The Evolution Continues

Considerations for the Future of Research in Online and Blended Learning

ECAR Research Bulletin | June 17, 2015

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This research bulletin is adapted from chapter 13 in Charles D. Dziuban, Anthony G. Picciano, Charles R. Graham, and Patsy D. Moskal, *Conducting Research in Online and Blended Learning Environments: New Pedagogical Frontiers* (New York: Routledge/Taylor & Francis Group, 2015 [forthcoming])

Although Internet-based online education is, on one hand, a natural evolution of the instructional technology that has been a part of higher education since the middle of the 20th century, it is also a major leap forward in terms of how faculty teach and students learn. A number of very successful academic programs and institutions now operate almost entirely on the Internet, without any bricks or mortar other than for administrative functions. Approximately one-third of the college population—or just over seven million students—now enroll in at least one fully online, for-credit course in any given year.[1] An online course was defined in an Allen and Seaman study as one where 80% or more of the seat time is replaced by online activity. Millions of other students are enrolled in blended or hybrid courses, although accurate data on this population are nonexistent. For the purposes of this bulletin, the word *blended* will be used to designate courses where some institutionally defined percentage of seat time is conducted online. Web-enhanced courses that do not replace seat time but have substantial Internet-based activity are also becoming commonplace in higher education. Although most MOOCs are not taken for credit, they enroll as many as 150,000 students in a single course. In sum, the point is being reached in American higher education where the majority of college courses have some Internet components, ranging from the fully online to the web-enhanced. Online education has evolved in a mere 20 years to become integral to how instruction is being delivered in colleges and universities. It is no longer a novelty and is becoming fully integrated into all teaching and learning. The purpose of this bulletin is to attempt to predict where the research in online and blended learning is going. This is a risky undertaking because predicting the future—and in this case the evolution and growth of technology, new products, and services—is difficult. While many try to predict *what* will happen and sometimes get it right, predicting *when* something will happen is even more difficult. Before discussing the future of research in online and blended learning, it might be prudent to discuss the future of online and blended learning. And before doing that, a review of the history of online and blended learning is in order.

This bulletin attempts to predict where the research in online and blended learning is going

Online learning as conceived today began in the 1990s with the Internet and World Wide Web. Online learning applications using local and wide-area networks existed before the Internet, but the model that

evolved over the past 20 or so years relies on ubiquitous data communications that are owned and operated routinely by all segments of the population. Today, people use laptops, cell phones, and other portable devices daily to stay connected with family, friends, and their studies.

The First Wave (the Beginning): 1990s

The technology of the first wave of online learning was based on slow-speed, dial-up modem lines. As a result, many of the earliest online learning courses were text-based and relied heavily on asynchronous learning. Digital multimedia was difficult and time-consuming to develop and was incredibly slow downloading to student computers. The main pedagogical model was a highly interactive, asynchronous learning network made popular by the Alfred P. Sloan Foundation's grant program entitled Anytime/ Anyplace Learning.

The colleges and universities most interested in online learning during this decade were those that had established distance education programs using other modalities such as television, radio, and course packs. Public institutions such as the Penn State World Campus and the University of Maryland University College were early leaders in the development of online learning programs. For-profit colleges such as the University of Phoenix also invested heavily in developing online learning programs.

By the end of the 1990s, hundreds of thousands of college students were enrolling in online courses every year. Allen and Seaman estimated that 1.6 million students were enrolling yearly in fully online courses by 2002.[2]

The Second Wave (into the Mainstream): Early 2000s

By the early 2000s, Internet technology had advanced to the point where most people were able to afford high-speed cable modems or DSL. This enhanced connectivity opened up the possibility of incorporating multimedia (pictures, sound, video) into online learning. Social media such as blogs, wikis, and YouTube also came on the scene, allowing for greater interaction. Faculty from around the country began sharing learning tools and objects in digital depositories such as MERLOT. Perhaps the most important development of this second wave was that online learning was no longer seen solely as a vehicle for distance education but could be used in mainstream education in almost any class and for any subject matter. The dominant pedagogical model of this wave was blended learning, as faculty and teachers from most sectors of education began to use online facilities to enhance their courses and to replace seat time in face-to-face courses.

Also during the second wave many colleges and universities scaled up their online and blended learning activities. Learning/course management systems such as Blackboard, Desire2Learn, and Moodle were acquired throughout education. For-profit colleges expanded their programs significantly as venture capital flooded into the sector. The fully online model continued to be the mainstay of for-profit colleges mainly because it was more cost-effective for those institutions that did not have brick-and-mortar campuses.

It is estimated that by 2008, 4.6 million students enrolled yearly in fully online courses in public and nonprofit colleges and universities.[3] Data for the for-profit colleges and universities are sketchy, but it is likely that over one million additional students were enrolled in fully online courses in this sector.

The Third Wave (the MOOC Phenomenon): 2008 to 2013

The term "MOOC" (massive open online course) was coined in 2008 by Dave Cormier and Bryan Alexander to describe an online course led by George Siemens of Athabasca University and Stephen Downes of the National Research Council. The course enrolled more than 2,000 students. With this course the third wave of online learning development began. In 2011, Stanford University offered several MOOCs, one of which, led by Sebastian Thrun and Peter Norvig, enrolled more than 160,000 students. Thrun shortly thereafter started the MOOC company Udacity. A few months later, Andrew Ng and Daphne Koller, both from Stanford University, launched Coursera, another MOOC provider. The MOOC model was grounded in improving student access to higher education and cost effectiveness. The emphasis was on massive enrollments. Venture capital flowed into MOOC development, especially as for-profit colleges lost some of their appeal due to ongoing federal investigations of recruitment and financial irregularities.

The major interest in MOOC technology was not its pedagogical benefits. However, courses that were enrolling hundreds of thousands of students attracted deserved attention. Faculty from prominent institutions such as Stanford University, Harvard University, and the Massachusetts Institute of Technology became associated with the MOOC phenomenon. MOOCs were glamorized by their founders at Udacity, Coursera, and edX as the technological revolution that would indeed change higher education. Significant investments of capital into MOOC companies were made by private investors and venture philanthropies. As a result, the media went into a frenzy. The *New York Times* declared 2012 to be "The Year of the MOOC."[4] Education policymakers and university trustees took notice and thought they had found a solution to their education funding woes. Some in the California State University System and the University of Virginia pushed for major new MOOC initiatives.

As the MOOC phenomenon took off, a closer examination of the pedagogical basis of their design was made by faculty and instructional designers, many of whom were experienced developers of online learning. The computer-assisted-instruction (CAI) style of many early MOOCs, based on "read, watch, listen, and repeat" course materials, was questioned by experienced developers who preferred more socially constructed pedagogical approaches that emphasize extensive interaction between students and faculty. In addition, high student dropout rates of 90% in some MOOCs could not be easily explained away. Lastly, but perhaps most significantly, was the failure by educational leaders and faculty to jump at the chance to use course materials developed by the faculty at Ivy League and other highly selective universities. On the contrary, faculty and administrators saw this as elitism and arrogance on the part of the MOOC providers.

By the end of 2012, more than seven million students were enrolling every year in for-credit online courses in public and private nonprofit universities.[5] Many more were enrolled in for-profit colleges and universities. MOOC courses added hundreds of thousands of students in mostly non-credit-bearing courses.

The Fourth Wave (Reconciliation of the Blended and MOOC Models): 2014 ->

In 2014, the fourth wave arrived, wherein blended learning technologies that allow for more extensive and personal faculty interaction were integrated with well-financed course content as developed by MOOC providers and others that instructors can use as they see fit. As it progresses, the fourth wave model will extend and combine the developments of the second wave (blended learning) and the third wave (well-designed MOOC content) and will incorporate a variety of pedagogical approaches using multiple content forms and instructional tools. Social and multimedia use is expanding, and students are relying on portable devices (laptops, tablets, personal data assistants, smartphones) for accessing and participating in course activities. In addition, a number of new facilities and approaches that were in their nascent stages in previous waves will expand. These include:

- Learning analytics
- Adaptive or differentiated learning
- Competency-based instruction
- Open resources, including material meant to replace traditional textbooks
- Gaming and multiuser virtual environments

All of the above, as well as typical face-to-face class activities—such as traditional lectures, class discussions, laboratory work, and internships—will be at the disposal of faculty. Pedagogy is driving and will drive technology in a comprehensive and sophisticated blended learning environment.

The evolution of the fourth wave blended/MOOC model will require more careful nurturing than sudden or disruptive changes. The potential for friction over whether content and course material are developed within or outside individual colleges and universities is great. In a survey of college presidents conducted by the *Chronicle of Higher Education* on change and innovation, important insights were provided about where campus leaders think online and blended learning are going. The following is an excerpt from the executive summary:[6]

> *Direction*: Two-thirds of presidents of public institutions think that higher education is headed in the right direction, as do well over half of their private-campus peers.
>
> *Modality*: An overwhelming majority of presidents—three-quarters at private institutions and even more at public campuses—think that blended courses that contain both face-to-face and online components will have a positive impact on higher education.
>
> *Focus*: Presidents say that when it comes to innovation in higher education, reformers pay too much attention to cutting costs and not enough to changing the model of teaching and learning.
>
> *Change Drivers*: Two-thirds of public-institution presidents think that politicians are the most influential drivers of change in higher education, and half of private-campus presidents agree with that assessment. The presidents on both types of campuses believe strongly that faculty should be the number-one drivers of change.

The last item is most telling. Faculty indeed should be the number-one drivers of change, and to a degree many have been at the forefront of the 20-year period of evolution of online and blended learning. They will have to continue to be at the forefront, understanding full well that forces outside the university will be moving to exert great influence on teaching and learning.

In sum, the fourth wave of online and blended learning provides fertile ground for research now and in the future.

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Research in Online and Blended Learning: What Is Driving the Agenda?

As next-generation research methods in online and blended learning evolve, several trends in education, technology, information, and communication will impact their direction. For instance, rapid change and the comparative value of short-term verses long-range outcomes have forced us to expand our concept of inquiry. Adding to these complications are increasing complexity and the impact of uncertainty. However, the coming research wave—although increasingly challenging—will provide opportunities for discovering useful information that was simply not possible a few decades ago.

Changing Baselines and the Long View

The four waves of online and blended learning constitute rapid change in the extreme. Aligned with this has been a wide array of research questions that have been explored over the years, ranging from the no-significant-difference phenomenon and metadata to the impact of MOOCs and predictive analytics. The upshot of these trends coincides with Roberts when he documents constantly changing baselines.[7] He argues that a kind of collective amnesia surrounds changes that happened over a more distant time frame. We tend to trust what we have seen for ourselves and dismiss events that occurred in the more distant past. He stresses that incremental changes inch up on us (noise pollution, diminishing green space, and longer commutes to work) and that we fail to notice them. In education, for instance, we can overlook the impact caused by changes in the learning space,[8] instantaneous communication,[9] information overload,[10] and the remarkably altered role of expectations for students and instructors in online and blended learning.[11] Diamond defines this as *landscape amnesia*, in which we forget anything but what we are experiencing at the moment and assume that the present is the way it has always been.[12] Many of us are subject to this phenomenon. We have been working in the online and blended learning research for so long that the structure of earlier education is slipping away. Johnson develops this idea further when he explores the notion of the long view.[13] He documents the impact of six developments in the world: glass, cold, sound, clean, time, and light. For example:

> Johannes Gutenberg's printing press created a surge in the demand for spectacles, as the new practice of reading made Europeans across the continent suddenly realize that they were farsighted; the market demand for spectacles encouraged a growing number of people to produce and experiment with lenses, which led to the invention of the microscope, which shortly thereafter enabled us to perceive that our bodies were made up of microscopic cells. You wouldn't think that printing technology would have anything to do with expansion of our vision down to the cellular scale.

As we enter the next phase of online and blended learning, researchers may develop more productive studies by turning their attention to longer-term outcomes and issues in education. These become evolutionary questions revolving around changes in our institutions, instructors and students, learning outcomes, educational cost, policy, diversity, opportunity, access, and the broader issues about how our society plans to educate a growing population of students who express increasing ambivalence about the value of a formal education. One example might be how online and blended learning have impacted the tragedy of the commons, where disciplines continue to be seen as distinct from each other.[14] These are big problems composed of a complicated network of smaller problems that we need to address one at a time. These bigger issues are solved by operating at the boundaries—for instance, determining more meaningful ways to evaluate whether students have acquired knowledge and information that will enable them to function effectively upon leaving institutions in which they have learned through online and blended learning. This is a problem that might be resolved by developing and evaluating a number of smaller assessment practices that change the paradigm for indexing learning outcomes. In spite of the enthusiasm for initiatives such as learning analytics, adaptive learning, competency-based instruction, open resources, and multiuser environments, the enduring impact of these developments on education remains, for the most part, undocumented.

Researchers may develop more productive studies by turning their attention to longer-term outcomes

The Speed of Light

An additional factor impacting the next generation of research is the viral nature of digital information. Seife characterizes this as a disconnect from all that we have known before.[15] Information moves around the world instantaneously and can be stored with perfect reliability. In an epidemiological sense, he compares digital information to a super virus that invades all aspects of society and education, changing the way we understand how students acquire knowledge. Powers describes this digital environment:[16]

> We're all busier. Much, much busier. It's a lot of work managing all that connectedness. The e-mail, texts, and voicemails; the pokes, prods, and tweets; the alerts and comments; the links, tags, and posts; the photos and videos; the blogs and vlogs; the searches; downloads, uploads, files and folders; feeds and filters; walls and widgets; tags and clouds; the usernames, passcodes, and access keys; pop-ups and banners; ringtones and vibrations. That's just a small sample of what we navigate each day in the room. By the time you read this there will be completely new modes of connecting that are all the rage. Our tools are fertile, constantly multiplying.

In many respects data behave this way. The future research agenda will call for us to manage these very large data sets that are in constant motion. The historical research paradigm may not be nearly as informative when we assess short-term changes (as in pretest/post-test differences), but it could prove to be more effective by examining the trends and trajectories of our data the way Rosling, Rönnlund, and Rosling accomplished with their Gapminder approach.[17] Even in this day of online journals, delay can make some of our research obsolete by the time it becomes available. We are convinced that research results need to move faster to keep up with digital information and data in contemporary education settings—especially online and blended learning.

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Complexity

Another important consideration for next-generation research will be the development of methods for dealing with and extracting information from complex systems such as classes, departments, colleges, university consortia, and state and national educational organizations. Complex systems constitute substantial challenges to cause-and-effect thinking. Forrester showed us that complexity exhibits certain characteristics:[18]

- Generally, it is impossible to predict how an intervention will ripple through a complex system.
- Very often outcomes will be counterintuitive.
- There will be both positive and negative side effects.

There are examples of this phenomenon from virtually all areas. Levitt and Dubner cite the bounty effect, wherein offering financial incentives intended to eliminate pests actually increase the infestation because certain segments of the population resort to pest farming as a cottage industry.[19] Another example of counterintuitive side effects comes with the United Nations Carbon Credit program to reduce greenhouse gasses, which motivated certain countries to produce more of the most harmful substances to obtain higher credits for the increased financial incentives.[20] Grosz describes an unanticipated outcome that involves praising children for their excellent work.[21] The natural assumption is that such praise would be motivating, but he cites a body of research that presents evidence showing the opposite effect. The praise proves to be a disincentive to the work ethic of children, interfering with their perseverance on more difficult tasks.

Complex systems constitute substantial challenges to cause-and-effect thinking

In the online and blended learning environments, we find ourselves conducting research where the results run counter to our expectations. Seife describes the increase of sock puppetry on the Internet, in which individuals manufacture completely fraudulent environments, creating a subculture whose members believe that what is being portrayed is genuine.[22] Further, he documents side effects such as politicians hiring companies to artificially inflate their Twitter following to make them appear much more popular than they really are.[23] Of greater concern is the process of search engine optimization (SEO), in which organizations specialize in gaming search engines with vocabulary and syntax to elevate websites, articles, journals, products, and other items to the front pages in order to create more business. This can be particularly troublesome when users search for valid and reliable information and assume they have found the most often referenced resources, given that the popularity of those resources can be the result of manipulation.

Taleb describes the issue this way: Complex systems are fraught with interdependences that are extremely difficult to deconstruct and hardly ever exhibit linearity in their relationships.[24] We contend that online and blended learning are complex systems. This means that if you double the online time in a blended course, it does not follow that learning gains will double. They may triple, quadruple, or, conversely, diminish by half. The relationships we identify in complex systems can increase or decrease in an exponential function.[25] Additionally, the relations are not necessarily reciprocal. For instance, finding a high positive correlation between students attending the wellness center regularly and their remaining in school does not mean that requiring all students to visit the center will result in higher retention rates, irrespective of course modality. Most likely there are many complicated interactions that result in good students attending the wellness center—their motivation, work ethic, educational engagement,

compulsivity, and an embraced connection between healthy bodies and healthy minds. Therefore, using the wellness center is an outcome and not a cause. In complex systems, if one is to frame outcomes properly, one must understand that correlation identifies common covariance, prediction identifies a specific outcome, and forecasting requires a probabilistic statement.

Uncertain Mediation, Ambiguity, and Ambivalence

SeténYi, when discussing the evolution of Hungary from communism to democracy after the fall of the Soviet Union, coined the term *uncertain mediation*.[26] By that he meant that there are never enough data to allow individuals, organizations, or governments to make clear-cut decisions. Actions must be taken, legislation passed, policies developed, and curriculum designed in the face of incomplete evidence. The concept of uncertainty has a longstanding tradition in many disciplines in which investigators understand that measurement, prediction, forecasting, and hypothesis testing all must accommodate error variance.

This theory relates closely to the notion of open systems that have continual input from external sources—as opposed to closed systems where inputs are finite.[27] This thinking pattern has implications for future research in online and blended learning. Contemporary educational environments are continually bombarded with external inputs. Questions about quality, learning outcomes, student engagement, faculty rolls, return on investment, policy, learning environments, value added, regulation, assessment, and many more find their way onto the agendas of researchers and evaluators who are expected to provide compelling evidence where no such evidence exists. This development will impact future research agendas and is likely to expand in the coming years.

Compounding uncertain mediation difficulties in research is the notion of ambiguity that is a cognitive phenomenon characterized by a confusion of ideas or facts.[28] If I see something coiled up in the corner of the barn and can't tell whether it is a rope or a snake, I suffer from ambiguity and don't know how to act until I determine which it is.[29] Many times we have encountered students who indicate they did not know what the instructor expected of them in their online or blended course. A study completed for the Sloan Consortium (now the Online Learning Consortium)[30] identified several elements that must be resolved about a course if ambiguity is to be diminished: reduced ambivalence, enriched learning environments, clear rules of engagement, instructor shows commitment to learning, instructor shows respect and concern, and instructor shows engagement. Lewis and Weigert[31] and Weigert[32] contend that a flight from ambiguity characterizes modern society and education, both of which are committed to the need for clarity. As researchers, we are continually asked whether something is this or that—is online learning effective or not, will analytics increase retention or not, are MOOCs effective learning devices or not, are students satisfied with online courses or not? Often these kinds of questions are generated from external sources in an open system and suffer from the binary fallacy. In almost all cases they cannot be answered by a yes or a no response. They will continue to impact future research in online and blended learning and require uncertain mediation.

Contemporary educational environments are continually bombarded with external inputs

The third construct that has research implications is that of ambivalence described by Long,[33] Weigert,[34] and Craig and Martinez.[35] Ambivalence is an emotional response characterized by simultaneous positive and negative feelings. Weigert cites several issues that foster ambivalence in contemporary society and education: pluralism, value relativity, increasing technological control of everyday life, a bewildering array of choices, instant communication, and exponential growth of available information. Craig and Martinez

raise this question: Have we not experienced mixed feelings about virtually everything we have encountered in life at one time or another—loved ones, children, government, charities, the economy, bosses, friends, and, in education, our classes, instructors, universities, classmates, the education we received, and our prospects for the future? Long used the ambivalence concept to explain the behavior of adolescents as they make the journey from childhood to adults, perplexed by positive and negative feelings toward authority figures (parents, teachers, and adults), and argued that ambivalence is an important catalyst for change in society. Ambivalence underlies a fundamental uncertainty about culture, society, and education. Mixed emotions in culture are characterized in any number of contradictory proverbs: look before you leap; he who hesitates is lost; if at first you don't succeed try, try again; don't beat your head against a wall; many hands make light work; too many cooks spoil the broth. Some contradictions relate to education: you can't teach an old dog new tricks; you are never too old to learn; a word to the wise is sufficient; talk is cheap. Ambivalence can also be found in online and blended learning: I love the convenience of online learning but miss the face-to-face time; I love working at my own pace but dislike having to log on every day; I love the technology but hate it when it breaks. The irony seems to be that ambivalence can be both a bad and good thing. How is that for an ambivalent statement? In the online and blended learning environment, ambivalence about those modalities leads to student confusion about their satisfaction. However, at the same, time Dziuban, Moskal, Kramer, and Thompson have shown that ambivalent students are the most reflective and thoughtful about the quality of their education.[36] Their ambivalence about online learning helped them identify the positive and negative aspects of what they experienced. Although on course evaluations students' overall ratings appeared neutral, the underlying reasons were considerably diverse.

Uncertain mediation, ambiguity, and ambivalence will impact future research. As the issues become more complex and develop with cumulative rapidity, evaluation procedures will have to accommodate unstructured situations. Direct interpretation will become more difficult, much like complex interactions in analysis of variance or suppressor variables in regression. Investigators will have to be more subtle and nuanced in their interpretations. Levitt and Dubner state:[37]

> These are multidimensional cause-and-effect questions, which means their outcomes are both distant and nuanced. With complex issues, it can be ridiculously hard to pin a particular cause on a particular effect.

While this may disappoint those who want direct and unequivocal answers, future research will address authentic questions in the educational environment instead of procedures like the no-significant-difference phenomenon that, in our opinion, was an answer looking for a question. Head, Holman, Lanfear, Kahn, and Jennions emphasized these issues with statistical hypothesis testing in the scientific literature using the term "p-hacking."[38] They pointed out that publication bias results when researchers select data or analysis procedures until nonsignificant results become significant. They demonstrate that the p-values (significance levels) can be manipulated easily. Often, significance is equated with strength of relationship, but tiny effect sizes can produce small p-values with large sample sizes. Dziuban, Moskal, Cavanagh, and Watts proved this empirically by systematically increasing the sample size until a nonsignificant result became significant, although the effect size remained constant.[39] Walster and Cleary provided a thoughtful perspective on data analysis when they suggested that statistical

Uncertain mediation, ambiguity, and ambivalence will impact future research

significance is best used as the basis for a decision-making rule and not as an absolute determinant.[40] They reemphasized that hypothesis testing answers the following question: What are the chances that I will get my sample results when the null hypothesis is true in the population? The point is that the analysis is much more meaningful if some thought and decision making go into the process prior to collecting and running any data.

Not Knowing and Being Wrong

Schultz cites a quote by Leonard Susskind, professor of physics at Stanford, member of the National Academy of Sciences, and pioneer in the development of string theory:[41]

> If I were to flip a coin a million times, I'd be damn sure that I wasn't going to get all heads.... I'm not a betting man, but I'd be so sure that I'd bet my life and my soul on it.… I'm absolutely certain that the laws of large numbers—probability theory—will work and protect me. All of science is based on it.… I can't prove it, and I don't really know why it works.

As we progress to next-generation research, it is going to become increasingly important to recognize that we simply don't know why certain things happen and that often our assumptions and conclusions prove to be wrong. Historically, we have avoided the three words "I don't know" in favor of conjectures that proved wrong over the long term. Many examples come to mind: speculation that many universities will close their doors, there will be a markedly decreased need for faculty members, universities will become diploma mills, the quality of learning will decrease because of the absence of face-to-face time, and on-the-job performance of online graduates will decrease. Each of these predictions has impacted higher education but not in the way so-called experts predicted. Levitt and Dubner cite Niels Bohr as saying, "Prediction…is very difficult, especially if it's about the future."[42] They go on with this anecdote:

> **Moderator:** "Tonight, our guest: Thomas Sargent, Nobel laureate in economics and one of the most-cited economist in the world. Professor Sargent, can you tell us what CD rates will be in two years?"
>
> **Sargent:** "No."

What are some of the reasons that so many of our assumed outcomes in online and blended learning have been something less than correct? Taleb points out that we are simply not very good at calculating the probability of the extremely small likelihood of events.[43] He shows that these "black swans" have had an impact on culture, society, or education. Once they happen, we tend to reconstruct a set of causal connections that explain why the event took place. There are many examples of black swans: 9/11, the Harry Potter novels, Google, the financial crisis of 2008, MOOCs, and Facebook. Lazarsfeld provides an example of how we tend to backfill incorrect explanations.[44] In describing a study of the American soldier, he presents several findings about the characteristics of American military personnel in World War II. For instance, among other findings he reports that men from rural backgrounds were in better spirits than soldiers from city backgrounds and that Southern soldiers were better able to stand the climates in humid tropical fighting areas than Northern soldiers. However, those results were the opposite of what the study concluded. He documented that almost everyone produced an explanation for why those erroneous findings were true. However, when the data were corrected, people built alternate narratives about the correct results without hesitation.

As researchers in the coming years of online and blended learning, we will have to be cognizant of our tendencies toward confirmation bias,[45] which is a strongly held belief that education will benefit from all

aspects of instructional technologies. This can happen quite easily since we tend to frequent groups and individuals that embrace our own beliefs. Additionally, we have to be careful of distorted memory, such as a belief that the lecture teaching method is inherently flawed. There are problems with lecturing in the digital world, but to assume that it should be completely abandoned is erroneous thinking. Further, the idea of sunk cost—the idea that so much has been invested that we can't afford to abandon or discard the initiative—can lead us astray. Avoiding the conclusion that the optimal decision is that an intervention should not be implemented aligns with sunk cost. This corresponds to the Bayesian theory,[46] where the best decision is not to implement the study. Finally, as researchers in the next generation, we will have to be wary of common-sense thinking because, as Kahneman and Watts point out, rarely does it lead us to the correct finding or conclusion—especially in a research context.[47]

Things to Consider as We Advance

The increasing impact of instructional technologies in online and blended learning will intensify the demand for information about their effectiveness. This places added responsibility on investigators to design and implement studies that respond to the needs of decision makers while simultaneously extending the boundaries of research into new areas. We live in a time of the perceived unbundling of higher education, increased complexity, uncertain mediation, ambiguity, ambivalence, and uncertainty. These challenges come from a changing educational landscape in which information grows exponentially, and though much of that information is valid, some of it is inaccurate. Therefore, filtering and monitoring the digital world will require a coalition of educational professionals: administrators, faculty members, instructional designers, faculty center staffs, students, and educational researchers, among others. These are not new role expectations but rather ones that have become much more important in recent years. Therefore, as we move into the next generation research agenda, a number of concepts might serve as useful benchmarks.

The increasing impact of instructional technologies will intensify the demand for information about their effectiveness

Beware of False Positives

Silver cites the frequency with which we report false positives in our research.[48] False positives come from studies that cite a significant difference, a strong relationship, an interaction pattern, a compelling narrative, an important demographic trend, or a reflective insight that may have been the result of a particular study but in practice has no lasting impact. In statistical terms this is a type-one error. This phenomenon can occur with research studies of virtually any method. These errors are costly and difficult to correct because they can lead to premature policy decisions and substantial resource allocation. As responsible researchers in online and blended learning, we have to be aware of the relative (and absolute) costs of specifying a false positive against its opposite, a false negative—concluding from your study that an intervention was ineffective when it would have created an impact.

Research Context Is Increasingly Important

In the changing educational environment we cannot approach inquiry into online and blended learning as if it were free from situational circumstances. We have entered a period of context-driven research. For instance, the answer to the question "Are predictive analytics effective for increasing student retention?"

has to be: *It depends on the context*. As we evaluate analytic procedures we find that many are tied to specific institutions with cultures that dictate what will be effective.[49] This is also true for online and blended learning. Therefore, as next-generation researchers, we will have to spend time and resources defining the context in which we conduct our studies. Certainly, this has been a requirement of research over the past decades, but it will be more important for the new educational environments in which we conduct research.

Research context closely relates to the framing of your study—the way you establish the mental picture of what you hope to accomplish. Lakoff argues that reframing a particular situation or context is the catalyst for change.[50] He describes the process this way:

> Frames are mental structures that shape the way we see the world. As a result they shape the goals we seek, the plans we make, the way we act and what counts as a good or bad outcome of our actions.

Others show that the manner in which you frame a situation or research study constitutes the primary determinant of how people will interpret what you report.[51] Often this is accomplished through the use of metaphors:[52]

> If we are right in suggesting that our conceptual system is largely metaphorical, then the way we think, what we experience, and what we do every day is very much a matter of metaphors.

Meyer makes a strong case that metaphors have been essential for enhancing our understanding of distance education (we substitute online and blended learning): the World Wide Web, the information highway, virtual, surfing, file, hard drive, mouse, and many others.[53] These frames transform things from a terminology that we may not fully understand to terms of something with which we have more familiarity. However, Meyer and Lanier point out that these frames can limit the situation.[54] For instance, *first do no harm with online learning* causes people to think in terms of possible damage caused by it. Alternatively, *searching for possible benefits of online learning* creates a distinctly different context. Outcomes that you find may not be all that you hoped for, but the second frame doesn't immediately direct people to look for harmful effects. Carefully choosing a frame for your study is an important first step in creating proactive and clearer understanding of what you wish to accomplish in your work.

The Best of All Worlds

The future research agenda will force us to devise an effective way to combine the old and the new research methodologies. Jenkins argues that in some cases new technologies replace old ones immediately, but the most common occurrence is an evolutionary convergence of them incorporating the best aspects of both by building a kind of eutectic structure.[55] Diamond makes the same point answering the question from an anthropological perspective: What can we learn and take from traditional societies?[56] The increasing demand for information places the responsibility on the research community to combine the best aspects of more established research methods and the emerging models being generated by online and blended learning. This convergence, however, places an important expectation on the research culture. No longer can we afford to collect data—be they quantitative, qualitative, artifacts, or observations—without some prior consideration of outcomes that will make a difference and will result in the implementation of a program, initiative, or

The future research agenda will force us to devise an effective way to combine the old and the new research methodologies

policy. The argument may be made that specifying the outcomes before the research is subjective and would invalidate the study. However, we contend that some aspect of all studies, even the most tightly controlled experiments, have a number of subjective elements to them.[57] Gibbons and Bunderson emphasize this point when they classify research into *explore*, *explain*, and *design*, where the final category places the responsibility on the researcher for some predetermined outcome that will lead to action.[58]

This notion parallels the area of design-based research (DBR), also referred to as educational design research.[59] DBR is best conceived of as a process rather than a set of procedures. Proponents of this approach acknowledge that the methods of implementing it can vary widely, though the purpose remains constant—solve practical problems through an iterative feedback approach while simultaneously discovering new knowledge.

In speculating about the future of research in online and blended learning, it seems clear that although many methods appear disparate, there is a constant that pervades then. All of the approaches to research become much more effective if the investigators can answer the question, "What will make a difference?"

The Need for Collaboration and Flexibility

Straus and his colleges created their facilitative leadership model based on a series of new directions and assumptions that effective leaders continually interact with their constituencies in an ongoing process.[60] In another initiative, aligned with facilitative leadership, Washington State University, the National Learning Infrastructure Initiative, the Coalition for Networked Information, and the TLT Group developed their transformative assessment paradigm. We quote from their rubric:[61]

> The assessment results are designed for multiple constituencies; the assessment plan includes feedback and corresponding resources and protocols for improving student learning, faculty teaching, administrative support, or some combination of these features. Assessment is open and fosters reflection.

The transformative assessment initiative reflects the facilitative leadership model and gives us some insight about effective research in the online and blended learning. We take Straus's work together with transformative assessment and some of our own thoughts and recast them into a facilitative research context:

1. Contemporary research is always formative and involves a series of continuous feedback loops that generate new questions as the previous ones are addressed. Effective research is a series of iterative approximations.
2. Research in online and blended learning will, by the nature of change, have to be opportunistic because innovations happen rapidly in this environment.
3. Collaboration among many constituencies in the research process will increase the potential for creating a motivating vision for research; focusing on relationships, processes, and outcomes; being good role models; and making research much more celebratory. Working in isolation produces less-than-optimal results.
4. Aligning oneself with a particular research method is not a particularly functional idea because of the number of research approaches that are available. This becomes a problem in conducting online and

blended learning research. The briefest of searches for types of research methods can be overwhelming. We present the results of that search in table 1, in no particular order:[62]

Table 1. A sample of research methodologies for online and blended learning

Comparison	Descriptive	Meta analysis	Participant observation
Survey methods	Phenomenographic	Retrospective analysis	Experimental research
Quasiexperimental	Cohort studies	Case studies	Predictive
Action research	Data mining	Literature reviews	Grounded theory
Focus groups	Longitudinal studies	Secondary data analysis	Historical research
Exploratory	Case control design	Reflective practice	Model building
Mixed methods	Theory-based research	Cross-cultural comparison	Cross-institutional studies
Interaction analysis	Demographic analysis	Inductive reasoning	Personal experience
Archival research	Deductive reasoning	Quantitative research	Qualitative studies
Empiricism	Observational studies	Phenomenology	Pre-experimental research
Correlational	Ethnography	Developmental research	Trend prediction
Ex post facto	Randomized trials	Decision-oriented studies	Design-based research
Diagnostic studies	Content analysis	Graphic analysis	Correlational research
Modeling	Interviews	Artifact analysis	

The list of research methods in table 1 is by no means exhaustive. However, the common thread in all of these approaches is that they respond to different contexts to produce useful information. In addition, there has been a longstanding initiative in the research community to blend research into more comprehensive underlying constructs. A predominant example is the extensive work that has been done to unify the classic divide between quantitative and qualitative research into mixed methods.[63] Other investigators, through careful analytic work, argue that the differences between quantitative and qualitative methods are much more perceptual than based in theory and practice.[64] This mutually exclusive distinction has never been productive; qualitative and quantitative studies can enhance each other in many and varied contexts. For instance, a complicated path diagram developed by a structural equation modeler is virtually incomprehensible to most people without a compelling explanatory narrative. On the other hand, an interesting narrative gains much more clarity if there are some data to verify its conclusions.

Good Ideas and Research

Johnson extended our thinking about where good ideas and research emerge.[65] The first idea is the notion of the *adjacent possible* that he attributes to the complexity theorist Stuart Kaufman.[66] The idea is that we ratchet progress through a series of small-step progressions of what is reasonably possible. We didn't jump from the magnifying glass to the electron microscope. That took many years. Initially, we didn't understand that student satisfaction with online learning was not one dimensional but much more complex.[67] That took two decades.

The second idea that facilitates research is the *liquid network*. Throughout this bulletin, we have stressed the need for collaborative work. This means that an idea is not a single thing but resides in many places. An idea intersects with multiple groups and is considered developed, reframed, and improved by each of them. The close proximity of individuals, either physically or virtually, working on an idea, has the potential for making progress by an order of magnitude. Liquid networks increase the likelihood of discovering the next adjacent possible because the problem is exposed to diverse perspectives of people who make progress by tinkering. An example of this liquid network in action is the Online Learning Consortium[68] working on the concept of asynchronous learning networks and localness. That took a long time and a number of people to design working blueprints.

The third notion is the *slow hunch*. This means that we have to take an idea and stay with it for a long time and allow it to develop. We like to think about eureka moments, but they are rare occurrences. Darwin and Edison worked on their ideas for years before they came to fruition. This proves to be true for most important discoveries and inventions. Arguably, we are in a slow hunch period with online and blended learning. We have learned much about them, but we have to stay on board for the long term to see their full impact.

Blending It All Together

Online and blended learning have forced contemporary researchers, of virtually all methods, to reconsider many of their approaches to inquiry—approaches that have remained stable and valid for a number of decades. New learning environments force educational institutions to change and adapt. Therefore, the way we create and use information has become more complex. With this change, we have gained research knowledge and insight into effective pedagogy, how students engage and learn, how educational institutions are impacted, what will be required of effective teachers in the future, how students value education, and what might be reasonable learning outcomes for higher education. However, very few of these results have been entirely conclusive. Talking about the new learning *environment* is probably a misnomer. We should be speaking about the new learning *environments* because there are many. Years of research experience convinces us that understanding online and blended learning will be an incremental upward spiral. The new research agenda will involve a continuing conversation among many constituencies where each one of them can make contributions to the research agenda.

We hope that we have made a case that important results and useful information can come from every approach to research. The research questions are extensive, and we need to use every resource at hand. This calls for much more collaboration between historical competitors if we are to understand the emerging learning environments that are dissolving the boundaries between disciplines, institutions, and national initiatives. In the new world, no one appears to own anything exclusively. In the future we will need serious reconsideration of established research cultures that have evolved over the years and of researchers who have devoted considerable effort to finding fault with approaches other than their own. The time is long overdue for us to vacate research comfort zones—for example, psychometric researchers should take a serious look at how grounded theory might help them and grounded theorists should explore the research possibilities modeling procedure. Such seemingly diverse approaches must have some things in common that would be mutually beneficial. Ideas are much better shared than protected.[69]

Kenneth Nordgren, project leader for developing blended learning at Karlstad University in Sweden, has suggested to us that a blended approach to research and evaluation is a natural outgrowth of blended assessment. Therefore, if we start blending the methods of table 1 instead of mixing them we may be able to become more effective at producing useful information. Multiple methods, though possibly costly and more time-consuming, will provide more meaningful results because the investigators will be better able to assess the cognitive, affective, and behavioral aspects of technology-mediated learning environments.

The idea of blending research methods is not new. Many investigators in the mixed-methods area have been advocating this approach for years, arguing for a blend of qualitative and quantitative methods.[70] Unfortunately a precise definition of blended research is difficult to frame in the same way that blended learning has been. However, the literature includes examples of investigators who blend research in creative ways. Brooks and Sandfort, for example, incorporated prototype analysis, quasiexperimental research, contingency analysis, and structural equation modeling in an interactively modified design.[71] The interesting feature of this work came from a blend over time where several versions of the original study informed each other in a progressive manner. Davis and Janowsky blended grounded theory methods with latent trait analysis in order to identify civility patterns in online and face-to-face courses.[72] This study breaks relatively new ground by incorporating two methods that have been considered almost antithetical to each other. Dziuban, Moskal, and Futch combined metaphoric analysis, ambivalence structures, prototype analysis, factor analysis, and decision trees in a blend of several procedures developing a model for how students react to their learning environments.[73] This study represented a Boolean intersection of multiple methods that historically have not been used simultaneously. Lieberman et al. incorporated another approach to blending research by using both faculty and students as investigators.[74] By adding students as active research participants, the blend involved cohorts. Riley et al. enabled several investigators to design their individual studies using a variety of methods and designs.[75] Subsequently she resolved the results into case studies and combined them into a kind of meta blend, elevating the granularity of the findings to a much higher conceptual level. These studies exemplify blending at several levels (methods, time, cohorts, and studies), creating information that surpasses individual methods or approaches.

Multiple methods will provide more meaningful results

Our job as evaluators and researches is to provide useful information, not simply report data.[76] By combining many methods, techniques, and domains, blended research, like blended learning, can bring the best of many approaches to improve the process.

Citation for This Work

Dziuban, Charles, and Anthony G. Picciano. *The Evolution Continues: Considerations for the Future of Research in Online and Blended Learning*. Research bulletin. Louisville, CO: ECAR, June 17, 2015. Available from http://www.educause.edu/ecar.

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