that few successful models of distance education have evolved. Most higher education institutions continue to struggle with simply establishing and maintaining their distance education programs, with the most notable advancement being the establishment of asynchronous learning networks [28]. "Uncoordinated attempts" at fulfilling the needs of students and faculty will continue to be the "norm" until a proven online pedagogy is adequately researched and defined [27, 28].

III. CONCEPTUAL FRAMEWORKS

The conceptual frameworks utilized for this study drew upon the work of Chickering and Gamson [38], Chickering and Ehrman [11], and Garrison et al. [39]. Shea et al. [12] sought to clarify the relationship between student satisfaction and student learning in the online classroom. They concluded that plentiful and instructive interaction between faculty and students in the Internet-based classroom resulted in greater

satisfaction and learning among enrolled online participants, while decreasing the level of interaction results in isolation and increasing levels of dissatisfaction. Specific findings from the study revealed that significant correlations existed between student satisfaction and faculty expressions of clear expectations, timely feedback, low levels of technical difficulty in the course, and high quality feedback on assignments. More specifically, Arbaugh [10] correlated faculty "immediacy behaviors" with student satisfaction in the online environment. Immediacy behaviors are faculty communications within the online classroom, including prompt feedback and use of humor or emoticons, which reduce social and psychological distances.

A. The Study

Two community colleges located in Texas, hereinafter identified as College 1 and College 2, participated in this quantitative research study correlating faculty actions with student satisfaction in the online classroom. These colleges are accredited by the Commission on Colleges of the Southern Association of Colleges and Schools and were classified as Associate's Colleges by the Carnegie Foundation. Both institutions are public, rural-serving institutions that met or exceeded the enrollment criteria required to qualify as Hispanic-serving Institutions during the fall 2006 semester.

B. Data Collection and Tools

Data for the study was obtained from student responses to each institution's existing online course/instructor evaluation instrument from the fall 2006 semester. Statistical analysis, including descriptive statistics, bivariate correlations and multiple regressions, were used to identify faculty behaviors which affected the satisfaction of students enrolled in online courses at each institution.

College 1 reported a 30 percent response rate with 426 individuals responding out of a 1,403 unduplicated online enrollments. Student responses were recorded on a 5-point Likert scale. Variable codes and unique responses to the institutional survey were standardized to a 5-point Likert scale (with 1 being strongly disagree and 5 being strongly agree). With 1,004 individual responses out of a 1,459 unduplicated online enrollment, College 2 recorded a 69 percent response rate for the instrument. Student responses on the original evaluation instrument were recorded on a 6-point Likert scale. Variable codes and unique student responses were standardized to a 5-point Likert scale for analysis purposes in this research study (with 1 being strongly disagree and 5 being strongly agree). The data for both groups was imported into Microsoft Excel spreadsheets for consistent labeling of data columns across institutions. In addition, recoding of data responses was completed in the Excel spreadsheets prior to importation into SPSS 11.0, where it was then analyzed.

IV. THE RESEARCH

A. Analysis and Findings: College 1

The results of the analysis indicated that three independent variables (see Table 1) received high positive responses, indicating perceived effective faculty actions within the online classroom. The instructors' abilities to clearly communicate expectations received the highest rating as 60.6 percent of respondents "strongly agreed" and 30.5 percent of respondents "agreed" that expectations were clearly stated. Respondents identified the timeliness/accessibility of the instructor as the second most recognized instructor action, with 58.9 percent of respondents strongly agreeing and 30.0 percent of respondents agreeing that instructors were available for consultation. Responses identifying the instructors' abilities to provide clear directions about the coursework closely aligned with the timeliness variable: 58.9 percent of respondents "strongly agreed" and 29.1 percent of respondents "agreed" that instructors provided clear, understandable instructions.

		Likert Scale			
-					+
1	2	3	4	5	

Survey Question	Variable Code	Frequency %			Response Rate	
The instructor spoke clearly and understandably. If the class was via the Internet, the instructor provided clear instructions about the coursework.	Directions	1.9	4.2	4.7	29.1	58.9
The instructor was accessible for consultation (e.g. questions, calls, e-mails, etc.)	Timeliness	2.1	2.8	4.5	30.0	58.9
Expectations were clearly stated either verbally or in the syllabus.	Expectations	1.2	2.1	4.2	30.5	60.6
The instructor showed enthusiasm for encouraging student learning.	Enthusiasm	2.3	3.8	9.4	29.6	54.0
The instructor created an atmosphere in which I felt comfortable asking questions.	Climate	1.6	2.8	8.0	31.5	54.9
The instructor's lectures and class-room activities helped me to learn the material.	Activities	2.6	4.7	14.6	27.7	48.6
Overall, the course was a valuable learning experience.	Value	2.1	4.0	4.7	34.3	54.2

Table 1. Response Frequencies for College 1

The instructors' actions aimed at creating positive learning environments and showing enthusiasm for student learning were also closely aligned in student "strongly agreed" responses totaling 54.9 percent and 54.0 percent, respectively. The instructors' successes at creating a positive learning atmosphere slightly edged out their successes at showing enthusiasm for student learning as 31.5 percent of respondents "agreed" that climate was beneficial as compared to 29.6 percent of respondents who "agreed" that instructor enthusiasm for encouraging student learning was present in the online class.

The engagement of the instructor within the online class through lectures and classroom activities received the weakest positive feedback as 48.6 percent of respondents "strongly agreed" that the lecture and classroom activities helped the student learn the material. In addition, 27.7 percent "agreed" and 14.6 percent chose to remain "neutral," neither agreeing nor disagreeing, in their assessment of the impact of online lectures and online course activities on their learning experiences. While 76.3 percent of respondents were in agreement that the instructors' actions positively impacted the learning experience, 14.6 percent could not determine the value of the instructors' engagement within the online class. This indicates an area for further refinement and research. Despite the concerns associated with the instructor's

online engagement, a majority of respondents, 54.2 percent “strongly agreed” and 34.3 percent “agreed,” that the online courses were valuable learning experiences. A small minority, 6.1 percent, expressed an opposing viewpoint.

Descriptive statistical analysis, conducted using SPSS 11.0 and detailed in Table 2, reaffirmed the previous findings as detailed in the frequency analysis. Student perceptions of faculty actions, rated on a 5-point Likert scale, were most positively recorded as: the instructor's expectations were clearly communicated (X = 4.43), instructor accessibility (X = 4.36), instructor provided clear instructions (X = 4.35), climate (X = 4.32), instructor’s enthusiasm (X = 4.09), and instructor’s lecture and classroom activities (X = 4.09). On average, as indicated on Table 2, the students enrolled in online courses at College 1 “agreed” that the online course experience for fall 2006 was a worthwhile experience (X = 4.32).

	N					
Variable Code	Valid	Missing	Mean	Median	Std. Dev.	Variance
Directions	421	5	4.35	5.00	1.019	1.039
Timeliness	419	7	4.36	5.00	1.036	1.073
Expectations	420	6	4.43	5.00	.939	.881
Enthusiasm	422	4	4.26	5.00	1.039	1.079
Climate	421	5	4.32	5.00	.990	.979
Activities	418	8	4.09	4.00	1.160	1.346
Value	423	3	4.32	5.00	.974	.949

Table 2. Frequency Analysis College 1

Further analysis on College 1 data sought to identify any existing bivariate correlations between independent variables, including directions, timeliness, expectations, enthusiasm, climate, and activities, and the dependent variable, value. Because the standard deviations for four of the six independent variables were greater than 1, the Spearman correlation coefficient, used for analyzing data which is not randomly distributed, was conducted for comparison purposes. One-tailed tests of significance (significant at the .01 level) were conducted to allow for directional interpretation of the correlation as all were anticipated to be positive in direction. Missing data values were pairwise deleted. Upon analysis, strong relationships were identified between all independent variables and the dependent variable, as identified in Table 3.

Independent Variable	Correlation Coefficient	Sig. (1-tailed)	N
Directions	.696	.000	421
Timeliness	.731	.000	419
Expectations	.765	.000	420
Enthusiasm	.787	.000	422
Climate	.775	.000	421
Activities	.687	.000	418

Table 3. Correlation Analysis Dependent Variable “Value” College 1

Analysis using the Spearman correlation coefficient indicated that there were moderate positive correlations between directions and value (r = 0.696) and activities and value (r = 0.687). High positive

correlations were found between timeliness and value (r = 0.731), expectations and value (r = 0.765), enthusiasm and value (r = 0.787), and climate and value (r = 0.775). Initial correlation analysis indicated that there was less than a 1 percent chance ($p < .01$) that the relationships occurred by chance.

Based upon the close relationships identified between multiple independent variables and the dependent variable, further study using multiple regression analysis was necessary to identify the amount of variance in the dependent variable, value, which could be attributed to each independent variable. Using the Stepwise Method for multiple regression analysis, all independent variables were entered into the equation and assessed for significance by the program as identified in Tables 4 and 5. All predictors were entered into the equation at a .05 level of significance, and removed from the equation if the significance fell below .10. Missing cases were pairwise deleted.

Predictors: (constant = value), enthusiasm, expectations, timeliness, activities, climate

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
5	.833	.693	.689	.543

Table 4. Multiple Regression Analysis Summary – College 1

	Unstandardized Coefficients		Standardized Coefficients		
Predictor Variable	B	Std. Error	Beta	t	Sig.
Enthusiasm	.302	.046	.322	6.511	.000
Expectations	.285	.038	.275	7.488	.000
Timeliness	.176	.036	.187	4.876	.000
Activities	8.450E-02	.034	.101	2.469	.014
Climate	9.691E-02	.045	.098	2.133	.034

Table 5. Degrees of Influence of Predictor Variables on Dependent Variable "Value"

The multiple R indicated a high positive correlation between five of the predictor variables and the dependent variable (R = .833). The R Square value for Model 5 ($r^2 = .693$) revealed that approximately 69 percent of the variance in the dependent variable, value, could be explained by the five independent variables, enthusiasm, expectations, timeliness, activities, and climate.

The degree of influence of each predictor variable was identified by the Beta value. For the College 1 sample, .32 of the defined variance in the perceived value of online courses was attributed to instructor enthusiasm (B = .322) for encouraging student learning. Clearly stated expectations (B = .275) accounted for .27 of the variance in the perceived value of online courses. The accessibility of the instructor for consultation (timeliness, B = .187) explained .18 of the identified variance associated with course value, while the instructors' lectures and activities (B = .101) and the instructors' abilities to create comfortable learning environments (climate, B = .098) had the least influence on the perceived value of online courses, .10 and .09 respectively. The independent variable, directions, was excluded by the SPSS statistical program during the Stepwise Method analysis as being non-significant, accounting for less than a 1 percent of the variance associated with the value of online courses.

All predictor variables selected in Model 5 of the multiple regression analysis correlated well with the criterion variable yet demonstrated no significant correlations with each other as illustrated in Table 6.

Variable Code	Enthusiasm	Expectation	Timeliness	Activities	Climate

Enthusiasm	1.0	-.175	-.125	-.423	-.429
Expectations	-.175	1.0	-.208	-.133	-.145
Timeliness	-.125	-.208	1.0	-.070	-.310
Activities	-.423	-.133	-.070	1.0	-.116
Climate	-.429	-.145	-.310	-.116	1.0

Table 6. Coefficient Correlations College 1

It should be noted, however, that three coefficient correlations revealed low negative correlations, as revealed in Table 6: enthusiasm and activities (r = -.423), enthusiasm and climate (r = -.429), and timeliness and climate (r = -.310). With the exception of enthusiasm, activities, climate, and timeliness were identified as having low levels of influence on the variance of the criterion variable. The presence of low level correlations indicated the need for further refinement of assessment questions as the faculty actions identified on the course/instructor evaluation instruments may not be adequately defined for respondents to effectively differentiate between the actions.

B. Analysis and Findings: College 2

Results of data analysis at College 2 indicated that student responses across the survey instrument were negatively skewed as indicated in Table 7. Both independent variables received high marks as illustrated in Table 8, indicating students perceived surveyed faculty actions were effective in the online class.

		- Likert Scale +				
		1	2	3	4	5
Survey Question	Variable Code	Frequency % Response Rate				
Timeliness of instructor response to assignments was?	Timeliness	1.7	2.0	7.6	38.2	47.9
The instructor's contribution to the course was?	Activities	1.3	3.1	.6	50.2	44.2
The online course as a whole was?	Value	1.2	4.1	.7	60.1	34.0

Table 7. Response Frequencies for College 2

While timeliness of the instructors' responses to assignments received the greatest majority of high positive responses as 47.9 percent of students "strongly agreed" that the timeliness of the instructors' responses was excellent, the total number of respondents identifying timeliness as a positive strength, 86.1 percent, was eclipsed by the total number of respondents who identified the instructor's engagement in the course as a positive action, 94.1 percent, as 50.2 percent "agreed" and 44.2 percent "strongly agreed" with the statement.

Further analysis indicated a non-response rate of less than five percent on any single variable as recorded in Table 8. Both independent variables recorded similar mean scores, timeliness (X = 4.36) and activities (X = 4.34), indicating respondents perceived both faculty actions as very similar, positive traits in the online class. The dependent variable, the value of the course (X = 4.22), was also perceived as positive by participating students.

	N					
Variable Code	Valid	Missing	Mean	Median	Std. Dev.	Variance
Timeliness	987	17	4.36	4.00	.947	.897

Activities	998	6	4.34	4.00	.761	.579
Value	1004	0	4.22	4.00	.756	.572

Table 8. Frequency Analysis College 2

Further analysis on College 2 data identified the presence of bivariate correlations between independent variables, timeliness and activities, and the dependent variable, value. Pearson correlations, designed for analyzing data with normal distributions, were conducted for comparison purposes. One-tailed tests of significance (significant at the .01 level) were conducted to allow for directional interpretation of the correlation as all correlations were anticipated to be positive in direction. Missing data values were pairwise deleted during both analyses. Correlation analysis revealed a moderate positive correlation between activities and value (r = 0.685) and a low positive relationship between timeliness and value (r = 0.327) as recorded in Table 9.

Independent Variables	Correlation Coefficient	Sig. (1-tailed)	N
Timeliness	.327	.000	987
Activities	.685	.000	998

Table 9. Correlation Analysis on Dependent Variable "Value" for College 2

Findings indicated that there was less than a 1 percent chance ($p < .01$) that the relationships occurred by chance.

Based upon the positive correlations identified between multiple independent variables and the dependent variable, further study using multiple regression analysis was necessary to identify the amount of variance in the dependent variables that could be attributed to each independent variable. Using the Stepwise Method for multiple regression analysis, all independent variables were entered into the equation and assessed for significance by the program as identified in Tables 10 and 11. All predictors were entered into the equation at a .05 level of significance, and removed from the equation if the significance fell below .10. Missing cases were pairwise deleted.

Predictors: (constant = value), timeliness, activities

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
2	.688	.474	.473	.549

Table 10. Multiple Regression Analysis Summary – College 2

	Unstandardized Coefficients		Standardized Coefficients		
Predictor Variable	B	Std. Error	Beta	*t*	Sig.
Activities	.654	.025	.658	26.168	.000
Timeliness	5.486E-02	.020	.069	2.731	.014

Table 11. Degrees of Influence of Predictor Variables on Dependent Variable "Value"

The multiple R depicted in the Model 2 summary and associated with the value of the course (R = .688) indicated a moderate positive correlation existed between the two predictor variables, activities and timeliness, and the dependent variable, value. The R Square value for Model 2 (r^2= .474) revealed that approximately 47 percent of the variance in the dependent variable, value, could be explained by the two independent variables, activities and timeliness.

The degree of influence of each predictor variable was identified by the Beta value. For the College 2 sample, the impact of the independent variables upon the perceived value of the course was distinctly different: the instructor's perceived contributions to the course (B = .65) had the greatest influence on the students' perceived value of the course followed distantly by instructors' abilities to respond to the assignments in a timely manner (B = .069). All predictor variables of the multiple regression analysis were correlated well with the criterion variable and demonstrated a low positive correlation (r = .392). The correlation between the independent variables, however, was not significant enough to impact the outcome of the regression analysis.

C. Analysis and Findings: Across Institutions

The discovery of correlations at both College 1 and College 2 using independent data sets necessitated further study across the Texas community college population. Because similar independent variables and a dependent variable were present on both instruments and significant correlations were recorded at the institutional level during the analyses of the individual colleges, it was possible to conduct additional analysis between institutional populations to determine if relationships using the similar dependent and independent variables existed across institutions in the community college population. Two independent variables, activities and timeliness, and the dependent variable, value, encompassed similar concepts across institutions. For purposes of this analysis, response scores to survey questions were standardized across institutions during the individual analysis process.

Analysis of data across institutions required the comparison of independent data sets. Responses to the archived course/instructor evaluation instrument at College 1 totaled 426, while responses to the archived course/instructor evaluation instrument at College 2 totaled 1,004. For analysis purposes, the total population of the College 1 data set was used during this step of the analysis process. An equal number of responses from the College 2 data set were extracted by SPSS using random sampling to generate a data set totaling 426. Reliability of the random sample for College 2 was verified by comparing the means and standard deviations of the original sample assessed during individual analysis with the descriptive statistics generated from the frequency analysis of the new data set. As detailed in Table 12, descriptive statistics from the original population set were very similar to descriptive statistics of the random sample set, indicating the creation of a valid representative group from the original College 2 population set for use in this analysis process.

	Original Population		Random Sample Population	
Variable Code	Mean	Std. Deviation	Mean	Std. Deviation
Activities	4.34	.761	4.33	.742
Timeliness	4.36	.947	4.37	.857
Value	4.22	.756	4.24	.723

Table 12. Reliability of Random Sample Population for College 2

In order to compare the data from the two community college population sets which experienced the same variables under study, independent samples t-tests were performed to determine if the distributions from College 1 differed significantly from College 2 on those variables which were found to be correlated in

the individual analyses. Missing data cases (N = 426), which comprised less than 1 percent of any variable as noted in Table 13, were excluded analysis by analysis.

Variable Code	College	N	Mean	Std. Deviation	Std. Error Mean
Timeliness	1	426	4.36	1.036	.050
	2	417	4.37	.857	.042
Activities	1	426	4.09	1.160	.056
	2	421	4.33	.743	.036
Value	1	426	4.32	.974	.047
	2	426	4.24	.723	.035

Table 13. Independent Samples Group Statistics

Independent samples testing results, detailed in Table 14, reflect levels associated with the assumption of equal variances across data sets. For both timeliness (p = .848) and value (p = .163), the t-test for equality of means revealed that the variables did not differ significantly at the .05 level. Initial readings of the activities variable (p = .000), however, indicated that a significant difference between population means was present. Results from Levene's test for equality of variances revealed that the variances between both colleges differed significantly on all assessed variables: timeliness (p = .025), activities (p = .000), and value (p = .000).

	Levene's Test for Equality of Variances		t-test for Equality of Means				
						95% Confid. Interval of the Difference	
Variable Code	F	Sig	*t*	df	Sig. (2-tailed)	Lower	Upper
Timeliness	5.025	.025	-.191	841	.848	-.141	.116
Activities	48.339	.000	-3.595	845	.000	-.373	-.109
Value	28.518	.000	1.398	850	.163	-.033	.198

Table 14. Independent Samples T-Tests for College 1 and College 2

Consequently, t values were used to confirm the differences. Critical values for the t distribution indicated that the t value corresponding with the .05 level of significance for this one-tailed test could not exceed 1.645; consequently, the t-test confirmed that the means for timeliness (t = -.191) and value (t = 1.398) were significantly similar across community college populations. The means value for activities (t = -3.595) was not significant across populations.

As a final step in the analysis of variables across community college populations, the one-way analysis of variance, ANOVA, was used to confirm the findings from the initial t-tests. It was found that the variance of the surveyed variables from College 1 and College 2 data sets did differ significantly, as recorded in Tables 15 and 16: timeliness (p = .025), activities (p = .000), and value (p = .000). Results recorded in the ANOVA calculation indicated that there was a marginally significant difference between the means of timeliness (p = .848) as recorded at each institution.

Levene's

Variable Code	Statistic	df1	df2	Significance
Timeliness	5.025	1	841	.025
Activities	48.339	1	845	.000
Value	28.518	1	850	.000

Table 15. Test of Homogeneity of Variances

Source	SS	Df	MS	F	Significance
Between Groups	.033	1	.033	.037	.848
Within Groups	761.435	841	.905		
Total	761.469	842			

Table 16. ANOVA Means of Timeliness College 1 and College 2

Critical values for the F ratio indicated that the F value corresponding with the .05 level of significance for this test could not exceed 3.84; consequently, the F test confirmed that the means for timeliness (F = .037) and value (F = 1.954) were significantly similar across community college populations. The means value for activities (F = 12.927) was not significant across populations.

Bivariate correlation analysis across community college data sets using associated variables further identified the presence of a bivariate correlation between the independent variable, timeliness, and the dependent variable, value. Spearman correlation coefficients were conducted for comparison purposes. Two-tailed tests of significance were conducted to allow for nondirectional interpretation of the correlation. Missing data values were pairwise deleted during the analysis. Correlation analysis using two-tailed tests of significance (significant at the .01 level) revealed a moderate positive correlation between timeliness and value (r = 0.512) as recorded in Table 17.

	Timeliness		
	Correlation Coefficient	Sig. (2-tailed)	N
Value	.512	.000	843

Table 17. Spearman's Correlation Coefficient Timeliness and Value Across College 1 and 2

Findings using two-tailed tests of significance indicated that there was less than a 1 percent chance ($p < .01$) that the relationships occurred by chance.

V. DISCUSSION

Results of this study support that student satisfaction with online courses appears to be impacted by instructor actions within the course. Correlations existed between specific faculty actions and student satisfaction at each institution. Data from both colleges revealed strong relationships between the independent variables identifying faculty actions and the dependent variables measuring student satisfaction with the online education experience. All analyses indicated that there was less than a 1 percent chance that the identified relationships occurred by chance.

College 1 registered the strongest relationships between the independent variables measuring faculty actions and the dependent variable measuring student satisfaction. High positive correlations were found to exist between the independent variables of timeliness/accessibility of instructor, clearly stated expectations, instructor enthusiasm, and comfortable climate and the dependent variable measuring course value. Moderate positive correlations were recorded between faculty actions involving clear directions and classroom activities and the students' perceived value of the course. Multiple regression

analysis further revealed that approximately 69 percent of the variance in the dependent variable, value, could be explained by the five independent variables, enthusiasm, expectations, timeliness, activities, and climate. The degree of influence of each predictor variable upon the criterion variable was determined to occur in the following order (from most influential to least): instructor enthusiasm, clearly stated expectations, instructor accessibility, lectures and activities, and climate.

Similarly, College 2 also recorded positive relationships between faculty actions and student satisfaction in online courses. A moderate positive correlation was discovered between the independent variable measuring activities and the dependent variable measuring students' perceived value of online courses. A low positive relationship was recorded between timeliness and value. Multiple regression analysis further revealed that approximately 47 percent of the variance in the dependent variable, value, could be explained by both of the independent variables, activities and timeliness. The degree of influence of each predictor variable upon the criterion variable was determined to occur in the following order (from most influential to least): instructor activities and timeliness.

Further study of correlated variables present in both College 1 and College 2 data sets revealed relationships do exist between faculty actions and student satisfaction across the identified Texas community college populations with respect to timeliness as perceived in online courses and students' assessed value of the course. The probability that instructors' accessibility and timeliness of response in the online course positively affected students' perceptions of the value of online courses is significant across the two institutions, both through the computations of similar means and the bivariate correlation analysis.

Unlike her sister institution, College 1 went beyond the physical actions of faculty within the online class (provided clear instructions, clearly stated expectations, was accessible, provided helpful lectures and classroom activities) to measure the impact of the social actions of faculty. Of unique interest at this institutional level was the students' identification of faculty actions involving expressed instructor enthusiasm and the creation of a comfortable learning environment. While specific techniques for creating an effective social climate were not detailed on the existing survey instrument, student responses to the social aspects of the learning environment support the theory and research behind Garrison et al.'s [39] Community of Inquiry model. Specifically, the social actions of the faculty in the online environment of College 1 would easily synchronize with the teaching presence identified by Garrison et al. within the framework of an effective online experience. As demonstrated through both Garrison et al.'s research and the results generated through the statistical analysis of College 1 data, teaching presence includes the faculty member's ability to facilitate and direct cognitive and social engagements within the online environment in such a manner as to provide meaningful and educationally worthwhile learning experiences and outcomes for the enrolled students. Based upon the conclusions of Garrison et al.'s [39] research and this study, further definition and refinement of teaching strategies which generate effective social behaviors and comfortable learning environments in the online class would benefit all online educators and participating students.

VI. IMPLICATIONS FOR PRACTICE

A comparison of results from this study and other foundational studies support the premise that faculty actions influence student satisfaction in the online classroom across higher education institutions. Findings from this study are unique in that they not only validate the effect of faculty actions on student satisfaction in the online, community college classroom, but they also identify concrete actions in which faculty may engage in the online classroom to positively influence student satisfaction. The results from this study provide a stepping stone for two-year institutions as they strive to effectively train and allocate faculty resources, improve recruitment and retention of online students, improve the quality of their distance education programs, and maximize funding opportunities.

The dissemination of the results from this research study may be used by two-year institutions, as well as other types of higher education institutions, to stimulate and direct college efforts to educate, train, and support faculty in the successful development and delivery of quality, online educational experiences. Using the results from this study, online course development and faculty training in the delivery of online course content could be programmed to incorporate specific faculty actions designed to enhance student engagement and satisfaction. Faculty training that emphasizes the benefits of concrete faculty actions in the online environment will not only generate an awareness of effective faculty actions but also encourage the development and utilization of original faculty actions in each online classroom which may further enhance student satisfaction.

It is anticipated that the incorporation of faculty actions in the online classroom will not only enhance student satisfaction in the individual course but also will impact student retention in online programs. In agreement with Menchaca and Bekele [45], students who are satisfied with their educational experiences are more likely to seek additional or similar opportunities with the same institution. With legislative mandates and funding increasingly tied to accountability based upon measurable outcomes, including retention and completion rates, community colleges are seeking to identify methods that will effectively retain students through the completion of their certificate and degree programs. Sustained and directed efforts to enhance student satisfaction in distance education courses can only benefit both course and program retention rates thus, impacting overall college enrollment and funding.

This study creates an opportunity for individual institutions to engage in conversations and customized research examining existing distance education programs, levels of student success and satisfaction in distance education, existing course/instructor evaluation methodologies and instrumentation, and faculty development opportunities. Customized research, based upon this study and identified foundational studies, could assist each institution in identifying best practices in online education that maximize the use of faculty resources and technology while effectively meeting the needs of their unique student populations. Revising instructor evaluation instrumentation to accurately measure effective faculty actions in the online classroom and creating faculty development opportunities to educate instructors on the best practices in the online classroom would positively impact student satisfaction within this increasingly requested educational forum. It is anticipated that such steps would have the cumulative benefit of increasing both student enrollments and retention for the entire institution.

VII. ABOUT THE AUTHORS

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AUTOMATING EXPERTISE IN COLLABORATIVE LEARNING ENVIRONMENTS

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ABSTRACT

We have developed a set of tools for improving online collaborative learning including an automated expert that monitors and moderates discussions, and additional tools to evaluate contributions, semantically search all posted comments, access a library of hundreds of digital books and provide reports to instructors. The technology behind these tools is Latent Semantic Analysis (LSA), a machine learning technology that understands the meaning of words and text in ways that agree highly with human judgments. These tools were evaluated in a series of studies with the U.S. Army War College and U.S. Air Force Academy. At the Army War College, we found that the automated monitor was as accurate at identifying discussion groups in trouble as trained human instructors, and has the potential to effectively reduce the amount of time instructors spend monitoring distance learning courses. At the Air Force Academy, the expert moderator significantly improved the quality of cadets' discussion comments in a collaborative learning environment.

KEYWORDS

Asynchronous learning networks, automated software agents, collaborative learning, computer supported learning

I. INTRODUCTION

We have developed a set of distance learning tools that can monitor, moderate, and assess distance learning courses automatically, greatly reducing instructor workload and increasing student performance. These tools were used at both the U.S. Air Force Academy and the U.S. Army War College. At the Army War College we monitored and assessed an online course activity. We were able to demonstrate the effectiveness of the monitoring tool for providing instructors with current information about how their students' discussions were proceeding, and were able to assess final products from the course activities with high reliability. In the experiment conducted at the Air Force Academy, students participated in one of three discussion conditions: (1) online and moderated by our automated moderator, (2) online with no automated moderator, and (3) face-to-face in a classroom. The quality of the students' discussions was higher when they discussed online with the automated moderator.

The paper begins with a review of relevant literature. Then the moderation and monitoring tool, Knowledge Post®, is described in detail followed by a description of the technology underlying the tool, Latent Semantic Analysis (LSA). The research conducted at the Army War College and the Air Force Academy follows. Next we present a description of how the technology could be made available to integrate with commercial distance learning products. The paper ends with a discussion of the implications that can be drawn from our research, and suggestions for future research directions.

A. Distance Learning

With the growth in popularity of distance learning courses, additional difficulties in knowledge management and assessment of student performance need to be addressed by technological rather than human capital. In 2003 an estimated 11 million post-secondary students participated in at least one distance learning course [1]. Nearly all of these distance learning courses used technology that included asynchronous computer-based instruction, and typically used online discussions. Other technologies, such as video conferencing, have become less popular.

Distance learning has also increased in elementary and secondary schools. During the 2002-2003 school year, over one third of public school districts had students enrolled in distance learning courses [2]. More recently (April, 2005), the U.S. Department of Education has recommended easing limitations on institutions to increase delivery of distance learning programs, arguing that online courses help students access a college education [3]. In military situations, communicating and learning at a distance is a given, hence the early and large emphasis on high quality online learning alternatives at schools including the US Army War College and US Air Force Academy.

The beneficial effects of properly constructed and administered online learning courses are well documented. A meta-analysis of 19 independent case and controlled studies found that when asynchronous discussion groups are instructor moderated, and engage both students and instructors, learning effectiveness is as high as face-to-face instruction and in some instances better [4]. Learning outcomes were measured differently in different studies, but included objective measures such as exam and course grades, quality of work, and participation rates, as well as more subjective measures, such as the overall amount of student learning, level of motivation, and frequency of access to instructors.

Some researchers prefer measures other than learning outcome as indicators of success in computer-supported collaborative learning (CSCL). [5] for example, argues that CSCL research should be concerned with understanding the process of meaning-making, not with the acquisition of knowledge. In essence, Koschmann proposes that learning outcomes are too separate from the actual processes involved in collaborative learning to provide a useful measure of success. Rather, an investigation of the interactions between students during learning, for example the language used, may provide a more appropriate assessment. Using a more process oriented technique to evaluate learning, [6] did a content analysis of four face-to-face classroom discussions and four asynchronous learning discussions with the same questions and instructor. They coded three different cognitive processes going from lowest to highest:

1. Exploration (e.g., rote factual responses, information exchange)
2. Analysis (simple and deep clarification)
3. Integration (connecting ideas, inference, judgment, resolution)

Their most interesting finding was that while there were about two times as many coded instances of cognitive processes in the face-to-face discussion, they were mostly in the lowest category—exploration. In the Asynchronous Learning Network discussions there were more instances of the two higher level processes in absolute as well as relative terms, further supporting the idea that asynchronous discussion groups show evidence of equal or better, and to some degree qualitatively different learning.

An important prerequisite of running a successful online course is having a moderator. A skilled moderator prevents many of the problems that can plague online courses, such as log-in lags that lead to a lack of continuity in discussions, too much student time spent coordinating, and problems using the

technology [7], [8]. Regular monitoring allows instructors to identify these problems and provide intervention before the problems escalate and disrupt the quality of the online course.

In order to keep an online discussion flowing smoothly, a moderator should check in on a discussion at least daily to detect any problems as early as possible. The moderator also needs to provide feedback to students to increase learning and motivation. If a discussion gets off-track, a moderator often needs to provide guidance to get students back on topic. Good moderation involves a lot of time and effort on the part of faculty. As a result, many faculty report that teaching online courses is actually more work than teaching traditional face-to-face courses [9], [10], and that they often spend several small chunks of time monitoring online courses, further disrupting their work schedules [11].

In an ideal world, instructors would have tools to manage their limited time and allow students to control the pace of their learning. Online course software would be self-monitoring, alerting instructors as needed. The software would keep track of participation and the ratio of on-topic to off-topic comments to determine when students need help. The software would provide students with feedback about their comments and overall performance during the discussion, as well as aid instructors in assessing the relative contributions made by each student.

Other researchers have attempted to address some of these issues. For example, [12] report on their efforts to use features of student discussions, such as dialogue acts and student roles, to predict the quality of a discussion and the appropriate intervention. Their system was unable to handle natural discourse, and instead relied on sentence openers that students selected to identify dialogue acts, e.g. “Do you think…” and “To elaborate...” Their automated learning companion, which behaved as a peer to the student discussants, was able to identify and intervene when students were confused. The learning companion drew attention to a student’s confusion by adding comments to the discussion reiterating the student’s question. However, the agent was not able to provide explanations or add information to the discussion. Furthermore, the agent missed occasions when it should have intervened, and frequently intervened when it was not necessary, both of which can disrupt collaboration among students.

Unfortunately, automated moderation software is not yet commercially available. However, these tools do exist in prototype form. The tools to be described have been integrated into the Knowledge Post online discussion environment and empirically evaluated in several military user communities. This report outlines the findings and a scheme for integrating these tools into disparate collaborative environments.

B. Knowledge Post

The capabilities of Knowledge Post as it exists today include the abilities:

1. To find material in the discussion or electronic library that is similar in meaning to a given posting (see Figure 1).
2. To have contributions automatically summarized by hovering the mouse over the subject of the note (see Figure 2).
3. To enhance the overall quality of the discussion and consequent learning level of the participants.
4. To have expert comments or library articles interjected into the discussion in appropriate places by automatically monitoring the discussion board activity (see Figure 3).
5. To automatically notify instructors when discussion goes off track

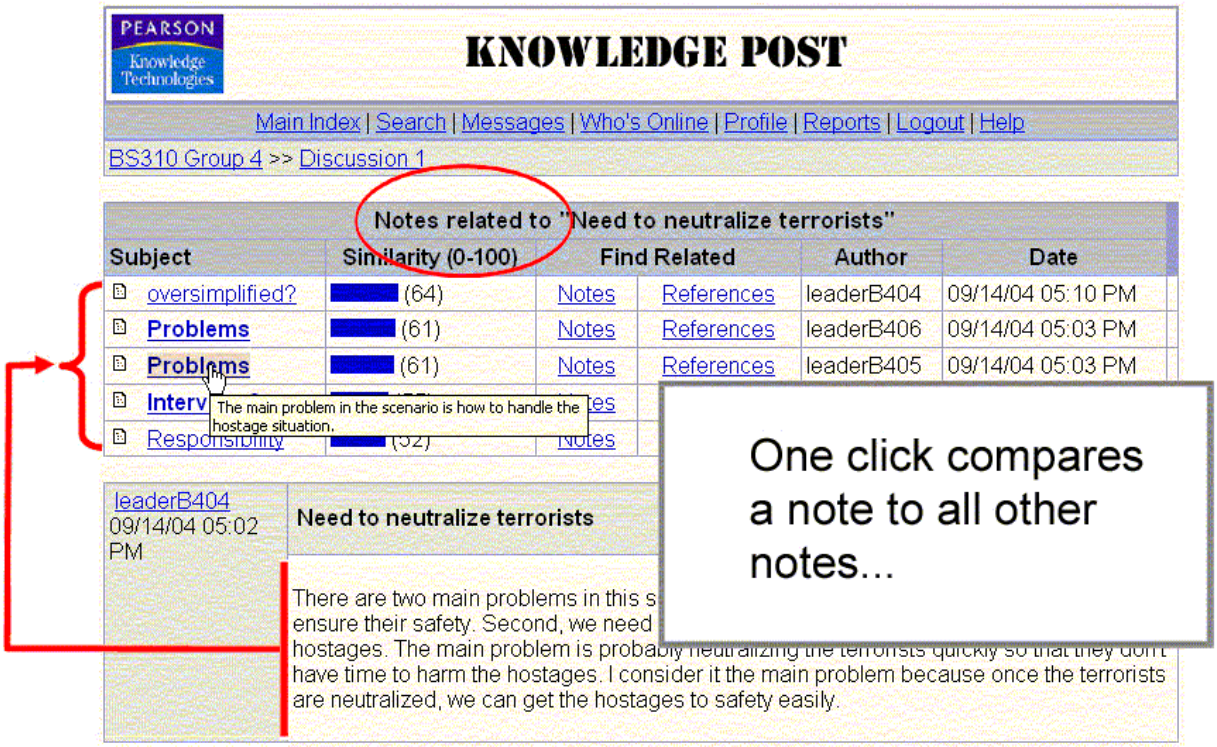

Figure 1. A screenshot from Knowledge Post showing the results of a search for notes similar to the note "Need to neutralize terrorists."

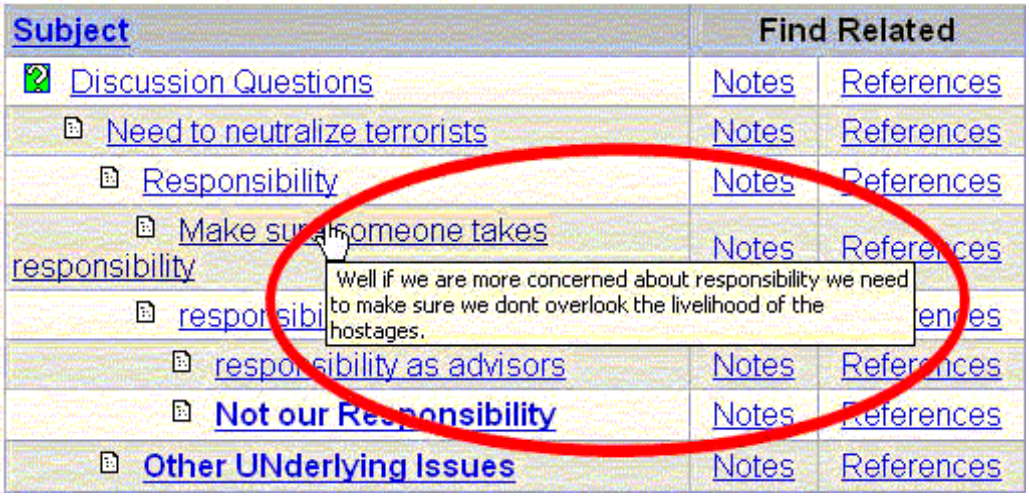

Figure 2. A screenshot from Knowledge Post showing the an automatic summary of the note "Make sure someone takes responsibility" generated by holding the mouse over the subject line.

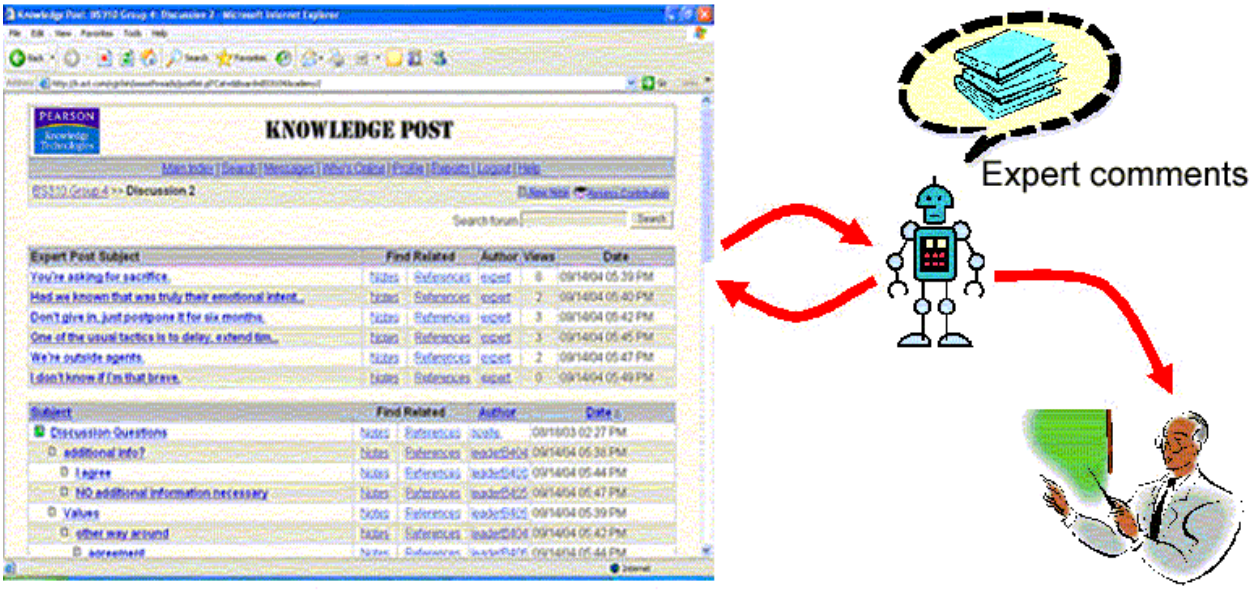

Figure 3. The automated moderator in Knowledge Post to automatically notify the instructor when the discussion goes off track.

The first three functions have been part of Knowledge Post for some time, and have been evaluated [13]. Several hundred Army officers, including Lieutenants, Captains, Majors, and Lieutenant Colonels have discussed military scenarios of this sort either face-to-face or using *Knowledge Post*®. Across a broad range of managerial and military scenarios, officers learn more using the threaded discussion tool than they do in face-to-face discussions. The scenarios used in these experiments were either "Think Like a Commander" (TLAC) scenarios developed at Ft. Leavenworth or "Tacit Knowledge of Military Leadership" (TKML) scenarios developed jointly by the Army Research Institute and Yale University [14]. The TLAC scenarios were developed to teach tactical and strategic thinking skills. The TKML scenarios are based on a carefully developed set of representative scenarios of challenging interpersonal leadership situations that are commonly encountered by Army officers, along with sets of alternative actions that a leader might take.

Thirty-eight officers discussed the scenarios face-to-face and wrote their responses using pencil and paper, while the twenty-eight typed their thoughts and eventual "solutions" into the online discussion environment. The electronic discussion group entered an initial response and then a final response after an online synchronous discussion. All responses were randomly sorted and the rank of the officers removed before they were then "blind" graded by two military leadership experts. The grading was based on their expert assessment of the quality of the proposed actions and comments. The results are shown in Figure 4 for all of the TLAC scenarios for one rater. (The same pattern of results has been found for the TKML scenarios and the other raters.)

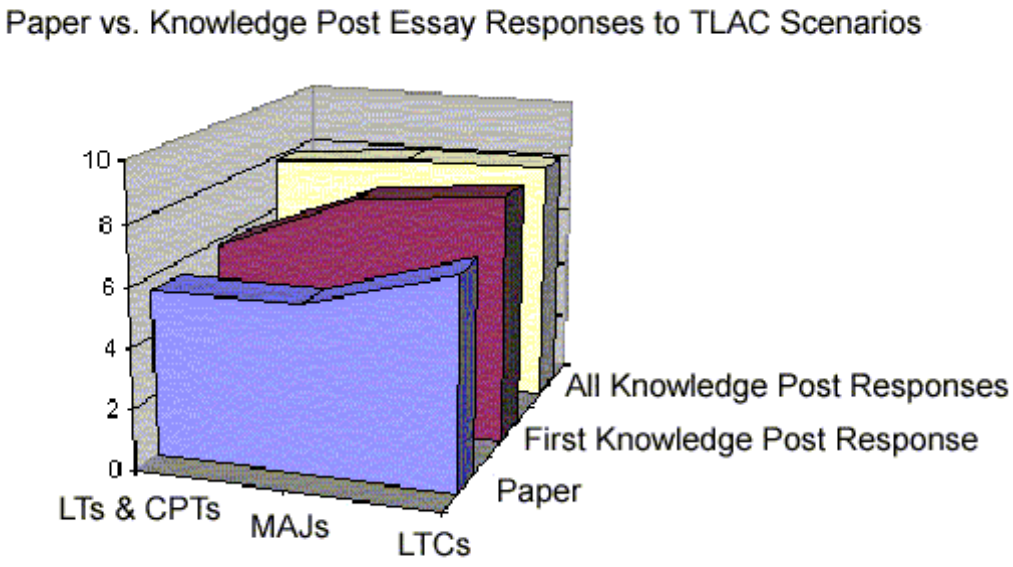

Figure 4. LTs, CPTs and MAJs all wrote better scenario responses using Knowledge Post than using pencil and paper [13].

The rated quality of responses, on a 10 point scale, is plotted for each of the four officer categories as a function of whether they were in a face-to-face discussion group and summarized their views using pencil and paper or whether they were in the electronic discussion group. Whether the discussion took place face-to-face or electronically made a large difference—those who used the electronic discussion group contributed much higher quality initial responses (shown as First *Knowledge Post*® in Figure 4) than those in the paper and pencil group. In addition, the lower ranking officers (Lieutenants and Captains) learned more using the electronic discussion group than did the same ranks of face-to-face participants.

Although senior officers (Majors and Lieutenant Colonels) had a slight superiority in the paper-based version, all officer groups improved through the *Knowledge Post*® discussion. Even the first response in the online format was superior to the final responses in the face-to-face discussion. Several factors may contribute to the better discussion and learning in the electronic medium. It is likely that the tendency for participants in online discussions to be more thoughtful, and engage in deeper cognitive processes [6], accounts for the advantage of the online responses. The anonymity that contributing to an online discussion provides may be another reason. The endurance of contributions made in an online environment may have also increased the officers' motivation to provide a better response. An additional factor is the parallel nature of the discussion—members of an electronic discussion can contribute simultaneously, thereby making more effective use of the time available. This is not possible in face-to-face discussions. The potential for deeper cognition, coupled with greater equality of participation and anonymity, results in a richer set of ideas generated by a greater number of people.

The other two features of Knowledge Post, automatic interjections of expert comments, and automatic notification of instructors when discussion go off track, have been evaluated more recently and are the subject of this paper.

C. The Technology behind the Tools

The tools that were developed do meaning-based search, summarize and assess postings, and moderate discussion groups by gleaning the meaning of the posted text automatically. The critical technology that performs these functions is Latent Semantic Analysis (LSA), a machine learning algorithm that understands the meaning of words and text in such a way that frequently matches the judgments of humans. For example, LSA infers similarity between words from the contexts in which they occur. Table 1 shows the similarity of five words. Similarity is measured by the cosine of the words in a high

dimensional LSA semantic space. The cosine ranges from 1 (perfect similarity and a zero degree angle between the two vectors) to -1 (180 degree angle between the two vectors). On average, two unrelated words will have a cosine of about zero.

	doctor	physician	surgeon	lawyer	attorney
doctor	1				
physician	0.61	1			
surgeon	0.64	0.65	1		
lawyer	0.06	0.06	0.13	1	
attorney	0.03	0.05	0.09	0.73	1

Table 1. LSA similarity between 5 words

LSA uses a fully automatic mathematical technique to extract and infer meaning relations from the contextual usage of words in large collections of natural discourse. It is not a traditional natural language processing or artificial intelligence program; it uses no humanly constructed ontologies, dictionaries, knowledge bases, semantic networks, grammars, syntactic parsers, or morphologies [15].

LSA takes as input large quantities of raw text parsed into words and separated into meaningful passages such as sentences or paragraphs. Although the technique is based on the statistics of how words are used in ordinary language, its analysis is much deeper and more powerful than the simple frequency, co-occurrence, or keyword counting and matching techniques that have sometimes been assumed to be the only purely computational alternatives to traditional Natural Language Processing. LSA learns about the relations between words and documents by machine analyzing large collections of text—currently handling a billion words of input. The output of this analysis is a several hundred dimensional semantic space in which every word and every document is represented by a vector of real numbers—one for each dimension. Semantic similarity is measured by the cosine of the angles between the vectors representing two words or documents. LSA is not keyword matching. For instance, in LSA similarity space the meaning of the two sentences listed below is extremely close, yet there are no words in common between them:

The doctor operates on the patient.

The physician is in surgery.

LSA is also able to deal with issue of polysemy, or words that have multiple meanings. LSA is able to determine that a word is similar to all of its meanings. For example, the word “fly” has several meanings, including an insect, and to travel through the air. In LSA similarity space “travel through the air” and “fly” are equally close in meaning as are “ two-winged insect” and “fly.” Further, LSA can disambiguate a word with multiple meanings by relying on the context that the word occurs in.

LSA simulates important practical aspects of human meaning to a very useful level of approximation [16]. And it does so using a robust, domain-independent process that allows it to effectively perform tasks that, when performed by a human, clearly depend on understanding the meaning of textual language. LSA does require a sufficient amount of appropriate text to perform optimally. There are countless applications of LSA including the ability to grade text essays and assign grades that are indistinguishable from a skilled human grader [17], as well as the ability to perform meaning-based search.

Alternative technologies have been used to support computer-supported collaborative learning, such as TagHelper, which was designed to analyze the collaborative learning process through automatic corpus analysis [18]. TagHelper is a technology tool designed to partially automate the tagging of content in a

discussion for purposes of process analysis. The authors propose that TagHelper may be used to support moderators of on-line discussions. [12] have also applied a variety of NLP techniques, including hidden Markov models and neural networks, with modest success.

We have taken a different approach using LSA to solve similar analysis and support problems with on-line collaborative learning. With LSA, there is no need for time consuming coding of content, which is often a subjective process that fails to generalize to new course content. Further, LSA has been shown to be more effective than other automatic techniques for modeling the semantics of human language in retrieval and indexing, [19], [20]. However, when text is very brief (less than a sentence) LSA may be less able to accurately assess meaning, and an approach more like TagHelper where content is tagged could be more appropriate.

D. The Automated Monitor: Research with the Army War College

The U.S. Army War College's distance education program is of the highest caliber in terms of course construction, faculty moderation, and the students who attend, typically high potential Lieutenant Colonels and Colonels. The Army War College has a large distance learning program with online discussions actively monitored by course instructors. We participated in a study with the Army War College in 2004, where we applied our monitoring technology to an online course activity, and returned live feedback to instructors. The monitoring tool was able to detect important shifts in discussions, and alert instructors in near real-time to potential problems. These initial results indicated that the automated monitor could benefit distance learning instructors by minimizing the amount of time spent monitoring online discussions.

E. II. Method

The automated monitor was developed and tested during an asynchronous distance learning activity offered to several hundred senior officers in January 2004 over a ten day period. There were 20 separate discussion groups with 12 to 15 participants per group. Participants were U.S. government personnel from all over the world—from Kuwait to Kenya to Kansas. The activity was titled "Interagency Process Simulation" (IPS) and dealt with U.S. foreign and security policy and the future of NATO [21]. Students addressed the following issues during the simulation:

- Continued U.S. engagement in Europe through NATO
- Russian membership in NATO
- European Union security and defense development

Participants were given unique roles, such as Deputy Secretary of State, and assigned to departments and committees, e.g., State Department, Policy Coordinating Committee, Deputies Committee. The departments and committees were organized according to the structure shown in Figure 5, with members of the Policy Coordinating Committee (PCC) also belonging to a department.

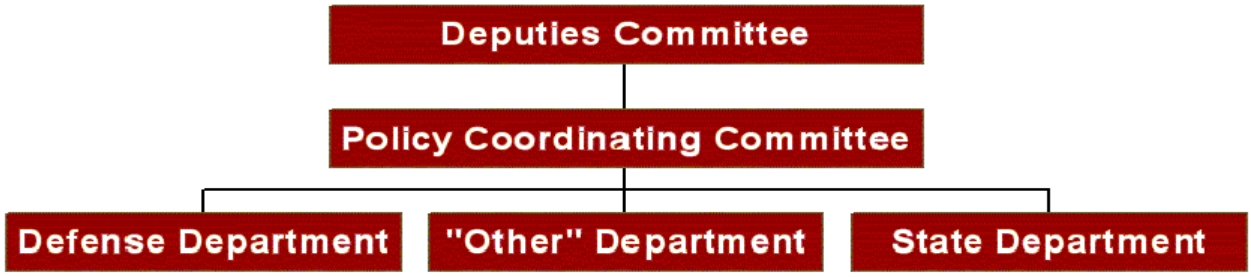

Figure 5. The organization of the Interagency Process Simulation activity.

During the first five days of the activity, the students who were part of the PCC discussed the three issues first in their departments, and then together as the PCC. At the end of the four days, these students completed a 450 word policy alternatives document that they sent to the members of the Deputies Committee (DC). Over the following five days, the students on the Deputies Committee discussed the issues and the recommendations made by the PCC. At the end of their deliberations, they submitted a 450 word final policy recommendation.

The discussion generated over six megabytes of text with a few hundred comments per group, for a total of 1829 comments. Comments were quite long and well-thought out, averaging around 150 words, indicating that students were heavily engaged in the simulation.

There are several ways to tell that a discussion group is "in trouble." The most obvious one is a low participation rate, and detecting this is not a technological challenge, although it provides useful information to instructors. Another indication of trouble is spending far too much time coordinating the group's work, i.e. figuring out who is going to do what, or straying too often from the topic at hand. Automatically detecting coordination difficulties and off-topic remarks was the technological challenge we addressed.

We reasoned that both coordination difficulties and off-topic remarks should be signaled by a series or a high proportion of "administrative" comments. At the other end of the spectrum a group that was "cooking" would have few administrative comments and a large number of comments related to the subject matter of the course. It is reasonable to expect that a higher number of planning and coordination (administrative) comments would occur at the very beginning of the course activity, as students make decisions about how to divide work, and discuss any technological or coordination issues.

F. A. Automatically separating administrative from content comments

The method developed automatically separated administrative comments from content comments. Separating the two types of comments can be viewed as a signal detection problem—a threshold is needed that identifies the greatest number of hits with the fewest number of false alarms. We used two techniques to score the comments, and then chose thresholds to maximize the accuracy of the separation of the comments. The two techniques are discussed in more detail below.

We were given text from an earlier run of the IPS activity in 2003, including the full text of the discussion with 1605 comments, and the 40 policy papers produced by the students. For the first scoring technique, we had four human graders (one military expert, two political science graduate students, and one non subject matter expert) assign a grade to the policy papers generated by each group yielding a total of 40 papers. The four scorers used the same rubric to score the papers. The reliabilities between the graders were modest with $r\ (40) = 0.43$, $p = .005$ as the best inter-grader reliability, which is on the low side of inter-rater reliabilities for such exercises. We then used a commercially available essay grading product, the Intelligent Essay Assessor (IEA), [17] based on LSA and other statistical language measures to predict the average of the four human grades for all of the group essays. We chose to model the average of the human graders, rather than any individual grader, because the average was a more stable estimate of the essay quality. The auto essay grader creates the best fitting statistical model to the grades, which can then be used to score new essays as accurately as human graders. In this case, the model correlated with the average human scores $r\ (40) = 0.56$, $p = .005$ and consisted of two LSA content measures and one readability measure. Using the IEA model produced for the final essays, we were able to score each comment. Because the model was trained on the course content, higher scores indicated that a comment was more similar to a high scoring policy paper, so included more content while lower scores indicated that the comment was more similar to a low scoring policy paper, and had less content.

The second technique we developed using the 2003 IPS course data did not require human scores. Instead, we conducted a principal components analysis on the set of LSA vectors representing the meaning of each paper. This method does not require any training on the human scores of the comments. The intuition behind this method is that a smart human grader, but one who is not necessarily a subject matter expert, could take a pile of essays on the same topic, read them all, compare them and in the end

have formed some opinions of which were the good essays and which were the poor essays, and these opinions would be reasonably accurate. This method produced a score for each paper, indicating the amount of content in the paper, with higher scoring papers having more content and lower scoring papers having less. The correlation between this unsupervised learning technique's scores and the average human scores was significant, r (40) = .51, $p < .001$.

The goal was to use these two types of scores to accurately separate the comments into two categories: administrative and content. A comment is defined as the entire text of a student's post. A human coded the comments as administrative or content, coding 449 of the comments as administrative, and 1156 of comments as content. A second human rater coded a randomly selected 10% of the comments (162). The correlation between the two human scorers was acceptably high (r (162) = .852, $p < .001$).

Separating the two types of comments can be viewed as a signal detection problem – a threshold is needed that identifies the greatest number of hits with the fewest number of false alarms. Using the first comment scoring method, an appropriate threshold was selected for separating the comments based on the IEA scores. The threshold was selected based on the IEA scores of the comments in such a way that the most comments, both administrative and content, were correctly classified. All of the comments above the threshold were classified as content, while those below the threshold were classified as administrative. This classification was compared to the human coding, and then hits and false alarms were calculated for various thresholds. The threshold that maximized hits and minimized false alarms was selected. Table 2 shows the classification based on the threshold selected.

	Classified Admin	Classified Content	TOTAL
Admin	331	118	449
Content	62	1094	1156

Table 2. The classification of comments from the IPS course.

This model correlated significantly with the human scores, r (1605) = 0.72, $p < .001$. Note that only 11 % of the comments were misclassified. Using the second method, the unsupervised learning algorithm, the comments were all scored, a threshold was selected in the same way and the comments were classified. This model also correlated significantly with the human scores r (1605) = .84, $p < .001$, and only 4.9 % of the comments were misclassified. Below are examples of the comment types:

ADMINISTRATIVE: I just want to say 'Thank You' to each of you in our group. It's been great teamwork. Look forward to meeting you all in June. God bless. Jim

CONTENT: The EU military capability needs to be more than a collective security (defensive) organization, it also needs to have a power projection capability to react to global contingencies that affect Europe. If the concerns can be overcome with effective cooperation and coordination between NATO and the EU, then the U.S. should support the EU's ESDP.

CONTENT MISCLASSIFIED AS ADMINISTRATIVE: Mark and Al: Greetings from San Antonio. The paper here says that the Germans and the French do not like our President's straight forward, Texas way. Well I guess they probably did not like LBJ in the 60's. Mark: I read your paper and then I read the Kennedy's comments. Pretty good stuff. I agree with Gary that the State may water down what comes out of the PCC in order not to offend. This is what Steve pointed out during his AAR. I am a little bit unsure on what happens next. Do we sell Kennedy on trying to revise his language to be more direct and if so who does? I am reaching here. For now though I will look and see what the IPS Gazette has to say for today.

Classifications from both comment scoring methods were very accurate. The classification based on the

unsupervised learning method is well suited for use in courses where human scored essays are not available to train IEA. The unsupervised learning method will be used as the basis for automatically coding comments and monitoring the 2004 run of the IPS activity.

G. Results of Monitoring the 2004 IPS Activity

During the activity we received via email all messages that were posted to the forum. The emails were processed each day at 3:00 pm, in order to return feedback by 5:00 pm. A total of 1829 comments were received. The course author, Charles Krupnick, invited us to provide a daily feedback report to all the instructors, customized to their discussion groups, detailing the students' performance, and indicating whether any groups needed instructor intervention. In essence, this feedback could act as a stand-in for the normal instructor monitoring.

Feedback was returned beginning with the third day of the PCC discussion and continuing through the first week. Feedback was returned for every day of the DC discussion during the second week except the first day. The first two days of the first week, and the first day of the second week did not yield much discussion, as students were busy reading instructions and course materials, and learning to navigate the forum. The daily feedback file sent to instructors included a brief summary at the beginning, where important information was listed including any groups that had nonparticipating key members (responsible for submitting policy papers) or had a high percentage of administrative comments, followed by a list of participation by student. Following is an example of the feedback returned to student discussion group 1 on the fourth day of discussion:

IPS feedback for comments posted between 5pm EST January 21 and 5pm EST January 22.

Notes: The following discussion groups had no posted comments from the Asst Sec of State for European and Eurasian Affairs for the last 2 days: SDG 06.

SDG 06

Student Name	Number of Contributions	
Student 1	0	Asst Sec of State for European and Eurasian Affairs
Student 2	0	
Student 3	1	
Student 4	1	
Student 5	1	
Student 6	1	
Student 7	1	
Student 8	1	
Student 9	3	
Student 10	3	

Total Contributions: 12

0% Administrative (off-topic)

100% Content (NATO)

The comments were scored using both the automated essay grader and the unsupervised learning method based on grades from the previous IPS administration (2003). The cut-offs to discriminate between administrative and content comments were based on cut-offs from the previous IPS (2003) as well. The course author, Charles Krupnick believed that the feedback was useful and contained pertinent information that could reduce the amount of time instructors spend monitoring the discussions. In future runs of the IPS activity, fewer instructors might be able to manage the course, while maintaining the same high level of discussion among the students.

H. The Automated Moderator: Research with the Air Force Academy

Scenario based instruction has become a popular way of instilling practical or tacit knowledge in students. However, scenarios can fail as a learning mechanism if the subject matter does not grab the students' attention, if there is not enough to say about the topic, or if there is not sufficient diversity of opinion among the participants. Even if a scenario is representative of problems encountered in the field, it may thus fail to generate discussion. For these reasons we constructed a scenario based on actual events, geared to military cadets, that engaged tactical and strategic military thinking, and for which there had been considerable debate among experts when the event occurred.

I. Developing an engaging scenario

Our scenario was based on the 2002 Moscow theater incident, in which a Chechen terrorist group took over a theater and held approximately 700 theater-goers hostage for three days. The real event was resolved when Russian forces released a sedative gas into the theater and stormed the building. As a twist on the actual incident, the scenario was set in the Philippines, some of the hostages in the theater were Americans, and the hostage-takers claimed that the incident was a direct reaction to the American military re-entry into the Philippines. The discussants played the role of an ADVON (advanced echelon) team commander, and were asked to develop reasonable courses of action. In addition to the scenario, background news articles were provided as part of the exercise. The news articles were adapted from real news stories that were published about the Moscow theater incident.

J. Collecting expert responses to the scenario

Colonels and Lieutenant Colonels from the National Defense University contributed their knowledge and expertise to the terrorist scenario in several pilot studies. Three Colonels and one Lieutenant Colonel in the U.S. Air Force were recruited to review the scenario for accuracy and generate expert comments. They were given the terrorist scenario and background news articles, and asked to discuss the scenario in a face-to-face group. A moderator prompted the officers to discuss various aspects of the scenario that cadets would later be asked to discuss in Knowledge Post. These experts included information that was missing from the scenario and background information, possible courses of action, and personal experiences that contributed to their decision-making. The officers' comments were recorded and transcribed. A total of 104 comments were generated.

One U.S. Army Colonel and two Lieutenant Colonels contributed to an online Knowledge Post discussion that involved Air Force and Army cadets as part of an in-class exercise. An additional 16 comments were generated by the Colonels. An example interchange is shown below:

Colonel 1: "All Commanders in similar situations should immediately review their initial mission statements and guidance. In this case Rules of Engagement and political priorities are important since you represent your country and its interests. Careful consideration of the consequences of your actions should include immediate and close coordination with the country team - including the embassy staff."

Colonel 2 replied: "Agree with this advice. In addition to being cautious, absolutely review the ROE's and any mission statements, OPORD's etc provided to me as CDR of the advance team, and be sure we adhere to these orders."

K. Selecting the Right Comment to Interject

To be effective, an automated moderator should interject relevant comments during the discussion. Additionally, the automated moderator will only have a chance of improving the quality of the discussion if the participants read the comments that it posts. If many of the comments seem to be off-topic or irrelevant, the participants will learn to ignore the automated moderator's contributions.

To make comments relevant, we used LSA to select the comment that was most semantically similar to the ongoing discussion at any given point in time. LSA was used to compare the text of the discussion to the database of officer comments. The officer comment that was most similar to the discussion up to that

point (had the highest cosine) was selected automatically and posted to the discussion in real-time. Because the automated moderator added comments from senior officers, the hope was that the comments contained important additional information for the participants to consider. As the discussion unfolded and new information was introduced by the participants, the agent continued to select and post new and relevant officer comments.

Based on pilot testing with Army ROTC students from the University of Colorado, we determined that the automated agent should interject a comment for every seven student comments. When comments were interjected more frequently, the agent's comments tended to be more frequent than any one student's comments. When the agent's comments were interjected less frequently, the agent failed to contribute more than a few meaningful pieces of information during the discussion. Selecting a rate of one agent comment for every seven student comments allowed the students to explore the bulk of the scenario on their own, but ensured that enough comments were added by the automated moderator that students were exposed to several important pieces of information they had failed to generate on their own. In an additional pilot study at Fort Hood, we gave transcripts of the scenario discussions from other officers. We asked the Fort Hood Majors and Lieutenant Colonels to indicate when a comment should be added and what the comment should be. There was no general agreement on when to interject comments. The officers did not seem to feel that there was an optimal time to correct the cadets. However there was high agreement that comments needed to be added in order to instruct the cadets on more appropriate responses to the scenario. Thus, the ratio of 1 to 7 used here may neither be optimal or appropriate for all circumstances.

L. Evaluating the Automated Moderator

We found this terrorist scenario to be successful in eliciting rich discussions within Knowledge Post because of its realism. Responses to this scenario also seem to discriminate well between officers at different ranks. Junior officers often focus on rescuing the hostages with direct military action, while more senior officers are generally concerned with the safety of the ADVON team they are commanding, rules of engagement, informing the appropriate chain of command, and possible diplomatic courses of action. Improvements in the junior officers' responses based on expert interjections should be measurable.

In order to determine how effective the automated moderator was in increasing the quality of the discussion, we conducted an experiment at the U.S. Air Force Academy in the fall of 2004.

III. THE EXPERIMENT

One hundred and twenty-six U.S. Air Force Academy cadets volunteered to participate in discussions of the terrorist scenario using Knowledge Post. The cadets participated in groups of approximately ten, for a total of twelve separate groups. The cadets were provided with the background news articles as well as the scenario. The cadets were asked to discuss various aspects of the scenario culminating in a decision about the best course of action. The discussion was conducted in three sections. During the first part, the cadets were asked to discuss the following questions:

1. What problem(s) needs to be solved in the scenario? What is the main problem that must be solved? Why do you consider this to be the main problem?
2. What information did you feel was most relevant and why?
3. Based on your collective wisdom, what additional information is still needed?

During the second phase, the cadets were asked to focus on making connections between the information presented during the discussion, by addressing these questions:

1. Additional information was needed to supplement the news articles. Did you attempt to find this information, if so what did you find? Is the additional information still relevant?

2. How does the information you identified as most relevant relate to the leadership topics discussed in class? At a minimum, discuss the CPP, Philippines, and U.S. in terms of the following leadership topics: i) Values and Ethics, ii) Personality.

3. After considering other discussants comments, evaluate the information considered most relevant in terms of the connections between the relevant information and/or with the leadership topics. Without actually discussing response options, what two or three pieces of relevant information when combined provide insight on an appropriate course of action? What are the associations that support combining the information? Why is this combination of information important?

In the third phase the cadets were asked to discuss these questions:

1. Discuss a personal experience that is relevant to the problem discussed, focusing on the collective information you combined during the previous discussion.

2. After considering other discussants' personal experiences, what course of action would you recommend to solve the problem? Why do you consider this course of action to be most appropriate?

3. What course of action would you recommend to end the hostage crisis? Why do you consider this course of action to be most appropriate?

The cadets were assigned to one of three conditions: 1. Knowledge Post with the automated expert, 2. Knowledge Post without the automated expert, and 3. a face-to-face classroom discussion of the scenario with a human moderator. All cadets discussed the same scenario and received the same instructions. They were all given one hour to complete the discussion with approximately twenty minutes spent on each of the three sections. To allow direct comparisons between Condition 1 and Condition 3, the human moderator in Condition 3 read aloud a selection of the expert comments that were interjected into Knowledge Post and did not add any of their own comments or moderation behaviors. The human moderators selected the comment from the database that they felt best matched the face-to-face discussion. We felt this was analogous to the way in which LSA was used to automatically select the best comment form the database. Figure 6 is a screenshot of Knowledge Post showing a discussion with expert comments added by the automated expert. The expert comments are presented in a table above the cadet discussion. This screenshot is taken from a completed discussion, and shows the second of the three parts of the discussion.

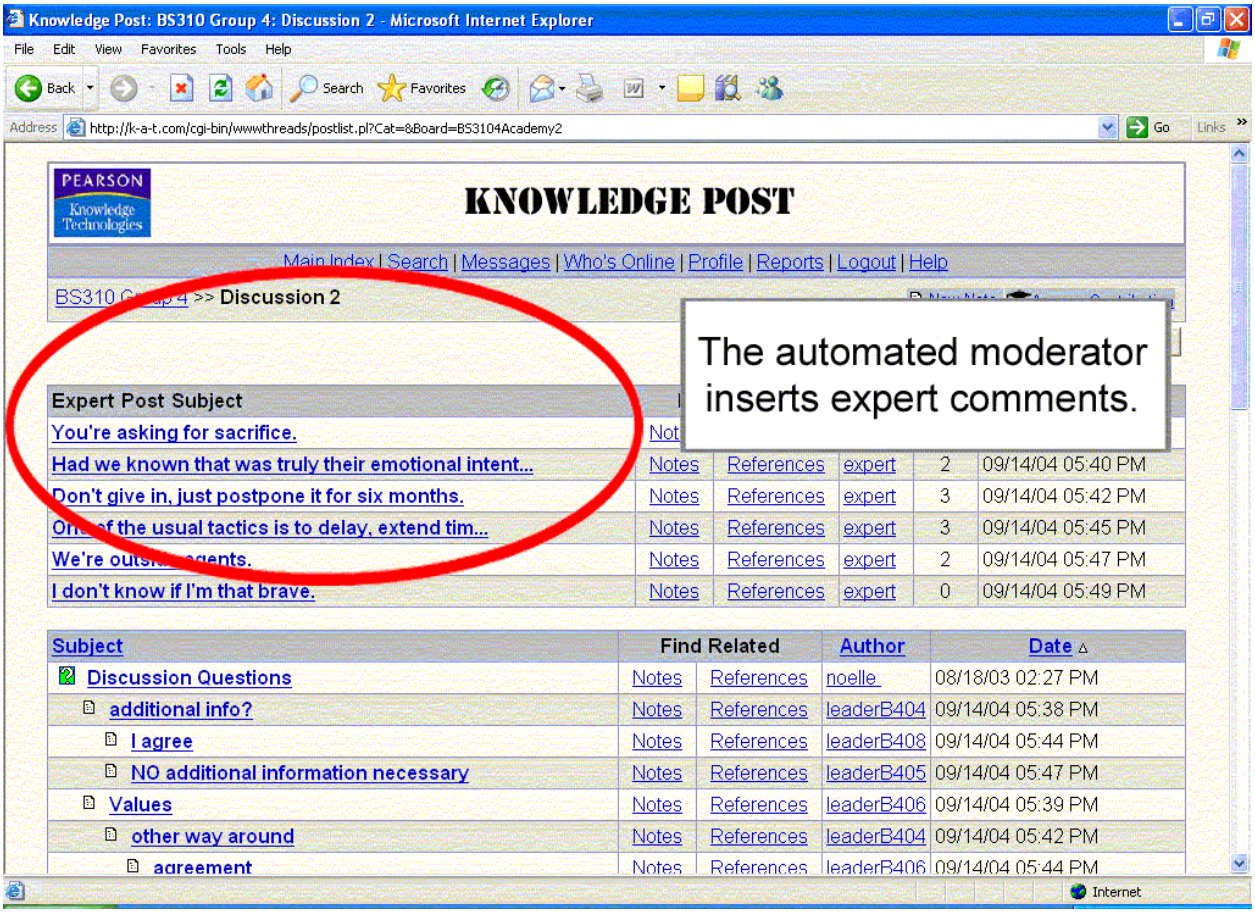

Figure 6. A screenshot of Knowledge Post showing the automated moderator's comments at the top.

IV. RESULTS

Based on previous research [4], [13], we expected Knowledge Post groups to perform better than the face-to-face cadets. We also expected that the cadets who had the benefit of the automated moderator would have the highest quality comments because of the additional knowledge and perspective they were exposed to through the senior officer comments. We did not expect these comments to have the same impact in the face-to-face group, mainly because face-to-face discussions offer fewer opportunities for participants to perform deeper levels of cognitive processing [6]. Further, fewer participants are likely to participate actively in a face-to-face discussion compared to a well-run online discussion [8].

We assessed the effectiveness of the automated moderator using three separate metrics: the quality of the cadets' comments, the number of moderator comments read, and the cadets' ratings of the moderator comments. We looked at the quality of the cadets' comments by comparing them with the senior officers' discussions. These discussions represented the highest quality of discussion around the terrorism scenario and included discussions among groups of Lieutenant Colonels and Majors from Fort Hood and Fort Sill, as well as NDU. Using LSA, we were able to compare the text generated by the cadets to the text of the entire senior officer expert discussion (not just the comments used by the automated moderator) and assess the similarity between the cadet comments and the expert comments. Analyses focused on the third portion of the discussion. The third section was chosen because the cadets discussed optimal courses of action and the resolution of the scenario in this section after having been exposed to a large number of expert interjections over the course of the exercise. Similarity was measured as the cosine between the cadets' comments and the expert discussion. Cosines vary between 1 and -1, with 1

indicating perfect similarity between the texts being compared, 0 indicating that there is no similarity, and -1 indicating perfect dissimilarity.

A. Quality of Discussion Comments

A one-way analysis of covariance was conducted to examine the differences between the three conditions (Knowledge Post with moderator, Knowledge Post without moderator and face-to-face). Discussion group was included as a covariate because the quality of cadet comments may be dependent upon the discussion group. Further, contrast codes were used to test the a priori hypotheses that the cadets who received moderator comments in Knowledge Post would have higher quality comments than those in the other conditions, and that cadets in the face-to-face condition would have lower quality comments than the cadets in either Knowledge Post condition. There was a significant main effect of discussion condition, over and above any effect of discussion group, $F(2, 112) = 9.7$, $MSE = .08$, $p < .001$. The contrast coded comparisons revealed that cadets who participated in a Knowledge Post discussion with the automated moderator had higher quality comments ($M = .64$) than did cadets who participated in a Knowledge Post discussion without the moderator ($M = .59$), mean difference = .065, std. error = .021, $p = .002$. Also as predicted, the cadets that participated using Knowledge Post (either with or without the moderator) had higher quality comments ($M = .62$) than those that participated in face-to-face discussions ($M = .54$), mean difference = .129, std. error = .033, $p < .001$. These results are shown in Figure 7.

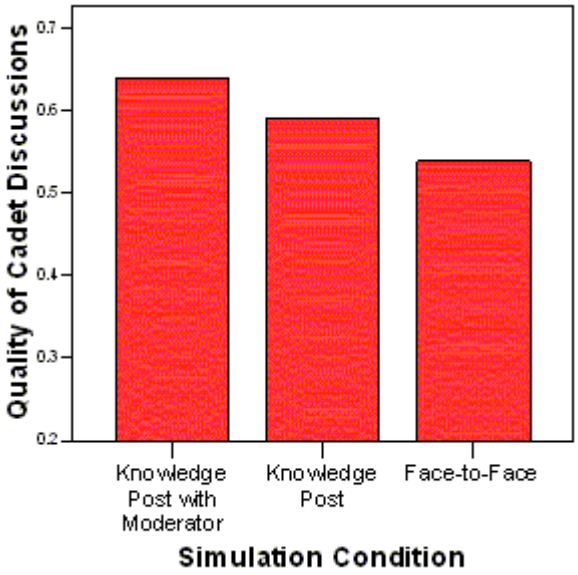

Figure 7. Quality of discussion comments in the three discussion conditions.

The covariate, discussion group, was significant as well, $F(1, 112) = 4.3$, $MSE = .04$, $p = .041$, suggesting that the separate discussion groups varied in quality. This is of interest, especially in light of research suggesting that dynamics within a group can mitigate learning, regardless of the quality of individual contributions [22]. This would be an interesting issue to follow-up in a future experiment, designed to examine the impact of group processes on collaborative learning.

These results clearly indicate that the automated moderator improves the quality of cadet comments through the online discussions. Further, the results suggest that the cadets incorporated the new information gleaned from the senior officer comments into their discussion – even though no senior officer was present. Knowledge Post, or other online discussions, may be an ideal environment for this kind of knowledge transfer, as the cadets in the face-to-face condition did not get the same benefits from the senior officer comments they were exposed to as the cadets in the automated moderator condition did.

B. Number of Moderator Comments Read

The cadets who discussed the scenario face-to-face had a live moderator who read aloud some of the comments collected from the senior officers during these face-to-face discussions (drawn from the same comments that were added by the automated moderator in Knowledge Post). On average, the human moderator added fifteen comments over the course of the hour's discussion. The face-to-face discussions were recorded and transcribed for later analysis. The cadets who used Knowledge Post with the automated moderator received an average of 30 expert comments over the three parts of the discussion. We assessed how many times cadets read the expert comments posted by the automated moderator in Knowledge Post. We reasoned that if the cadets thought the comments were useful they would read them more often, and continue to read them throughout the course of the discussion.

We looked at how many times the cadets who received comments from the automated moderator actually read those comments during the hour long discussion. Because the students had only one hour for the discussion, they were limited in the number of comments they were able to read. On average each individual cadet read 19% of the comments, six of the 32 added by the automated moderator. However, the group of cadets as a whole read 63% of the expert comments (20 out of the 32), suggesting that much of the information contained in the expert comments may have been shared during the discussion. As a comparison, on average students read 42% of the comments written by other students over the course of the discussion. The students also continued to read the moderator's comments periodically throughout the hour long discussion, reading two comments per section, on average. This is a good indication that the cadets found the moderator's comments relevant throughout the discussion, although perhaps not as relevant as they found each others' comments.

C. Cadet Ratings

Following the discussion, the cadets were asked for feedback on the automated moderator including their impressions of the automated moderator's comments. They rated the usefulness, relevance and how much they liked the moderator's comments on paper using a 7 point Likert scale. The Likert scale had a midpoint labeled "somewhat", and end points labeled "not at all" and "very much" for each of the attributes they were asked to rate.

We also looked at the comments collected from the cadets following the discussion. When asked whether they thought the moderator's comments were relevant, the average rating was 4.9 out of 7. Similarly, the ratings of comment usefulness averaged 4.5 out of 7. When asked how much they liked the moderator, cadets responded with an average rating of 4.4. All ratings fell between "somewhat" and "very," providing further evidence that the cadets found the moderator's comments relevant and useful and that they generally liked the moderator's presence in the discussion.

V. DISCUSSION

Knowledge Post differs from a vanilla online discussion group in many useful ways, including semantic searching and automated monitoring and moderation. These enhancements are currently available only within Knowledge Post, and integrating with all of the online discussion group vendors would be prohibitive as the vendor space is large and the APIs required for integration do not yet exist. Instead, we envision an architecture as shown in Figure 8 in which the LSA search facility and automated moderator functionality operate as commercially available internet-based services that can be integrated into any forum software package or group discussion software (e,g., Wiki's, IRC chat, etc.) via an exchange of XML messages.

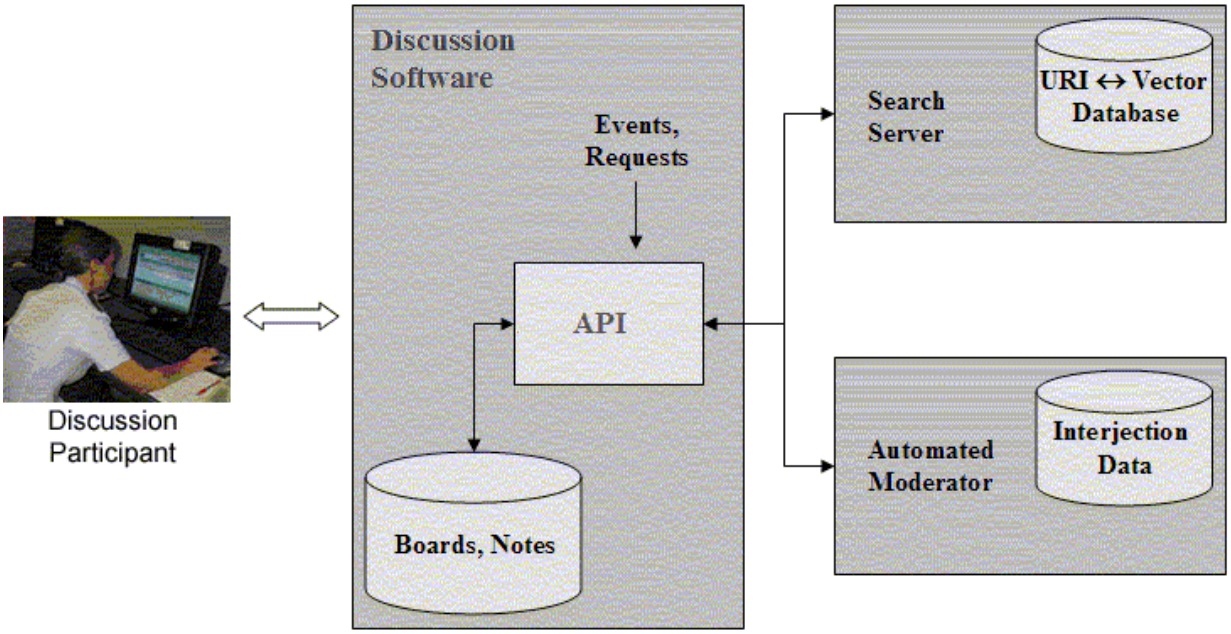

Figure 8. Knowledge Post Service Architecture.

The architecture provides two cooperating information services accessible via APIs we would provide and publish. The Search Service maintains a database of domains (corresponding to a board in a discussion forum, a stream of IRC chat or a Wiki topic area) containing elements (corresponding to posts in a forum, statements in a chat stream, or pages in a Wiki). Client applications label domains and elements using a unique identifier, such as a URL or URI, and send them to the search service for indexing. An LSA vector is created for each element received by the search service and indexed against the corresponding unique identifier. In addition, the search service computes a summary sentence for each element, which is returned to the discussion board software to be displayed whenever a concise summary of the message is needed (for example, as a mouse tooltip). The element text is discarded by the search service, and only the LSA vector is stored.

While this architecture allows the Knowledge Post features to be more accessible to other online discussion group software, there would be some development work required to adapt our tools for use with other software. There are also additional requirements for applying the automated moderator in other courses, namely a selection of "expert" comments appropriate for interjecting into a discussion. However, comments written by the instructor during a previous course on the same topic could be collected and used. Another option would be for the instructor to set up a discussion group and invite a few colleagues to join in a discussion of a scenario problem that the students in the course will be discussing. As long as the comments collected represent a greater understanding of the domain, the students should benefit from being exposed to the comments during their own discussion.

VI. CONCLUSIONS

We have developed a distance learning tool set that includes automatic embedded assessment, monitoring and moderation, as well as unique reports. With the current boom in distant learning courses, tools are needed to help faculty better manage the extra effort involved in teaching distant learning courses. Through a series of studies with both the U.S. Army War College and the U.S. Air Force Academy we have demonstrated a) the effectiveness of the automated monitor for reducing faculty workload and improving responsiveness to students, b) the accuracy of our embedded assessment, even for never before seen content, and c) the learning benefits of participating in an online discussion with an automated moderator.

The primary contributions from the studies with the Army War College are methods to do automatic embedded assessment of groups and individuals in collaborative learning environments, as well as the development of an automated discussion group monitor. Two methods for embedded assessment were outlined: one that created a statistical grading model mimicking human grading and the other an unsupervised learning method that required no human grading, ordering the samples from best to worst. The methods performed nearly equivalently, implying that the unsupervised learning method could be used with new courses and operate as a valid embedded assessment tool.

The monitor that distinguishes content from administrative comments has great generality and could be applied to automatic discussion alerts for instructors. The algorithm runs concurrently with ongoing discussion groups, analyzing the time series pattern of administrative and content comments. Instructors could be alerted to potentially troublesome patterns—e.g., groups in which the proportion of administrative comments is quite high, indicating either coordination problems or off-topic discussions. In addition, unusually high content scores by an individual or group is also worthy of instructor attention, perhaps to prompt words of praise to the group or to direct other groups to the noteworthy interchanges.

Our work with the Air Force Academy yielded an impressive automated moderator that demonstrated the ability to mimic the presence of senior military officers in a collaborative learning environment. This moderator was able to improve the collective knowledge of a group of cadets discussing a military scenario over the course of a single hour.

The automated moderator is an effective method of disseminating knowledge from senior officers to cadets or junior officers. The collection of expert comments is not automated at this point. However, Knowledge Post itself is an easy mechanism for collecting expert comments, and does not require that a group of experts be co-located in space or time, as the experts may participate in an asynchronous discussion. Contributions from the experts are then loaded directly into a Knowledge Post database, and can be interjected into subsequent student discussions. We found that LSA was able to select comments that were relevant and contained enough additional knowledge to improve the quality of cadets' discussions around a military scenario. The cadets chose to read these comments over the course of the discussion, suggesting that they saw the value in the comments. Feedback provided by the cadets following the discussions supports this conclusion as well. The cadets on average reported finding the moderator's comments relevant and useful.

The moderator selects comments that humans find useful and it does so quickly and automatically. The moderator uses a set of senior officer comments that take very little time to collect, and in turn passes this information on to hundreds of junior officers with minimal resources. Using the same method, the moderator is capable of choosing appropriate reference material from the electronic library, and automatically adding this information to the discussion. The important implication of the automated moderator we developed is that it provides an efficient manner of disseminating large amounts of institutional knowledge contained in key, senior people to the rest of the institution.

Because the techniques we describe are based on LSA, they are relatively content-independent, and can be applied in a variety of subject matter areas. However, additional refinements would no doubt be required to maximize the benefits of this tool set for other courses. We have outlined the steps needed to integrate our distance learning tools with existing discussion environments, which would make these innovations available to the discussion group world at large. The tools we have developed offer a substantial improvement over traditional distance learning environments, providing enhanced learning while reducing instructors' labor intensive moderation and monitoring.

VII. FUTURE DIRECTIONS

There are several studies that we feel would further the results reported here. It would be very interesting to assess the direct impact of using our automated tools on instructor workload by having instructors record the amount of time spent performing various tasks in courses while using traditional online

discussions or online discussions with our automated tools. We would expect to find some reduction in workload when our tools were used, but would these reductions be across the board? Or would the tools only reduce the time spent on certain tasks? Similarly, instructor ratings of student discussions and comments would provide additional evidence that our tools can increase student knowledge.

In the current study we compared the automated moderator to a human moderator, but the human moderator was limited in the number of comments they could add to the discussion. One benefit of a human moderator is that they can think on their feet and adapt to changing discussion topics. A direct comparison between the automated moderator and a skilled human moderator would provide the ultimate test of the automated moderator's effectiveness.

Both the Army War College and the Air Force Academy have student populations that are typically well above average. Using these tools in a wider range of educational institutions may require some adaptation of our technology to be as effective in monitoring and moderating more average students. A demonstration that the tools can be used across a spectrum of different courses and student bodies would greatly increase the generalizability and applicability of our results.

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IX. ABOUT THE AUTHORS

Noelle LaVoie is a Senior Member of Technical Staff at Pearson Knowledge Technologies. She received her Ph.D. in Cognitive Psychology from the University of Colorado at Boulder in 2001. She has over ten years of experience conducting research and complex data analysis techniques. Her research interests include collaborative learning technologies, applications of computational linguistics and AI in education, and leadership training. She has coauthored several papers and presentations on these topics. Noelle has also worked for U S West's Advanced Technologies Design & Usability group, on both wireless and broadband products, where she was involved in usability testing, design, and prototyping.

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Karen E. Lochbaum is Vice President of Software Engineering at Pearson Knowledge Technologies, she directs all software development done at the company. Previously, she was responsible for development of the Intelligent Essay AssessorTM. While earning her Ph.D. in computer science from Harvard University, Lochbaum held a fellowship from Bellcore, where she worked as a technical staff member on projects involving development and applications of Latent Semantic Analysis. For five years, she was a member of technical staff at U S WEST Advanced Technologies, where she performed exploratory software research and development, including work on two projects for Latent Semantic Analysis applications that led to patents. Lochbaum has published numerous technical articles in

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David Wroblewski holds a Bachelors of Science in Computer Science from the University of Wisconsin-La Crosse. Since 1981, he has developed software systems from such diverse domains as ring laser gyro control software, knowledge-based natural language parsing, semantic analysis, and pragmatics for intelligent help systems, and modeling and provisioning of high-capacity optical networks. Prior to joining PKT in May 2004, Mr. Wroblewski held positions as Research Leader at MCC's Human Interface program, Distinguished Member of Technical Staff at U S WEST Advanced Technologies, and Senior Member of Technical Staff at Emperative. Mr. Wroblewski is co-author of a patent concerning the use of enhanced scroll bars in graphical user interfaces and is author or co-author on numerous technical papers in natural language processing, artificial intelligence, and human-computer interface design.

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