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Letter from the Editor

Dr. Melissa Layne

When our editorial staff posted the call for papers in early spring for this special issue, I certainly did not expect the overwhelming number of submissions we received. However, I suppose when you request articles around two highly-regarded annual reports, *Grade Change: Tracking Online Education in the United States, 2013* (Allen & Seaman, 2014) and the *NMC Horizon Report 2014 Higher Education Edition* (NMC & EDUCAUSE Learning Initiative, 2014), you are bound to receive a positive response! We had a difficult time paring down to the final seven, but believe we have included an exemplary compilation of work from experts in both education and industry.

This special issue is "special" for a number of reasons. First, as previously mentioned, it is based upon two reports that are invaluable resources to those involved in the field of online teaching and learning, *Grade Change: Tracking Online Education in the United States, 2013* (Allen & Seaman, 2014) and the *NMC Horizon Report 2014 Higher Education Edition* (NMC & EDUCAUSE Learning Initiative, 2014). Both reports have core commonalities that lend to their long-held credibility and widespread global attention. These commonalities include:

- addressing questions and issues common to higher education;
- rigorous data collection and analysis by experts in the field of online teaching and learning;
- consistent methodologies that allow for the tracking of the growth and development of online learning and educational technologies;
- identifying challenges and trends that ultimately impact online higher education planning and decision-making; and
- disseminating results that are widely-cited by educational and industrial researchers for the development of further studies.

Secondly, this issue of *Internet Learning* marks the debut of interactive and device responsive issue versions in addition to the print version. To view these versions, please refer to the *Internet Learning* website http://www.ipsonet.org/publications/open-access/internet-learning for instructions on how to download this issue (and future issues) to your desktop and other various mobile devices. This bold move to digital scholarship and publishing demonstrates our commitment to provide our readers with not only an engaging encounter with the written word, it exemplifies our dedication to "practicing what we preach" by keeping current on innovative developments in the evolving field of scholarship and publication. Therefore, I would like to thank Nicole Lea of *Sorelle Design*, South Africa who has been invaluable and instrumental in the digital transformation of this issue, American Public University System's Holly Henry Cooper, who designed, laid out, and integrated the transformed journal into Adobe's InDesign software, the creative multimedia team of J. Sean Geary and Jaime Goodman from American Public University System who created the four complex interactives in our featured article, and Ty Crawford for his design of the journal's new logo.

Lastly, the works written by the authors in this issue embody a more holistic approach to online teaching and learning topics. No longer should we isolate education and industry. No longer should we limit the inclusion of conceptual works and opinion pieces from academic journals. No longer can we afford to ignore the potential that partnerships between market-driven, student-centric companies and reputable, higher education institutions can provide to both entities. Therefore, the articles included in this issue cover topics such as MOOCs, new online learning business models, gamification, interactive and blended teaching environments, data visualization and online collaborative efforts on a global scale.

The first article, *Enter the Anti-MOOCs: Reinvention of Online Learning as Social Commentary*, by New Media Consortium's Larry Johnson and Samantha Adams-Becker, discusses in depth these "high-level experiments in online learning" (a.k.a, the Anti-MOOC) as virtual spaces created to promote social interaction and commentary. In the second article, *Positioning for Success in the Higher Education Online Learning Environment*, Jeff McCafferty presents an analysis of current online learning and higher education markets in terms of identifying factors that impact the development and expansion of online learning. Britt Carr's case study, *Gamifying Course Content with Smashfact* describes Smashfact—a recently-released study-game app for faculty that increases student engagement levels by "gamifying" basic course content, thereby reducing barriers to success. Students are able to use the app on any of their devices: phones, tablets or desktop computers. Our fourth article, *Problems And Possibilities of Gamifying Learning: A Conceptual Review* by Hannah Gerber continues the exciting discussion on gamification by providing a brief overview of the concept of gamification and examines and compares gamification with edutainment and game-based learning. Gerber asserts that in its current industry-driven conceptualization, gamification will not work when implemented in educational arenas, and that to be examined and used within educational frames, gamification must be re-examined and re-conceptualized. Our fifth article, *Using Early Warning Signs to Predict Academic Risk in Interactive, Blended Teaching Environments*, by Julie Schell, Brian Lukoff and Cassandre Alvarado offers an evidence-based process for identifying characteristics correlated with student academic underachievement at the course level in blended, interactive teaching environments. *Visualizing Knowledge Networks in Online Learning* by Marni Baker-Stein, Sean York and Brian Dashew introduces the development of a framework and methodology aimed to yield a better understanding of social interactions and knowledge construction in online courses that employ both formal and informal social and cooperative learning activities. In our final article, *Integrating Online Global Collaboration* authors Zhenlin Gao and Tom Green share their account of an online, collaborative project based upon the premise that students today are instinctively collaborative, innately cooperative, and structurally wired for small-group interaction mediated by language and an awareness of the intentionality of others. This unique project involved collaboration between students from School of Media Studies and Information Technology at Humber College in Toronto and students from the School of Animation at Shenzhen Polytechnic (SZPT) in China. As evidenced in these articles, the field of online teaching and learning is undoubtedly giving rise to a variety of exciting possibilities to greatly improve student outcomes, and those of us at *Internet Learning* are thrilled to be able to share this knowledge with our readers.

Respectfully,
Dr. Melissa Layne, Editor-in-Chief for *Internet Learning*

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Enter the Anti-MOOCs: The Reinvention of Online Learning as a Form of Social Commentary

Larry Johnson & Samantha Adams Becker[A]

Introduction

The term "massive open online course," (MOOC) although coined in 2008 by Stephen Downes and George Siemens, really came into broad use in 2012. Since then, MOOCs have gained public awareness with a ferocity not seen in some time. World-renowned universities, including MIT and Harvard University (edX) and Stanford University (Coursera), as well as innovative start-ups such as Udacity, jumped into the marketplace with huge splashes, and have garnered a tremendous amount of attention — and imitation. Designed to provide high quality, online learning at scale to people regardless of their location or educational background, MOOCs have been met with enthusiasm because of their potential to reach a previously unimaginable number of learners. The notion of thousands and even tens of thousands of students participating in a single course — working at their own pace, relying on their own style of learning, and assessing each other's progress — has changed the landscape of online learning.

A number of respected thought leaders, however, believe that the current manifestation of MOOCs has significantly deviated from the initial premise outlined by George Siemens and Stephen Downes when they pioneered the first courses in Canada. They envisioned MOOCs as ecosystems of connectivism — a pedagogy in which knowledge is not a destination but an ongoing activity, fueled by the relationships people build and the deep discussions catalyzed within the MOOC. That model emphasizes knowledge production over consumption, and new knowledge that emerges from the process helps to sustain and evolve the MOOC environment.

Despite their philosophical distinctions, one aspect that both early and contemporary MOOCs have in common is that there is little common ground in any of this landscape. Each MOOC example puts forth its own model of how online learning should work at scale. Some MOOCs leverage a multitude of emerging pedagogies and tools, including blended learning, open educational resources, and crowdsourced interaction; others follow a fairly traditional lecture-based model, using studio-produced videos. The technologies that enable the workflow of MOOCs vary in different models, but in its early conceptions, the bias was toward tools that were readily available and easy to use. Early MOOCs drew upon cloud-based services such as Wikispaces, YouTube, and Google Hangouts, among many others, to foster discussions, create and share videos, and engage in all the other activities that have become essential to teaching and learning in a modern online learning environment.

While extremely promising, the more current MOOC models differ from those connectivist models, and largely mirror traditional lecture formats. Coursera, for example, is centered around video lectures led by renowned educators from prestigious universities in popular areas such as microeconomics and artificial intelligence. Stu-

[A] New Media Consortium

dents watch these videos and demonstrate what they have learned via quizzes and papers. Although the quality of the video and related content provided is high, this delivery model is very much based in traditional models of instruction, and does not include the notions of openness and connectivism outlined by Siemens and Downes. Indeed, the content on each of the major sites is not "open," as pervasive copyright notices make clear.

Coursera, edX, and Udacity, the three major players in the MOOC space, have put a lot of money and effort into developing high quality proprietary content, which is housed in learning environments that each bring their own unique and proprietary "secret sauce." A variety of forms of machine intelligence have been developed as part of these systems to assess student performance. The social structures of the major MOOC projects are essentially similar, with students participating in online forums, study groups, and in the case of Coursera and Udacity, organized student meet-ups. Content-wise, Coursera emphasizes video, with students watching recorded lectures from field experts as the main substance of the courses. At the time of publication, Coursera had over four million students enrolled in 400 courses, while edX and Udacity had reached 1.75 million students, across 60 courses and 30 courses, respectively.

In response to what many see as problems in the pedagogical, financial, and other models of the high profile MOOC providers, a curious form of social commentary has emerged — the "Anti-MOOC," a term coined by Audrey Watters that refers to online courses that are specifically positioned as experiments in online learning that, in well-defined ways, do not ascribe to the models used by the Courseras, Udacities, and other large providers.

Anti-MOOCs have a unique role as counterpoint to the more high-profile online learning projects. As massive open online courses continue their high-speed trajectory, many educational leaders and theorists feel that there is a great need for reflection — especially that which includes frank discussions about what a sustainable, successful model looks like. In this context, many Anti-MOOCs are high-level experiments in online learning created expressly to generate a counterpoint to MOOCs and a basis for social interaction and commentary. In some ways, this may reflect the view of many experts that the pace at which MOOCs are developing is too rapid for genuine analysis; alternatives need to be created to provide comparison points. Others maintain that MOOCs are not the disruptive technology initially touted, and that the current landscape is uniquely (and probably only temporarily) open to new ideas in online learning.

When MOOCs were Young

When Stephen Downes and George Siemens coined the term in 2008, massive open online courses were conceptualized as the next evolution of networked learning. The essence of the original MOOC concept was a web course that people could take from anywhere across the world, with potentially thousands of participants. The basis of this concept is an expansive and diverse set of content, contributed by a variety of experts, educators, and instructors in a specific field, and aggregated into a central repository, such as a website. What made this content set especially unique is that it could be "remixed" — the materials were not necessarily designed to go together but became associated with each other through the MOOC. A key component of the original vision is that all course materials and the course itself were open source and free — with the door left open for a fee if a participant taking the course wanted university credit to be transcripted for the work.

Except for a few notable exceptions, such as the compelling DS106 from the University of Mary Washington, this constructivist model has not found much traction among MOOC designers. Early MOOCs leveraged a multitude of established and emerging pedagogies and tools, including blended learning, open educational resources, and crowd-sourced interaction. The technologies that enable the workflow of early MOOCs varied, but the common thread has been that these sorts of tools were readily available and easy to use. The first MOOCs drew upon cloud-based services such as WikiSpaces, YouTube, and Google Hangouts, among many others, to foster discussions, create and share videos, and engage in all the other activities that have over the last five years or so have become essential to teaching and learning in a modern online learning environment.

While the influence of these early MOOCs on online pedagogy has been significant, it is important to remember that online learning is not new. The category encompasses any learning that takes place through web-based platforms, whether formal or informal, and online learning providers have been toiling in these fields for more than 20 years. What has made the topic new is the recent and unprecedented focus on providing learning via the Internet that has been stimulated by the tremendous interest in massive open online courses.

MOOCs received their fair share of hype as they exploded onto the education landscape in 2012. Big name providers including Coursera, edX, and Udacity count hundreds of thousands of enrolled students, totals that when added together illustrate their popularity. One of the most appealing promises of MOOCs is that they offer the possibility for continued, advanced learning at zero cost, allowing students, life-long learners, and professionals to acquire new skills and improve their knowledge and employability all of the time. MOOCs have enjoyed one of the fastest uptakes ever seen in higher education. Yet critics loudly warn that there is a need to examine these new approaches through a critical lens to ensure they are effective and evolve past the traditional lecture style pedagogies.

MOOCs as Big Business

In 2012, the Federal Reserve Bank of New York reported that Americans owe over $900 billion in student loans. At the same time, 40% of university students across the nation do not complete a degree within six years. There is a growing number of students concerned about what they are actually getting in exchange for the tremendous costs of their education. As inexorably as Moore's Law has governed the shrinking size of transistors and chips, higher education budgets seem to be following a sort of inverse of the law, in which costs rise year upon year, with tuition rates rising even faster as public support dwindles.

This is the environment in which MOOCs have prospered. More than any idea that has come along in years, university presidents and boards of trustees see a new business model in these large-scale courses, and as such, have invested a great deal of efforts in exploring their potential. In October 2012, Stanford University President John Hennessy referred to the incredible pace of development in MOOCs as a tsunami. "I can't tell you exactly how it's going to break, but my goal is to try to surf it, not to just stand there," he said in a panel discussion on the changing economics of education.

The major players are all well known: Coursera, started by two computer science professors at Stanford University; Udacity, which emerged from a Stanford University experiment in which Sebastian Thrun and Peter Norvig put their class on artificial intelligence online, with tremendous results; and edX, the lone nonprofit, based in Cambridge, Massachusetts that was founded and is jointly governed by MIT and Harvard. Each has invested millions in their own online learning platforms. The main difference between them is the courses they have to offer and the structure and style of delivery of these courses.

Coursera was founded in 2011 and publicly launched its proprietary platform in April 2012. More than 80 institutions, including Yale, Northwestern, and Stanford, offer some 400 courses. The company claimed more than four million students in late 2013. Among the major players, Coursera has generated the most funding, with more than $65 million invested so far. In January 2013, the company launched a new service that it said could be its biggest source of revenue: selling "verified certificates" that authenticate students' identities and offer a more valuable credential. Titled "Signature Track," the new program garnered 25,000 signups and earned $1 million in revenue by September 2013.

Udacity, founded in 2012, famously began as a hugely successful experiment by Stanford University professors, Sebastian Thrun and Peter Norvig, who put online their class on artificial intelligence. Thrun is the inventor of Google's self-driving car and one of the forces behind Google Glass. Unlike EdX and Coursera, Udacity produces courses in its own studio, rather than distributing content created by universities; their 30 courses are taught by faculty from at least five universities, plus private partner companies such as Google, NVIDIA, Microsoft and Autodesk. As of the end of 2012, the company reported more than 750,000 students. Udacity raised $21.1 million in capital by December 2012, and the number of courses doubled in 2013, with high-profile partnerships announced with the Georgia Institute of Technology (Georgia Tech) and San Jose State. However, the company has experienced challenges in 2013; in January, San Jose State was signed as a major partner, with a major for-credit course experiment planned, but early results were mixed, and in July, the effort was put on hold. Georgia Tech is currently working with Udacity in an online master's degree that gives students a real economic incentive.

As *The New York Times* noted, when Georgia Tech's master's degree in computer science is launched in January 2014 using Udacity's platform, they will do it for a fraction of the on-campus cost, a first for an elite institution. If it even approaches its goal of drawing thousands of students, it could signal a change to the landscape of higher education. The online degree will cost students $6,600, far less than the $45,000 that the same program would cost on campus.

EdX, the sole not-for-profit entity in the top three, was founded in May 2012, and has grown to include 28 institutions in what is called the xConsortium. The organization offers about 60 courses on its open source platform, and claimed one million registered users in June 2013. Led by co-founders MIT and Harvard, plus Berkeley and Cornell, EdX has $60 million in funding from Harvard and MIT in startup money, along with another $1 million from the Bill and Melinda Gates Foundation. In February 2-13 and then again in May, EdX doubled its university partners and expanded abroad.

The early success of the major players, and the tremendous attention they have drawn, both in terms of student interest and funding, created a firestorm in both the educational and financial press. By the end of 2012, MOOCs were the topic of discussions at the highest levels at virtually every major university.

With the tremendous focus and attention on the phenomenon, inevitably the hype began to build. Traditional universities were doomed, so the conventional wisdom went, condemned to irrelevance by an onslaught of MOOCs. According to Wired, in early 2012, Udacity's Sebastian Thrun mused that ten might survive.

MOOCs in Transition

Barely a year later, the tide has turned. What education experts and journalists once lauded as innovative and exciting has now become the subject of criticism in a stream of news stories and blogs that questioned how far apart the promise and reality have been. After a year of hype and curiosity, concrete data on the results of the early MOOC offerings finally surfaced, and the results have added fuel to the critical fire.

Even Sebastian Thrun, Udacity's founder, has adopted a new perspective based on the initial findings. In a comment to The Chronicle of Higher Education, he said, "A medium where only self-motivated, web-savvy people sign up, and the success rate is 10% doesn't strike me quite yet as a solution to the problems of higher education."

Thrun's shift in stance is significant, and signals a new view of MOOC s that is more critical and less willing to be supportive of MOOCs in general. As Jonathan Rees quipped on his More or Less Bunk blog, "Anti-MOOC really is the new black."

In July 2013, the end of San Jose's State University's high profile MOOCs-for-credit experiment with Udacity after just six months marked the turning point for many. The pendulum of public fascination began to swing back with a vengeance, and an outpouring of articles and commentaries suggested that MOOCs, far from being the "Single most important experiment in higher education," as *The Atlantic* put it in July 2012, are increasingly under a very critical microscope. That same month, George Siemens' observed on his ELEARNSPACE blog that, "Critiquing MOOCs is now more fashionable than advocating for them."

Some thought leaders, on the other hand, view the initial disappointing data spawned by MOOCs as unsurprising, and symptomatic of higher education in general. Jonathan Tapson detailed these viewpoints as falling into two rather succinct perspectives: first, many advocates of the status quo argue that a high-quality student-teacher or student-peer interaction is all but impossible on the web. Second, as MOOCs have very low completion rates (from 5 to 16%), they are quid pro quo not effective substitutes for real education.

Tapson counters this last point, by noting "a small percentage of a very large number is still a large number. When 14% of the 160,000 students who signed up for Udacity's Introduction to Programming passed, that added up to 23,000 completions." He went on to observe that across the four universities in which he had worked, this common freshman course probably had fewer than 10,000 completions in those institutions entire history. Udacity managed this in three months, he observed, with a staff of less than a dozen, and on a budget far less than the sum those four university departments probably spent on it combined.

Others, including Doug Guthrie at Forbes, are very concerned about the ongoing revelations of poor test results, high dropout rates, and disgruntled university instructors. He partly attributes these outcomes to a lack of innovation in higher education pedagogy, and from that perspective, thinks it is clear that MOOCs are not the panacea for 21st Century higher education that their proponents claimed they would be. "MOOCs have turned out to be only a minor achievement in pedagogy, " he noted, "and an expensive one at that." In Guthrie's view, MOOCs were largely online lecture halls, yet "nobody in the business of instructional design feels that lecture halls, whether on campus or online are a good way to teach students."

Not all the news is critical. As Tamar Lewin of The New York Times wrote, since the first free artificial intelligence course from Stanford enrolled 170,000 students two years ago, MOOCs have drawn millions of people to sample learning from the world's top universities. There have been heartwarming results, such as the perfect scores of Battushig, a 15-year-old Mongolian boy, in a rigorous electronics course offered by MIT.

Nonetheless, as Lewin goes on to note, while there is justifiable excitement around the reach of these courses, MOOCs have not delivered on the expectation of profound change, in his view because they offer no credit and do not lead to a degree. Levin feels that the decision of Georgia Tech to offer a MOOC-based online master's degree in computer science for $6,600 could be a game-changer. The dean of the Georgia Tech's College of Computing, Zvi Galil, expects that the program could attract up to 10,000 students. Noteably, the program may be a response to declining international enrollments as well. "Online, there's no visa problem," he said in Lewin's The New York Times article.

The prospect of a low-cost degree from a world-class institution has generated tremendous interest. Some, Lewin writes, think the leap from individual non-credit courses to full degree programs could signal the next phase in the evolution of MOOCs and bring real change to higher education. While some believe in potential of MOOCs and others see the movement as all hype, there is a middle ground; the fact that the topic is being discussed so intensely means that it has the opened doors to new ideas. MOOC have catalyzed countless conversations about how to improve online learning— what is working and what is not.

"Perhaps Zvi Galil and Sebastian Thrun will prove to be the Wright brothers of MOOCs," said S. James Gates Jr., a University of Maryland physicist who serves on President Obama's Council of Advisors on Science and Technology. "This is the first deliberate and thoughtful attempt to apply education technology to bringing instruction to scale. It could be epoch-making. If it really works, it could begin the process of lowering the cost of education, and lowering barriers for millions of Americans."

Even for those who recognize vast potential in MOOCs, it is still challenging to discern what will happen next and which efforts will be successful. Georgia Tech's Dr. Galil is primarily concerned with breaking new ground.

"This is all uncharted territory, so no one really knows if it will go to scale," Dr. Galil said. "We just want to prove that it can be done, to make a high-quality degree program available for a low cost." In response, Lewin asked, "Would such a program cannibalize campus enrollment?"

"Frankly, nobody knows," answered Galil, and it is still far from certain if the degree program will be sustainable. While a single pilot effort may be successful, expanding to include more for-credit MOOCs across institutional offerings poses its own set of problems, requiring a larger financial investment for more instructional design, scaffolding, and staff. Some are skeptical that tuition for fee-based MOOCs can remain as low as they are in the Georgia Tech model.

"The whole MOOC mania has got everyone buzzing in academia, but scaling is a great challenge," said Bruce Chaloux, who until his recent untimely death was executive director of the Sloan Consortium, an advocacy group for online education. "I have to believe that at some point, when the underwriting ends, to keep high quality, Georgia Tech would have to float to more traditional tuition rates."

Even if providers find ways for the costs of for-credit MOOCs to remain modest, there is still the lingering question of whether the degrees will ever be valued as highly as those from brick-and mortar institutions — or at all.

"Georgia Tech is exceptionally important because it's a prestigious institution offering an important degree at very low cost with a direct connection to a Fortune 100 corporation that will use it to fill their pipeline," said Terry W. Hartle, the senior vice president of the American Council on Education. "It addresses a lot of the issues about universities that the public cares about. But how good and how transferable it is remain to be seen."

Students on MOOCs

For students, the promise of MOOCs is very appealing at the surface. Many current models present opportunities for learners to freely experiment with a variety of subjects and acquire new skills that may not be associated with a degree plan at brick-and-mortar institutions. An English major, for example, could enroll in an edX course on the foundations of computer graphics or circuits and electronics.

One such student, 21-year-old Feynman Liang, has completed 36 massive open online courses through Udacity and Coursera — while simultaneously pursuing majors at both Amherst College and Dartmouth University. He believes the combination of face-to-face and online courses have given him a more well-rounded education. "A big reason why I'm able to have taken so many MOOCs is because I'm fortunate to be in an environment which enables it," Liang reported to TheGoodMOOC.com. "Professors and other students provide me with an intellectual community I can go to whenever I have questions about things being covered in MOOCs."

At the same time, Liang notes a concern. "I find MOOCs to particularly excel when it comes to lectures and assignments requiring little creativity," said Liang. "Traditional classrooms are superior to MOOCs when it comes to personalized mentoring and uniform standards, which make assigning creative assignments particularly difficult."

While Liang does not believe that the quality of MOOCs will surpass that of traditional, face-to-face learning experiences, he recognizes their promise. "By shifting the lecture and homework part of the classroom to an online platform, professors can focus on adding value through personalized mentoring and open-ended projects."

Liang's balanced perspective is an important part of the ongoing conversation around MOOCs, and points to a future in which MOOCs have an understood and valuable role to play in concert with more formal education approaches. Others see a need to move to new models, informed by the MOOC experiments, but which include other elements, including more personalization and interactivity, along with improved engagement strategies.

Enter the Anti-MOOCs

In this mix, some institutions are calling an end to MOOC mania, and making impassioned arguments for more measured approaches. The administration at American University has issued a "moratorium on MOOCs," according to The Chronicle of Higher Education. "America is purposely avoiding experimentation before it decides exactly how it wants to relate to the new breed of online courses. I need a policy before we jump into something,'" said Scott A. Bass, the provost, in an interview.

Larry Cuban, in an article for the Washington Post, noted that MOOCs have attracted advocates, of course, but also a growing number of skeptics and agnostics, and these two groups are fueling the anti-MOOCs response in a variety of ways. Skeptics, for example, include those who question the premise of learning online as opposed to face-to-face in lecture halls and seminars. Cuban references a recent poll in which nearly 60 percent expressed "more fear than excitement" for expanding online courses. Some of the more active skeptics are urging faculties to take action, lest computer screens replace professors.

Agnostics, Cuban argues, question the hype of MOOCs revolutionizing higher education while seeing both pluses and minuses to virtual learning. They know that approaches such as offering lectures to hundreds of undergraduates are themselves cost-saving strategies. Hybrid teaching practices might indeed be pedagogically superior to large lectures.

Respected blogger Audrey Watters, who may be considered part skeptic and part agnostic on this point, coined the term "Anti-MOOC" in a post about a consortium of ten universities. The group announced a program offering online, for-credit courses in which any students at their respective schools could enroll. Called "Semester Online," the program includes Brandeis University, Duke University, Emory University, Northwestern University, University of North Carolina at Chapel Hill, University of Notre Dame, University of Rochester, Vanderbilt University, Wake Forest University, and Washington University in St. Louis. In this case, the "anti" was aimed at the notion of massiveness — enrollments would be capped at around 20 per course section, a direct rejection of one the pillars of the large-scale offerings. The University of Maine at Presque Isle is another institution attempting this kind of an anti-MOOC approach: a free online offering that is more like the "high-touch" experience of a conventional online course which Michael Sonntag, the provost, calls a "LOOC" — a "little" open online course.

A partnership between the New Media Consortium (NMC), ISTE, and Hewlett Packard is packaging anti-MOOCs into a comprehensive strategy to deliver professional development to science, engineering, and mathematics teachers at the HP Catalyst Academy. While still building a model that is intended to scale, their notion is to focus primarily on pedagogical innovation, using the medium itself to help deliver the learning. A course on social media, for example, is conducted entirely in Facebook.

Probably the definitive Anti-MOOC can be found in Digital Storytelling 106, a very popular online course better known as "DS106". The online digital storytelling course at University of Mary Washington (UMW) is one of the few that adhere to the original connectivist notion of a massive online course, open to all, but one must be a registered student at the university to receive credit. Their course also differs from the current MOOC scene because there is no one assigned faculty member to teach it. For the past several years, DS106 has also been taught at several other institutions, and UMW is currently exploring how to give credit to other state college students as well as incoming high school students..

Responses such as these are explicitly citing how what they intend to do is not what MOOCs do — and that is the essence of the Anti-MOOC. One of the founders of the MOOC movement, George Seimens, shared recently on his ELEARNSPACE blog, with some cynicism, "If 2012 was the year of the MOOC, 2013 will be the year of the anti-MOOC." Siemens feels that by and large, faculty do not like MOOCs, and details reasons such as elite university models, poor pedagogy, and blindness to decades of learning sciences research.

Whither, From Here?

Wherever one stands on MOOCs, one thing is clear: online learning has "come of age." The vast scope of articles in the recent press, and even the focus of most research in to online learning in the past two years has been on the MOOC phenomenon. Authors and researchers are no longer asking if online learning is effective. We know it can be if well-constructed. More and more, the design of online learning is specifically intended to encompass the latest research, the most promising developments, and new emerging business models in the online learning environment. At many institutions, online learning is an area newly ripe for experimentation — some would argue it is undergoing a sea change, with every dimension of the process open for reconceptualization. On campuses around the globe, virtually every aspect of how students connect with institutions and each other to learn online is being reworked, rethought, and redone — but it will be some time yet before ideas coalesce enough to be validated by research and implemented broadly.

In many current models, massive open online courses present opportunities for learners to freely experiment with a variety of subjects and acquire new skills that may not be associated with a degree plan at brick-and-mortar institutions. A Neurology major, for example, could enroll in a Udacity course on artificial intelligence. Learners are not stuck on a single pathway.

Related advances in both classroom and online learning are emphasizing personalized learning, and if massively open online courses could both scale globally and yet cater to individual learning styles, it would be a very exciting combination. In their current forms, MOOCs already allow learners of all ages, incomes, and levels of education to participate in a wide array of courses without being enrolled at a physical institution. The most effective MOOCs make creative use of a variety of educational strategies and frequently leverage multimedia to demonstrate complex subjects. One recent entrant in Spain, unX, has integrated badges as a way to reward learners for their participation and concept mastery.

If MOOC projects proliferate, advocates hope that providers will invent innovative ways for learners to demonstrate their knowledge at scale. Peer review systems, student gurus, badges, and other forms of assessment are currently being explored, but there is no real verdict yet on what is most effective. To continue to gain traction, MOOCs will need to strike a fine balance between automating the assessment process while delivering personalized, authentic learning opportunities.

It is that last point that brought Forbes' Guthrie to suggest that MOOCs are nowhere near the kind of transformative innovation that will remake academia. That honor, according to Guthrie, belongs to a more disruptive and far-reaching innovation — big data and its applications. Big data, he feels, is very likely to revolutionize online learning. It will be the means by which we customize learning to match the needs of individual students, especially in the online learning space. Big data will give institutions the predictive tools they need to improve learning outcomes for individual students. By designing curricula that collect and interpret data at every step of the learning process, customized modules, assignments, and feedback can be targeted to student needs in the moment.

Time and other authors will settle those questions, but there is no doubt that MOOCs have already had a significant influence on the future course of online learning, and continue to do so. Whether it be through the offerings of the large-scale providers, or via the Anti-MOOC-inspired online courses at individual universities or consortia, online learning has earned its place in the academy.

Welcome to the new era of online learning!

Online Learning in Practice

A sampling applications of massively open online courses highlighted in recent Horizon Project research includes the following:

- Acamica is a platform used by Latin American learners to access interactive courses from experts in different areas. As students progress, they build online knowledge profiles to share with prospective employers or institutions: go.nmc.org/aca.
- Bossier Parish Community College offers an online degree program in which students can do a majority or all of their coursework online. The online instruction involves presentations, video tutorials, discussion boards, and other learning activities: go.nmc.org/bpc.
- The Buena Vista School District launched the Buena Vista Online Academy, an online alternative to a brick-and-mortar school for students: go.nmc.org/bvsdoa.
- Bunker Hill and Mass Bay Community College partnered with MIT's edX to offer MOOCs to their students. They are the first two-year colleges to work with the popular MOOC provider: go.nmc.org/edXMA.
- The California Institute of Technology piloted the "Learning from Data" MOOC in April 2012. The first offering included live streaming and real-time Q&A sessions with the participants, along with automated grading and discussion forums. Since then, it has been offered four times, with over 100,000 enrolled students. go.nmc.org/caltech
- Colorado Technical College developed an online learning platform called MUSE (My Unique Student Experience), which caters to students' varying learning styles: go.nmc.org/muse.
- The Games MOOC is a community site woven around a series of three courses about the use of games in education, including traditional games, massively multiplayer online role-playing games, game-based learning, and immersive environments. The first courses were piloted in the fall of 2012. go.nmc.org/gamesmooc
- The Gates Foundation awarded a grant to Ohio State University to design a MOOC for Coursera. This course will engage participants as writers, reviewers, and editors in a series of interactive reading, composing, and research activities with assignments designed to help them become more effective consumers and producers of alphabetic, visual, and multimodal texts. OSU faculty members have developed the Writers Exchange, an idea-networking website to support the course: go.nmc.org/osu.

- Google created an open course builder and its first massive open online course, "Power Searching with Google." It drew 150,000 students, and helped sharpen their Internet search skills. go.nmc.org/googco
- In the spring of 2013, Indiana University-Purdue University Indianapolis and the Purdue University Department of Music and Arts Technology will offer a new MOOC, "Music for the Listener," that can be converted into credit. The six-week course covers the music of western civilization from 600 AD to the present. The learning environment is bethrough Course Networking, with full translation features, rich media, and social networking tools: go.nmc.org/thecn.
- Maricopa Community Colleges' Career and Technical Education 230: Instructional Technology course stems from a National Science Foundation-funded project to increase the ability of STEM teachers to collaboratively learn and apply STEM skills using information and communication technology. Participating educators acquire knowledge and skills using Canvas and 3D Game Lab learning management systems, and Google+ Community. go.nmc.org/opecou
- Maricopa Community College offers 600 online courses via a cohort of ten community colleges, and serves nearly 70,000 students each year: go.nmc.org/maricopa.
- A MOOC called "Landmarks in Physics" delivered through Udacity was created by an MIT graduate who filmed in Italy, the Netherlands, and England to create a virtual tour that explains the basic concepts of physics at the sites of important discoveries in our history: go.nmc.org/phy.
- The online learning platform Veduca provides Brazilian users with 5,000 online classes, licensed from some of the world's top universities, such as MIT, Harvard, Yale, and Princeton, and translates them into Portuguese: go.nmc.org/ved.
- Open Universities Australia launched Australia's first MOOC provider, called Open2Study, in March, 2013: go.nmc.org/ouamooc.
- Senior academic leaders at the University of Queensland have resolved to develop up to 12 open online learning courses over the next two years. Their main interest is in how MOOCs will enable new opportunities for campus-based students: go.nmc.org/uqmooc.
- Oregon Virtual Education is an online learning program that offers free enrollment. Classes can be taken to supplement or replace traditional classroom learning: go.nmc.org/orved.
- Through the open source platform unX, Iberoamerican universities can offer MOOCs for online learning and vocational training. The model includes interactive features, along with a digital badging system: go.nmc.org/unXIA.
- The University of Melbourne became the first Australian university to join Coursera, a leading international online course provider. Macroeconomics and Epigenetics are two of the courses planned to go live by the end of 2013: go.nmc.org/auscou.
- The University of Texas Online High School provides students with an opportunity to receive their high school diplomas through a flexible, distance education model: go.nmc.org/uths.

For Further Reading

A sampling of recommended readings related to massively open online courses that have been highlighted in recent Horizon Project research includes the following:

Adaptability to Online Learning: Differences Across Types of Students and Academic Subject Areas go.nmc.org/adapt (Di Xu, Community College Research Center, February 2013.) A comparison study examines student success in an online environment.

Colleges Adapt Online Courses to Ease Burden go.nmc.org/ease (Tamar Lewin, The New York Times, 29 April 2013.) Nearly half of all undergraduates in the U.S. arrive on campus needing more work before they can begin regular classes for credit. Colleges are beginning to experiment with online versions, which allow students to take these initial courses easily and cheaply.

College Is Dead. Long Live College! go.nmc.org/ylazv (Amanda Ripley, TIME, 18 October 2012.) When the Pakistani government shut down access to YouTube, an 11-year old girl continued her online studies using Udacity.

Credit for MOOCs Presents Challenges in Australia go.nmc.org/credmo (Charis Palmer, The Conversation, 7 November 2012.) Following the news that Antioch University was working with Coursera to offer credit towards a degree, Australian tertiary education providers debate the possible negative consequences of this approach.

How Online Learning is Saving and Improving Rural High Schools go.nmc.org/rural (Tom Vander Ark, Getting Smart, 26 January 2013.) Rural high schools face immense challenges, including federal and state education funding inequities, which causes thousands of schools to close down per year. Online schools even the playing field.

How 'Open' Are MOOCs? go.nmc.org/ope (Steve Kolowich, Inside Higher Ed, 8 November 2012.) This article explores several misunderstandings in the way many chief academic officers view massively open online courses and their potential to supplement traditional university classes.

Jump Off the Coursera Bandwagon go.nmc.org/cou (Doug Guthrie, The Chronicle of Higher Education, 17 December 2012.) This author observes that as universities rush to deliver online education, they may be too quick to launch insufficient models. As a result, many MOOCs are not addressing critical pedagogical issues, in addition to interactivity and customization.

MOOCs and Money go.nmc.org/money (Matt Greenfield, Education Week, 1 October 2012.) MOOCs have some possible monetizing strategies that can work as long as they continue to attract millions of students. The author argues that many current students are attracted to MOOCs out of curiosity, and ponders whether enrollment numbers will continue to be high over the next few years.

The Single Most Important Experiment in Higher Education go.nmc.org/single (Jordan Weissmann, The Atlantic, 18 July 2012.) This article discusses Coursera's new partnerships with several other universities. One school, the University of Washington, is giving credit for its Coursera courses. The funding from all these new universities will allow the company to blossom as a market for learning.

States, Districts Require Online Ed for High School Graduation go.nmc.org/require (Kelsey Sheehy, US News, 24 October 2012.) A growing number of school districts, including those in Virginia and Idaho, have recently signed legislation making it mandatory for students to take at least one online course in order to graduate high school.

The Teacher You've Never Met: Inside an Online High School Class go.nmc.org/onlinete (Nick Pandolfo, TIME, 13 June 2012.) This article explores the life and work of an online K-12 teacher at Colorado's 21st

Century Virtual Academy. The teacher reports frustrations in not being able to read students' body language to better understand their learning needs.

xED Book go.nmc.org/xed (Dave Cormier, George Siemens, and Bonnie Stewart, Accessed 2 January 2013.) George Siemens and two education researchers are writing a book that will discuss how the Internet is restructuring knowledge and the implications for MOOCs. They are currently chronicling their ideas on this site.

The Year of the MOOC go.nmc.org/moo (Laura Pappano, The New York Times, 2 November 2012.) Over the past year, MOOC development has become a major trend. This article examines the current higher education institutions and organizations offering MOOCs, discussing their strategies and the challenges each are facing.

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Positioning for Success in the Higher Education Online Learning Environment

Jeffrey McCafferty

As colleges and universities explore how to approach online learning in a manner appropriate for their own specific objectives, they face an evolving environment shaped by a variety of demographic, technological, economic, and competitive factors that add opportunity, uncertainty, and complexity. This paper examines many of those factors and what institutions interested in developing and expanding their online learning can do and are doing to be successful, however they define success, in this environment. Analysis of the current online learning and higher education markets is provided as well as recommended questions that institutions should address when forming their online strategy.

Keywords: *online learning, business models in online learning, online market environment, higher education, engaging and effective, branding, differentiation, value, global, student support*

Introduction

The current online learning market is in a transformational period. Against the backdrop of increasing innovation in content design, delivery, and support has emerged a diverse array of traditional and non-traditional educational institutions and companies seeking to meet demand. These organizations are engaging in a higher education market defined by expanding acceptance of online learning and growing competition for credentialed and non-credentialed learning shaped in part by high-profile activities that have been long in the making such as Massive Open Online Courses known commonly as MOOCs (ALISON in 2007), Open Educational Resources (OERs) (MIT OpenCourseWare in 2001), and Competency-Based Education (CBE) (1970s).

For colleges and universities trying to navigate in this environment, the range of engagement in online learning is often defined by how an institution is positioned on the higher education landscape. It is also a function of what an institution considers the primary reasons for developing online courses and programs, some of which are learning-driven, some operations-driven, and some market-driven (see *Figure 1* below).

Learning-driven

- Providing educators with and training them on a variety of tools and approaches to present course material more effectively to enhance student learning.
- Using technology to enable faculty members to better meet the unique needs of individual learners.
- Creating real-time interventions where the student can quickly obtain necessary help and the instructor can readily track student progress more closely, which can benefit all students, particularly those requiring remediation.
- Implementing OERs into the classroom to both “flip” the classroom and to lower the cost of education to students.

- Developing communities of learning both within classes and institutions as well as among institutions.

Operations-driven

- Using online learning to increase institutional size without expanding the physical campus.
- Finding efficiencies in administrative expenses by using technology to automate many back office processes.
- Building online courses that can be offered repeatedly or at scale, thereby reducing costs.
- Cost-effectively providing student support services (such as advising, tutoring, career services) online in conjunction with online courses.

Market-driven

- Using online education to increase access to courses and programs to grow or supplement enrollments.
- Expanding the institutional brand to enhance awareness and prestige which may have enrollment, research, and fund-raising benefits.
- Addressing the needs of new non-traditional potential students – high school students, adult learners, corporations/associations/government employees, international students, alumni, and life-long learners.

Noted scholar on disruptive innovation, Clayton Christensen, has stated that "fifteen years from now more than half of the universities will be in bankruptcy, including the state schools" (Schubarth, 2013) unless they adopt online education and technology to lower costs and tuition and fundamentally change their business models. While some people may consider that to be an

Figure 1. Examples of primary reasons for developing online courses and programs

overstatement and that the higher education model is resilient, the reality is that for many institutions, the change has already begun as more colleges and universities have adopted online education, increasingly with market considerations in the forefront.

The question for many institutions is whether a transition to online learning for market reasons is solely sufficient to keep them from becoming obsolete. If a preponderance of colleges and universities adopt online education, the basic economic supply-and-demand dynamics are not necessarily changed but they can be skewed towards institutions that distinguish themselves. A review of the online higher education landscape can prove to be a worthwhile guide as institutions seek to find their way successfully into online learning, no matter how they define success for themselves.

Online Higher Education Market Dynamics

The most recent survey report from the Babson Survey Research Group details a large, but slowing online higher education market. *Grade Change: Tracking*

Online Education in the United States (Allen & Seaman, 2014) reveals that online enrollments continue to comprise a larger share of currently stagnating higher education enrollments (see Table 1).

The height of both recent higher education growth and online growth came in the Fall 2009 as the impacts of the recession drove students, many of whom were adult students, into colleges and universities. Since then, declining growth has occurred due to the end of the baby boom echo generation and a very slow growth economy that has stretched family finances and made adult students, who have historically been primary participants in online programs, defer their educational pursuits.

According to the Western Interstate Commission for Higher Education (WICHE) in its 2012 report *Knocking at the College Door: Projections of High School Graduates* (Prescott & Bransberger, 2012), the funnel for higher education enrollments are projected to moderate before the next period of sustained growth begins in 2020. This is also the date that President Barack Obama has set as the goal for America to reclaim its position as the nation with the highest proportion of college graduates in the world. At the time that goal was set in 2011, the college attainment rate would have had to increase by approximately 50% nationwide (8 million students) by the end of the decade according to projections made by the U.S. Department of Education (U.S. Department of Education, 2011).

Increasingly, online education is being used to assist in reaching toward that goal. Despite a slowing growth rate, online learning continues to gain traction, reflecting a shift in perception about the quality of online education as well as a realization by many institutions, large and small, public and private, that online learning represents an opportunity to enhance the quality of education, meet the expectations of digital natives, lower the cost of education and stem the rising tide of student debt, while providing an avenue to expand access and increase revenues in a time of lowered government fiscal support. According to the Babson Survey Research Group, not only have more schools provided online offerings in the past decade, more have also started online degrees (Allen & Seaman, 2013) (see Table 2 below).

Moreover, despite perceptions that online education is primarily a for-profit institution endeavor, in reality non-profit colleges and universities offering online education far outnumber the for-profit providers (Table 3) (Allen & Seaman, 2014).

Online learning has been a natural fit for many non-profit institutions, especially those with a mission to expand educational access. Increasingly, as government financial support has waned, more non-profits are finding it necessary to expand their online initiatives as a revenue supplement and to address various pressures related to the following.

- **Their States** – Feeling the financial pinch, state legislatures are urging their higher education institutions to seek out more cost efficient ways of delivering education and to find ways to deal with capacity constraints especially for students seeking to transfer from community college to four-year institutions.
- **Their Boards** – College and university boards are increasing their interest in online learning as a path to address state legislatures demands, enhance academic quality and operational efficiency, demonstrate institutional innovation, and grow enrollments and market awareness/institutional prestige. The pace at which boards are pressuring college administrators to move forward with online initiatives can be a source of friction

Table 1. *Higher Education Online Enrollment as a Percentage of Total Higher Education Enrollment*

	Total Enrollment at Degree Granting IHEs	Total Enrollment Annual Growth Rate	Students Taking at Least One Online Course	Online Enrollment Annual Growth Rate	Online Enrollment as a Percent of Total Enrollment
Fall 2007	18,248,133	**2.8%**	3,938,111	**12.9%**	**21.6%**
Fall 2008	19,102,811	**4.7%**	4,606,353	**16.9%**	**24.1%**
Fall 2009	20,427,711	**6.9%**	5,579,022	**21.1%**	**27.3%**
Fall 2010	21,016,126	**2.9%**	6,142,280	**10.1%**	**29.2%**
Fall 2011	20,994,113	**-0.1%**	6,714,792	**9.3%**	**32.0%**
Fall 2012	21,253,086	**1.2%**	7,126,549	**6.1%**	**33.5%**

Notes:

- Green sections show peak levels
- Red block shows negative higher education enrollment growth, something that had not occurred since 1996
- Yellow block shows a rising online growth rate, however at a slowing rate

Table 2. *Percent of Institutions Providing Various Online Offerings*

	2002	**2012**
Online Courses and Full Programs	34.5%	62.4%
Online Courses Only	37.2%	24.2%
No Online Offerings	28.3%	13.4%

Table 3. *Online Offerings by Institutional Control in 2013*

	Have Online Offerings	**No Online Offerings**
Private For-Profit	532	304
Private Non-Profit	1,430	315
Public	1,731	20

at some campuses, perhaps most notably during the failed ouster of Teresa Sullivan as president of the University of Virginia in 2012.

- **Their Students** – The digital native generation, which lives, communicates, and learns in an age with advanced technology at its fingertips, and is increasingly exposed to online learning at the K-12 level and through services such as the Khan Academy, are coming to college expecting online options.
- **Their Strategic Interests** – Online education is increasingly viewed as a core attribute as evidenced by the 65.9% of chief academic leaders in the 2013 Babson online education survey saying online learning is critical to their long-term strategy; the second highest percentage during the past decade. Further, 74% of those academic leaders responded that learning outcomes in online education are the same or superior to those in face-to-face settings (down slightly from the previous year) (Allen & Seaman, 2014).

The way non-profits have approached online learning has depended on what they hoped to gain and the resources they had to work with. In particular, they have:

- **Done It on Their Own** – Institutions with the necessary human, financial, and technological resources and a clear sense of how online learning addresses their strategic needs can find it preferable to build their online capabilities with limited outside involvement.
- **Worked with Schools in Their System** – The University of Massachusetts Online, the University of Wisconsin Extension, and the State University of New York are examples of a system approach, where several schools contribute to the online options and can share similar technology and resources.
- **Partnered with a MOOC Provider** – As of July 2014, Coursera had 52 U.S.-based college and university partners and edX 17 U.S.-based collaborating schools. While the MOOC model continues to evolve with some initiatives looking more like "traditional" online offerings, the value in the exposure they provide to institutions trying to establish an online voice cannot be dismissed.
- **Worked with an Online Enabler** – An increasing number of schools use a third-party online enabler to help them launch and manage their online program. These firms come from a variety of industries including publishing (Pearson/Embanet and Wiley/Deltak), education software providers (Blackboard), for-profit higher education institutions (Kaplan – Colloquy), and pure online service plays (2U, Academic Partnerships, Bisk). In some cases the firms are not working with the entire institution, but instead a specific department. The Parthenon Group estimates that the enablers currently bring in an estimated $1 billion a year in tuition revenue, while the market is expected to double in four years, according to Global Silicon Valley (GSV) Asset Management (Howard, 2014).

Despite the rising number of non-profit schools entering the online market, according to higher education market research and consulting firm Eduventures, only a few schools dominate the market as 3% of higher education providers enroll 45% of the total online student headcount (Eduventures, 2014). Many of those providers are for-profit institutions, including four of the top five in market share, as evidenced by the following table of leading online providers (Table 4).

Table 4. *Leading Online Education Degree Providers*

	Fall 2014 Estimated Online Students
University of Phoenix	184,000
American Public University System	111,000
Liberty University	95,000
Ashford University	61,000
Grand Canyon University	53,000
Western Governors University	50,000
Walden University	50,000
Southern New Hampshire University	44,000
Kaplan University	40,000
Excelsior College	37,000

Notes:

- DeVry University may be on this list but they do not provide data that leads to a good estimate of online degree headcount.
- The student count is for students enrolled in online degree programs.
- Sources of data include SEC filings for publicly-traded companies, analyst reports of financial filings, university-supplied fact sheets, media reports, and APUS estimates.

It is important to note that four institutions on the list gained market share in the past year: Liberty, Grand Canyon, Southern New Hampshire, and Western Governors (WGU), and all of them except Grand Canyon are non-profits. They have all successfully leveraged a distinct strategy that emphasizes their strengths.

- Liberty has capitalized on its faith-based brand generated from the legacy of the late nationally recognized minister, televangelist, and political commentator Dr. Jerry Falwell, Sr., as well as its television programming to promote the institution.
- Grand Canyon also uses its faith-based roots along with strong regional marketing, an emphasis on building campus community for onsite and online students around athletics and the arts, a focus on regional high-growth industries, and a unique reinforcing strategy where they use their high-quality academics onsite foundation (minimum onsite admissions GPA requirement of 3.0 and average onsite student GPA of 3.5) to drive full-pay online enrollments, which in turn subsidize the tuition of the onsite students (tuition discounts over 50%) enabling Grand Canyon to compete for top onsite students.

- Southern New Hampshire leverages its status as a private non-profit university while promoting its low costs and its online competency-based College for America that is aimed at corporations and charges only $2,500 a year.
- WGU, the low-cost self-paced competency-based university, has grown by promoting its affordability and the connection of its curriculum to employer needs. It has expanded to five states, establishing itself as a legislature-recognized in-state online learning institution.

The growing strength of the non-profit institutions in the top ten list is indicative of a larger trend where the traditional online, mainly for-profit, powers are beginning to lose market share to non-profit institutions that are beginning to grow their operations at a larger scale and the increasing number of smaller institutions in the space that are collectively chipping away at the overall market share. This market erosion of the larger providers is exacerbated not only by other schools expanding their offerings, but also by the proliferation of non-traditional entrants such as organizations providing American Council of Education-approved courses like StraighterLine, OER providers, MOOC companies, coding bootcamps, and badge providers. The resulting over-supply is hitting at a time of stagnating higher education enrollments and slowing online growth, producing an online content supply and demand imbalance. While this has led to a wealth of options for students seeking educational content, it has also intensified the level of competition, especially among colleges and universities attempting to enhance enrollments. In such an environment, many institutions will need to differentiate themselves if they seek to gain students through online education.

Key Online Higher Education Market Differentiators

To be successful at scale in the competitive online higher education market will take leveraging market differentiators. Among them include the following:

- Brand Matters – The prospective online student is not a particularly savvy shopper. Eduventures has noted in several of its adult higher education consumer reports over the years that most online student prospects only consider 2-3 schools, setting the highest priority for schools local to them and those that have been recommended to them by a personal acquaintance (Eduventures, 2012).

  In an increasingly competitive market, better-respected institutions with large networks of students, faculty, and alumni, will gain the reputational advantage. Coupling branding with outstanding academic quality and student service, affordable pricing, industry-relevant curriculum, and a network of professional contacts will prove a very worthy value proposition in the market. This "branding premium" combined with competitive pricing can give a huge market advantage to an already established institution. For instance, according to Eduventures, 44% of all online degree enrollments originate in the same state as the provider. However, when those data are broken down by institution-type the percentage is much higher at 77% among public institutions because they have the locational branding advantages, in-state pricing, and they provide the student comfort in being able to travel to a campus if they need face-to-face communication (Eduventures, 2014).

In specific markets, the branding impact has already been established. For example, The American Public University System, through its American Military University (AMU) founded in 1991 as an institution focused on serving the military and related national security professionals, has become the leading higher education provider in the military market in terms of enrollments through tuition assistance. It has done this by building trust among the educational service officers at bases across the country and the servicemembers whom they serve through a combination of providing one of the lowest tuition and fees in higher education, engaging in face-to-face outreach led by retired military personnel, delivering support systems and creating policies aligned with military service requirements, and offering quality academic programs associated with military and related careers. The "branding premium" in the military has led AMU to have referral rates for new military students well above 50%.

- Engaging and Effective Online Learning that Leads to Successful Outcomes – According to Eduventures annual adult higher education consumer surveys, potential online students who regard online quality as equal to face-to-face (F2F) or "depends (on the course)" continues to rise from 58% in 2006 to 71% in 2013. However, while perceptions of online learning have improved, something is missing to get prospective adult students fully invested in online education. In fact, the Eduventures research reveals that blended solutions are the most preferred among prospective adult students. Only 11% of the 3,080 prospective adult students surveyed in 2013 cited "online" as their delivery mode of preference, while 36% either said "even balance" (between campus and online) or "majority online" (Eduventures, 2013).

Moving forward, institutions that are able to provide the feel of a blended course in an online experience may find successful learning models that appeal to a wide-range of students. Elements of such models could include:

- **Engagement** – Educational researchers have demonstrated that effective online learning requires student engagement with the instructor, the content, and each other (Dixson, 2010). As online learning evolves, both faculty initiatives and educational technology companies are trying to address this important learning element. For example, two University of Texas at Austin psychology professors have created a Synchronous Massive Online Class (SMOC) which is a live course for online students built around student participation, engaging course content, humorous video and graphically appealing presentations, interactive chat rooms, and the use of OERs to nicely align the online experience in a collaborative environment. Online enabler company, 2U, has developed a platform that includes a grid of "live tiles" that display real-time video feeds of the professor and students during class sessions enabling student/professor interaction, similar to that of a traditional face-to-face classroom.
- **Adaptive** – Be it intuitive within the software to intervene as necessary in a self-paced course or as a warning signal for faculty intervention in a traditional online course, adaptive learning offers the promise of rapid onsite assistance and targeted learning based on learner knowledge in an online setting.

Along with various software providers, colleges and universities are taking the lead in the field. For instance, Carnegie Mellon University has been working on adaptive applications for several years through its Open Learning Initiative, and is currently developing MOOC technology capable of identifying student learning patterns and intervening when necessary.

- **Gaming** – The New Media Consortium in its *2014 Horizon Report for Higher Education*, identified games and gamification as one of the six important developments in educational technology for higher education over the next five years because the group-play interaction and problem-solving components can enhance learning and collaboration in an online environment (Johnson, Adams Becker, Estrada, & Freeman, 2014). According to market research firm Ambient Insight, higher education gaming only comprises 1% of the near $1.6 billion global game-based learning market, but revenues are expected to triple from 2012-2017 as more institutions build gaming into their online curriculum (Adkins, 2013). Purdue University, the University of Oregon, the University of Pennsylvania, and the University of Central Florida are among the growing number of institutions that have both been on the development and application side of game-based learning.
- **Badging** – Aligned with gamification is badging. Carnegie Mellon researchers are finding that integrating badges into courses motivates students to keep learning. Purdue University is one of a growing number of institutions using badging to promote completion and provide learners with carefully defined competencies that they can use to enhance their transcript and create a profile for current and future employers.
- **Mobile** – While the use of college mobile apps continue to rise, and learning management system (LMS) providers are expanding their mobile capabilities, a fully intuitive compatible mobile online learning experience that mimics the desktop experience would have great value in providing dispersed students a seamless learning environment. This is true not only in the United States, but particularly abroad, where mobile usage is high and the Content as a Service (CaaS) model delivered through telecom providers is widely used for education purposes.

- <u>Deliver and Leverage the Value Proposition</u> – Increasingly, colleges and universities, both in the U.S. and abroad are relied upon as prominent contributors to sustainable economic growth in part because they serve as centers of innovation and because they can produce a knowledgeable and skilled workforce. A consequence is that schools are under growing pressure and scrutiny to cultivate students, regardless of academic major, who can readily transition into the workforce.

This dialog has fed into a broader debate around the value of higher education. A quality education at an affordable price is not a good value unless it gets the student where he or she wants to go personally and professionally. In a time of increasing student debt and what has been for the past several years, a soft job market, this focus on value has intensified.

The data show that a higher education degree has economic value as employment and salary levels rise with greater amounts of education (Figure 2 below). However, as the labor market has struggled, the value of a college education has been questioned by graduates who cannot find a job or find a job in their desired field.

- As of June 2014, at 10.5%, the unemployment rate for individuals aged 20-24 was more than twice that of those aged 25-54 at 5% (U.S. Bureau of Labor Statistics, 2014a).
- In the *Voice of the Graduate* report prepared by McKinsey & Company and Chegg, Inc., 41% of respondents from *U.S. News & World Report* top 100 colleges and 48% from non-top 100 colleges could not get a job in their desired field (Dua, 2013).
- In a 2013 student loan survey conducted by Wells Fargo, when asked about the cost for a college education in relation to opportunities a degree provides, 31% of the 1,400 millennials surveyed said they would have been better off working instead of going to college and paying tuition (Wells Fargo, 2013).

While part of the reason for the education/employment divide is grounded in the post-recession economy, many employers in the U.S. also claim that higher education does not deliver graduates with the proficiencies they need. This belief has helped shape their declining view that higher education institutions are providing value, which is in contrast to the perspectives of college presidents who believe a college education has increased in value (Figure 3).

Academics and pundits can and *will* debate whether the value of a college education is found in personal enlightenment or career preparation. The reality is that it is not an either/or proposition. The programs with the greatest impact will provide both the professional proficiencies that employers say they want and the communication, writing, interpersonal, planning, leadership, and critical thinking qualities they need, thereby positioning graduates for success in whatever endeavor they seek.

In an increasingly competitive higher education market, particularly for online students, and where the rewards of a college education are questioned, institutions that are able to unlock value, articulate it clearly, and align it to their mission and their areas of programmatic strength and differentiation will create distinction to separate themselves from other institutions thereby improving their competitive position. Today, that increasingly requires a combination of the quality education, affordability, and branding aspects previously noted above along with either a focus on industry needs and/or a clear articulation of the ways the core values of a liberal arts education are central to addressing industry concerns.

- **Competency-Based Education** – CBE is not a new approach, having been applied for decades as a staple of corporate training. Its use in higher education has wavered over that time period but in the current market, where online education provides an opportunity to develop targeted competency-based programs, the approach has gathered momentum. Even the United States Department of Education has approved certain CBE programs for federal financial aid, marking a significant shift in unlocking funding from seat time.

Institutions such as Western Governors University and Excelsior College have built curriculum around competencies either in a self-directed manner or within

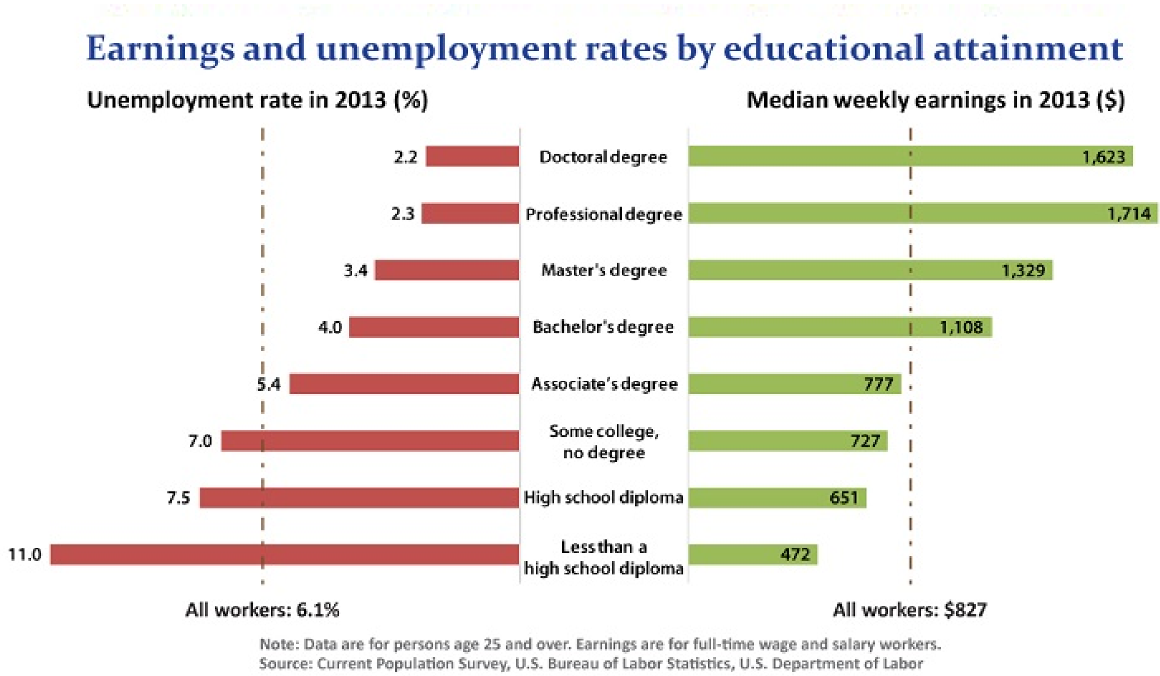

Figure 2. Earnings and unemployment rates by educational attainment

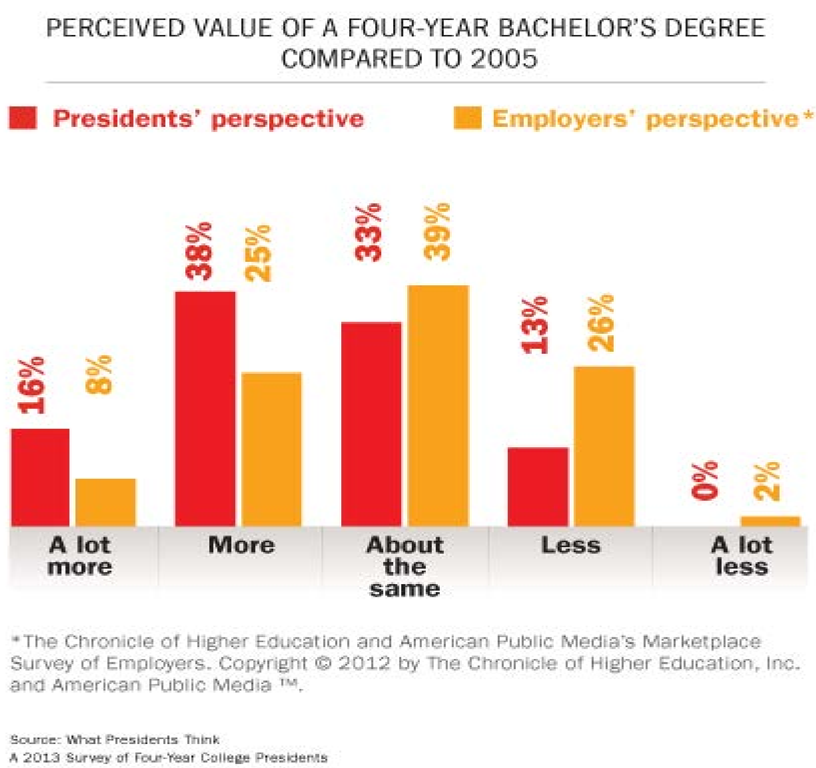

Figure 3. President and employer perspectives of the value of a bachelor's degree compared to 2005

the context of faculty-led courses. Southern New Hampshire University, with its College for America, targets companies with a low-cost CBE model to educate their workforce. The University of Wisconsin System has launched CBE to reach the education and employment goals established by its state legislature. The Lumina Foundation, through its Degree Qualifications Profile initiative, is working with dozens of institutions to enhance the alignment of competencies within their curriculum.

While one positive attribute of CBE is its alignment to targeted skills and a resulting student transcript that can be readily understandable to employers, it may be just as important as a way to keep college costs down. At $2,500 a year for all the courses one can take, the College for America program at Southern New Hampshire College represents an affordable model. The real cost advantage is that students have the opportunity to complete their degrees faster. While CBE is not a model for all students, because of the level of motivation and prior educational and professional experience required to maximize its benefits, it is likely to increasingly become a staple of many institutional offerings.

- **Modularized Learning** – Gradually, institutions are exploring partnerships with industry groups to align curriculum with their specifications. Through the use of stackable credentials, curriculum is developed that meets specific qualifications that can either be completed as a standalone certificate program or grouped together to meet an entire industry certification. Three of the more notable examples of this have been the partnership between the University of Phoenix and the National Association of Manufacturers, the North Carolina Community College System green-jobs pathway initiative, and the Texas Community College System alliance with the oil and gas industry.
- **Follow the Puck** – Hockey legend Wayne Gretzky has talked about advice his father had given him while learning the game: "Skate to where the puck is going to be, not where it has been." It is an insightful viewpoint that many innovators have embraced. As industries evolve, tracking high-demand fields and labor market trends and developing online programs around them can help an institution, especially a well-branded one, create a first-mover advantage. Likewise, identifying fields that have not seen as much online activity can also create an advantage in an increasingly crowded online market. Currently, fields such as Data/Analytics, cybersecurity, and Science, Technology, Engineering, and Mathematics (STEM) are among the areas where there exists innovation, but not yet a wide range of online offerings.
- Provide Opportunity and Articulate Success – Whether through onsite or online learning, the value proposition fails if the student does not attain his or her desired outcome, which for the majority of students is a career in their desired field. Similar to traditional students, online students require the same level of access to opportunities such as career centers, internships, and alumni networking. For an institution seeking regional or national online enrollment, this often requires expanding those services and industry contacts. It also requires the institution to develop the processes from onboarding through graduation that help clearly

articulate for students the path from degree selection to desired outcome. For-profit institutions, given their primarily adult and national student populations are particularly adept at both building those networks and helping students identify their pathways via competency dashboards and career guidance systems.

- Support Your Future Students – Colleges and universities are developing bridge programs and online high schools to generate a pipeline for new quality students (for example, the University of Texas at Austin). Additionally, some institutions with a significant amount of online content may find it appropriate to provide it as OERs or to lease it to community colleges or K-12 schools. Among the angles and considerations to providing content include:
    - Providing content to smaller colleges or community colleges that do not have many online courses may prove cost beneficial to those schools. Community colleges in particular may be a willing partner. The latest survey from the Instructional Technology Council of the American Association of Community Colleges revealed that 48% of the respondents reported that student demand for distance education courses exceeded the distance education offerings at their college in 2013 (Lokken & Mullins, 2014). In addition to supplementing the course catalog, community colleges could also be specifically interested in online content that they may not be equipped to provide, such as in STEM. Moreover, in a state system where transfer of credits among community colleges and four years schools is mandatory, providing online courses to in-state community colleges would ensure that the courses align with the four-year school degree enabling a seamless transfer for students and a potentially greater likelihood of success in completing their bachelor programs.
    - There might also be opportunities in the K-12 space for online content; however, there can be issues regarding connectivity. The February 2014 announcement by President Obama that seven private companies will give donations totaling $750 million to improve technology in schools, with the goal of connecting 99% of students to high speed internet is a positive development. However, according to the EducationSuperHighway Initiative, more than 70% of current schools are not hitting the minimum goal for Internet connectivity (Severns, 2014). Despite this, a report from Project Tomorrow noted that 83% of high schools offer online programs (Project Tomorrow, 2014). As high schools are the likely preferred market for college-generated content, there is the possibility for collaboration and content distribution.
    - Leasing content does come with its issues as there is meaningful competition from the publishers, although university content could carry credit. Some potential partners may also find that other MOOC and OER content sufficient for their needs, at least for the purposes of blended learning. There may be resistance among faculty about teaching outside content. Also, institutions and possibly accreditors may have concerns awarding credit for content that was not produced in-house.

- Use Online to Expand Your Reach Abroad – According to data retrieved from the United Nations Educational, Scientific and Cultural Organization Institute for Statistics (UIS) database, in 2012, there were over 174 million students outside the U.S. enrolled in tertiary education (which Americans commonly refer to as postsecondary education), compared to nearly 21 million enrolled in the United States. While the number of global enrollments appear substantial, in reality there is plenty of room for growth in higher education attainment internationally as the penetration rate of college-aged students (up to age 25) enrolled in tertiary education is only 32% globally, compared to the U.S. rate of 94% (UIS, 2014). Also, as in the U.S., adult students are progressively pursuing advanced education, particularly as more companies abroad seek better-qualified employees to address their workforce skills gaps and workers update their education to be competitive and increase their income.

According to the 2013 Institute of International Education (IIE) *Open Doors* report, in the 2012/13 academic year, 819,644 international students were enrolled in the U.S., an increase of 7.2% over the previous year and the seventh year of consecutive growth. Despite this growth, international students represent only 3.9% of the total number of students in American undergraduate and graduate programs. Moreover, disparity abounds as only 5% of U.S. institutions enrolled 69% of the international students that were in the U.S. in 2012/2013 and three states – California, Texas, and New York hosted 32% of the international students (IIE, 2013).

Only a small number of those international students are studying primarily online as most of these students want the on-campus experience and the amount of online learning by international students interested in studying at U.S. institutions is often restricted by foreign governments, especially if the government is sponsoring the student through scholarship programs. However, this does not mean there are not online opportunities for schools to consider. In particular, institutions should explore:

- Using MOOCs to reach foreign students and serve as a way to gauge their qualifications for admittance to the institution. In addition, as the MOOC providers continue to build their network globally with universities, corporations, and governments, MOOC-affiliated schools may gain access to potential partner institutions interested in online education.
- Creating partnerships with institutions abroad that are interested in joint and dual degree programs where portions are delivered online.
- Getting online courses/programs approved by the local Ministries of Education. In February 2014, the United Arab Emirates published a list of 105 colleges and universities around the world, including 34 in the U.S. that it recommends to UAE students for online education. (Wam, 2014)
- Using online education as part of global programs. For example, Duke University has an online element to its long-running Global Executive MBA.
- Creating partnerships with local industry.

    - For example, Apollo Global, which oversees several international colleges and universities, and HT Media Limited, which publishes the Hindustan Times, Hindustan and Mint newspapers in India, created a joint 50/50 partnership, India Education Services Private Ltd., to develop educational content and expand corporate education. The partnership in 2013 opened the Bridge School of Management that is currently offering an 11-month post-graduate blended program in management.

- International companies are also seeking appropriate online learning from U.S.-based colleges and universities to assist in employee education and training. This is especially true in some countries, such as India where the disparity between the pool of qualified college graduates and employer needs is so stark that companies help educate a large section of the workforce.

Framing Success

The online education landscape of today offers the promise of enhanced student learning and the opportunity for institutions to expand their horizons, providing greater access and enhanced efficiencies. It also offers the potential peril that without a clear strategy, some institutions may be among those left aside as Clayton Christensen has projected. Colleges and universities, through differentiation, articulating a deep understanding of what they want to achieve through online learning, incorporating some of the principles and practices previously described, and defining success on their terms, can not only find their footing on the landscape, but also thrive.

The decisions about how to go online and what is the primary institutional driver are unique to each college and university, and on many campuses, each department. The following general questions, which are by no means exhaustive, can help your campus begin to frame its online learning approach.

- Why do you want to go online?
- How does your purpose for online learning align with your institutional mission and vision?
- Where do you see your online learning program in five years?
- Whom are you trying to serve with online learning?
- How will you measure success? What tools will you use to track your progress? To whom will you report your outcomes?
- Is the cost of going online worth the benefit?
- What happens if you do not go online?
- Who is going to lead the initiative?
- What resources (human, technology, infrastructure, financial) do you have? What resources will you need?
- Should you build your online capacity in-house or seek partners? What criteria will you use for partners?
- What do your students think of online learning? What supports will you have in place for them so that they can succeed?
- Who are the faculty champions who are willing to work in online learning? What are their motivations for doing it? How can they be best supported and what training will be put in place?
- What content do you want to make available (courses, certificates, degrees, credit/non-credit)? What programs should you consider to deliver online? What are going to be your standards for online learning quality?

- What is your competitive position and what differentiator will make you noticed should you wish to take your online programs to market?
- How are you going to articulate your online initiative to your stakeholders? What mechanisms will you have in place to collect and respond to feedback from them?
- Have you discussed your online ambitions with your institutional, and if appropriate, programmatic accreditors?
- Have you explored potential state and federal regulatory and legal issues that might arise from your online programs?
- In addition to academics and information technology, what other departments and processes will be impacted (admissions, student accounts, registrar, student services, career services, marketing, etc.)? How will you support them?
- Is your current educational and business software – Learning Management System, Student Information System, Content Management System, Customer Relationship Management, etc. – sufficient for your plans?
- Is your IT network robust enough to support the bandwidth necessary for campus-wide online learning?
- Will your online learning platform support mobile delivery? What policies will you implement about technology in the classroom?

Whether and how to engage in online learning is a strategic decision that each institution must decide for itself. It is imperative that campuses have meaningful discussions about it before, during, and after any implementation. Continually exploring and understanding the environmental trends and how they interact with the institutional culture and objectives will greatly assist in making informed decisions. Ultimately, regardless of whether schools want to be major players in the market or only want to use online learning for the benefit of its traditional students, faculty, and stakeholders, to be successful they will need to address online learning in a way that is consistent with their mission and with student learning and needs at the core.

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About the Author

Jeffrey McCafferty has over 20 years of experience in higher education administration and consulting. Working directly with senior leadership in both traditional and non-traditional university settings; he has acquired and applied considerable and wide-ranging expertise in university operations and structures, strategic planning, market research, corporate training, business development, university policies, and online education. Previously the Special Assistant to the Provost at American University and a Senior Associate at ICF Consulting/Arthur D. Little, Inc., Jeffrey currently is the Associate Vice President of Strategic Planning for the American Public University System. At APUS, he coordinates with the executive management and Boards to develop, align, and track the APUS strategic plan. He also offers strategic guidance and planning on a variety of key business development and institution-wide initiatives. His environmental scanning and industry assessments are shared across the institution and with key stakeholders to support informed decision-making.

Gamifying Course Content with SmashFact

Britt Carr

Introduction

The annual report, *Grade Change: Tracking Online Education in the United States, 2013* (Allen & Seaman, 2014) revealed an important and surprising trend: an increasing proportion of educational leaders view online courses as requiring greater discipline in order to be successful than face-to-face learning. In fact, more than 2/3 of those surveyed believe that students who are taking courses online face greater barriers. This poses a potential problem for both learners and institutions. For learners, this means the responsibility for completion of a degree requires exceptional intrinsic motivation and initiative in figuring out the key concepts they need to master in order to be successful. For institutions, students who are not successful drop out, and degree completion rates are a key metric of success, and academic leaders identify the issue of student retention for online courses as a serious concern. Therefore, identifying ways to enhance student success in an online environment is not just a concern for students themselves, it's an important challenge for all of higher education.

Those who take online courses require greater self-discipline for reasons outside of the learning environment, with many students choosing this type of learning environment because they are also juggling things like full-time jobs and family obligations while also trying to pursue a degree. As a result, online students already face an uphill battle because they have less time than traditional students for their courses. However, they also face the limitation that they do not have the face-to-face feedback from instructors to learn which key concepts they need to master. As we look to the future of online learning, a majority of higher education students can expect to take at least one online course. In order to enhance online students' abilities to utilize the time they have available for their courses, and instructors' success in meeting their students' educational needs, we need solutions that isolate the most important concepts and help students master them faster.

This article describes one particular solution that fills this need, a new product introduced in November of 2013 called SmashFact. SmashFact was designed as a solution for faculty to reduce time making rudimentary terms and concepts more engaging and spend less time on remedial learning. The tool facilitates the learning process by "gamify-ing" basic course content and reduces the barriers to success. By allowing teachers to transfer course content into a study-game app, students are able to use the app on any of their devices: phones, tablets or desktop computers.

Background

Beginning in 1994, I began developing interactive learning solutions for higher education. As an instructional designer and educational technologist at a university, my job facilitated an opportunity to meet with faculty and delve deeply into their educational problems for which they were seeking solutions.

Video 1. A timed theater lighting simulation that would allow students to diagnose lighting system problems
https://www.youtube.com/watch?v=96amweDM6Xo

Early on, I was called upon to help solve instructional problems brought to me by faculty that required students to learn complex procedures or analyze a situation and act accordingly. I quickly became efficient at developing truly engaging tools that helped reduce the key barriers to learning for which faculty and administrators were seeking technological solutions.

These unique educational problems rarely lent themselves to "point-and-click the answer" solutions. Multiple-choice activities were only an extension of "point-and-click." In fact, the byline of my learning activities blog was "Multiple Choice is Boring." I was in a professional role where I could approach a learning problem with whatever I could dream up, and each solution provided an opportunity to push the boundaries with how each activity could be employed to enhance the educational goals and student outcomes.

In 2005, a faculty member in a theatre department approached me to create a timed theater lighting simulation that would allow students to diagnose lighting system problems without hurting the theater's equipment or themselves. I developed a photorealistic simulation of the theater for which students could navigate and find a non-working light and fix the problem before the show started. The result was students having substantially more opportunities to practice learning this important skill they needed (see *Video 1*).

In another example, I was asked by a biology department to design a fetal pig dissection, to allow online nursing students to be able to dissect a photorealistic fetal pig. The costs associated with bringing online students into a lab, having clean, sharp instruments, and storing pig fetuses, and dealing with the sour smell of formaldehyde was no longer an issue. In addition to making the learning experience more convenient, students were able to practice the dissection

Video 2. An interactive fetal pig dissection
https://www.youtube.com/watch?v=vDuRi2buAFk

Video 3. Jazz by Ear game
https://www.youtube.com/watch?v=N2IvfunjnFI

process, something rarely possible when working with a fetal pig in a lab (see *Video 2*). *Note: Video contains graphic material.*

In 2006, the then Dean of Fine Arts at Miami University, Dr. Jose Bowen (author of Teach Naked) came to me with a request for an activity to support his popular Jazz History course. His class was a face-to-face course, and he was interested in developing a teaching activity that facilitated the "inverted classroom" approach. Prior to this time, I was not familiar with the term, despite the fact that my most effective learning activities also effectively facilitated the process of moving the content delivery out of the classroom, to save time for more meaningful activities during class.

The activity, *Jazz by Ear,* provided the inspiration to SmashFact. This activity was a learning game version of the popular game "Name That Tune" tailored for Dr. Bowen's Jazz History students. The activity was designed to teach students with no musical ability or training, the skill of analyzing jazz styles and famous pieces. The solution saved both students and Dr. Bowen valuable time. Students could study (play) at their own pace, remediate where necessary, and they knew that they were studying exactly what the Dr. Bowen needed them to study. *Jazz by Ear*'s level design spelled out what the student needed to know and let them practice as often as needed to prepare them for the exam (see below).

Faculty could not possibly repurpose these learning tools unless they had a programmer on staff. *Jazz by Ear* was developed in Adobe Flash and delivered to students via browsers. Its reuse by other faculty would require two things:

1. In order to use *Jazz by Ear* in another jazz history class, faculty members would need to align their courses with the way the game levels were laid out according to Dr. Bowen's semester plan.
2. For faculty in other disciplines wishing to repurpose the *Jazz by Ear* style game, a Flash Developer would need to sift through the code, make appropriate changes and prepare media to be in the proper format for delivery.

With these barriers, I determined that a system was needed that could allow faculty to create an activity that could be customized for their curricula. I determined that the interface needed to be simple enough to be employed on smartphones and to allow different types of content (audio, images and text) to be used. Perhaps most importantly, I decided it needed to offer a method for faculty to get their course content into the game without great effort.

In level 1, students learn instrument recognition. Level 2 teaches the student to listen for the most prominent or solo instrument. Each subsequent level became progressively more difficult, and was aligned with Dr. Bowen's curriculum. In order to advance in the game, the current level had to be mastered. Mastery was achieved by randomizing the sounds in question, as well as the answers on the screen. Each incorrectly answered question was then returned to the queue until it was answered correctly. By level 32, students were asked to determine the jazz style by listening to a particular artist.

Since I was the only instructional technologist working for the university at that time, planning for an activity to be reused was critically important. By changing the artwork and swapping the sound files, I was able to reuse *Jazz By Ear* for another Fine Arts faculty who taught phonetics.

This time, I developed a game that associated each sound with the appropriate symbol. The game was called "Phun with Phonetics".

SmashFact website address: http://www.smashfact.com/iljDemo/index2.html

SmashFact

The solution I developed was SmashFact. This educational tool provides teachers/professors a way to "gamify" study material by quickly turning course content into a customized app without having to write any code. Like the other activities I had developed, SmashFact provides a platform for faculty members to engage students while letting them practice exactly what they need them to know. SmashFact is flexible, allowing faculty embers to include audio, images or simply use text.

How SmashFact Works:

1. Teachers transfer study content from their course lectures on SmashFact.com. Content can include text, audio or images.
2. Teachers send a 'SmashFact Code' to their students
3. Students purchase the app (for any smartphone, tablet or laptop) and paste in SmashFact code. Students play by "Smashing" the correct answer as fast as they can.
4. Teachers get usage data to share with administration or to use as attendance, grades for extra credit or participation points.

After registering on smashfact.com teachers and faculty are walked through the activity creation process by a step-by-step 'wizard' which introduces them to the terminology and requirements for creating their own study app. Faculty need to:

1. Provide a title - This allows students to identify your activity in their app.
2. Add a 'Level' - levels can be levels of difficulty or they can align with your curriculum (i.e, Chapter 1: Level 1, Chapter 2: Level 2, etc.).
3. Fill the level with a Question / Answer pair- Questions can be text, audio or images. Add a question and its answer. Faculty can even specify three custom

distractors for each level. A minimum of four question / answer pairs are required for each level.

4. Specify a course to use the activity in. Assigning an activity to a 'Course' helps faculty keep tracking information organized.

SmashFact offers a means by which to track and produce customized analytics via detailed reports on students' progress, which can be imported into MS Excel or most learning management systems.

A 'Dashboard' keeps activities organized, and lets the faculty know how many students are using their activity.

SmashFact offers a means by which to track and produce customized analytics via detailed reports on students' progress, which can be imported into MS Excel or most learning management systems.

Testing Assumptions

SmashFact.com launched on November 26th, 2013, and the student apps became available for download from Amazon, Google Play and iTunes on January 8th, 2014. As of January 8, 2015 (on year to the date of the app release) SmashFact now has over 428 faculty users and is in 102 colleges and universities institutions across the U.S. and Canada.

The app itself is designed to refresh activity data every time it is opened on the student's device. This was intended to let faculty add, adjust or rewrite questions as the semester progresses. Faculty can use this feature to progressively build the activity as the semester moves forward, customizing and modifying the content as needed along the way. One approach is to add a level for each lecture or chapter or week covered in class, giving faculty the means to stay ahead of the course's delivery without having to design the whole activity upfront. Each time students re-launch the SmashFact app, the new information is refreshed.

SmashFact is suitable for most subjects and for most grade levels. The purpose of the activity is to facilitate lower-level learning, focusing on drill and practice of facts, terms and their definitions, and recognition of ideas and concepts. The app is also helpful for bringing students back up to speed after a long and academically lazy summer. SmashFact activities can also be designed for one course and reused for remediation in later semesters during higher-level course work.

Although the app was designed primarily for college students, the structure and purpose of the product lends itself to learning that occurs in the K-12 environment as well. During beta testing, I created a simple SmashFact activity for my first grader. "Addition and Subtraction" has helped my son and his peers drill simple math problems. In one week, these simple drills helped my son achieve a perfect score on his timed math tests, where he was having difficulty even finishing before.

SmashFact has been modified to facilitate 508-compliance. The SmashFact app interface by design was to aid those with poor vision, by using big buttons and bold contrasting type for questions and answers. Student feedback is delivered in traditional color form (green for correct and red for incorrect) and also delivered audibly. A smash sound indicates a right answer while a golf club swing/miss indicates a wrong answer. Faculty click a link to have all of their SmashFact content (with the exception of images) exported in a standard HTML file which can be read by most screen readers, top to bottom, left to right. The activity can be refreshed by the student to allow the answers and distractors to be randomly delivered for further practice.

Future Directions

Future versions of SmashFact will address several learning challenges raised by faculty members. The first issue is related to scoring. Currently, students have 10 seconds to answer each question. For every second that passes, students lose 10 points from the allowable score for each question. Missed questions are thrown back into the "unanswered" queue. No additional points are added for replaying a level. Future versions will adjust replay scoring to allow students to improve their score by practicing more.

In addition, future versions will offer the ability for students and faculty to track incorrect answers. Faculty members will be able to customize game feedback to prompt student to replay levels with a high number of incorrect answers. This feature will also help faculty identify poorly written questions or course content for which students are experiencing particular difficulty. In the next version, SmashFact will offer adjustable font size to increase the amount of characters a question can contain. Currently the limit is 56 characters. Fourth, we will consider the settings for previewing questions. Faculty can currently press a button and see a preview of how their question will appear in the SmashFact app. However, in the next version, a thumbnail image and speaker indicator will be available in the Question/Answer settings.

Finally, faculty members will be offered the opportunity to share their activity with others. This feature may be particularly useful as a kind of open source educational solution. Faculty members can make available their app for colleagues or teaching assistants so they can begin the development of the own version by building on an existing activity. A "Duplicate" function will allow faculty in the same program to share the same root activity, and each faculty will be able to customize questions or make an easier/more advanced versions.

Conclusions

Higher education is facing new challenges as a growing proportion of higher education learning is occurring online. In fact, as of Fall 2012, 7.1 million students were taking one online course, indicating that 1 in 3 courses are now occurring online, and this number continues to grow. In order to increase the success of student outcomes, and increase degree completion for online students, we need to employ educational interventions that facilitate mastery of key concepts, particularly in introductory and "weed-out" courses — the most common type that are taken online. SmashFact offers one solution designed to decrease barriers to learning for both students and instructors.

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About the Author

Britt Carr is the co-founder of Advanced Authoring and developer of SmashFact, has been developing interactive learning since 1992. In addition to helping solve teaching and learning challenges for universities across the country, he has served as a consultant to interactive software giants Macromedia and Adobe Inc. From 2008 - 2013, Britt was nominated as a Higher Education Leader and in 2009 received the "Impact Award" from Adobe for contributions to education. He lives in San Martin, California with his wife and two children.

Problems and Possibilities of Gamifying Learning: A Conceptual Review

Hannah R. Gerber

This article presents a brief overview of the concept of gamification and examines and compares gamification with edutainment and game-based learning. The paper theorizes that gamification in its current industry-driven conceptualization will not work when implemented in educational arenas, and that to be examined and used within educational frames, gamification must be re-examined and re-conceptualized.

The *2014 New Media Consortium Horizons Report, Higher Education Edition* (Johnson, Becker, Estrada, & Freeman, 2014) indicated that gamification and games in learning environments are quickly becoming an important development in educational technology, positing that these trends will become more mainstream within a two to three year adoption period. Gamification, the use of game thinking and game mechanics, is used to engage audiences and solve problems. As a growing trend in industry, it is also quickly gaining traction within educational arenas (Deterding, 2011; Kapp, 2012; Zicherman, 2011).

Gamification, in its current conception, is a relatively recent trend/phenomenon emerging from the commercial videogame industry, which is a billion dollar industry that supersedes the music and movie industries. Due to the major success of videogames in today's culture, with as many as 97% of today's youth reported as playing videogames on a regular basis (Lenhart, et. al, 2008) and the age of the average gamer hovering around 30 years of age (Entertainment Software Association, 2013), scholars and industry leaders have begun to examine what makes these environments so engaging and have attempted to take these elements and create experiences for their customers, clients, or patrons.

Defining Gamification

As explained previously, gamification is the use of game thinking and game mechanics in non-game situations, but what exactly is game thinking and game mechanics? It is important to note that many game designers and researchers agree that gamification is more than points and leaderboards, and that certain elements and traits must be considered and included when gamifying a system (Bogost, 2011; Layne, 2011; Nicholson, 2012; Schell, 2010). Too often, companies and entities go forward with attempting to use gamification and they end up putting a glossy veneer of points and badges on a product (website or idea) that is possibly an undeveloped or underdeveloped process or idea, leaving some of the best traits of gaming, such as narrative and immersion, out of the experience (Schell, 2010). Many games scholars criticize gamification because of the simple focus on the points and scoring system, and lack of focus on the more nuanced meaning and engagement that games can generate

(Bogost, 2011; Zicherman, 2011). Bogost (2011) suggests a better name for gamification in its currently used application, in many instances, is exploitationware, as he feels that the best elements of the game are left out and the rest is left to exploit the customer through marketing, points, and badges. For the purpose of identifying the important elements and traits within gamifying as related to game-thinking and game-mechanics, it will be important to understand the role and importance of ownership and immersion, narratives and quests, feedback loop, and crowdsourcing.

Ownership and Immersion

Many game scholars and game developers agree that the elements of what makes a game good, should also be considered and embedded in a truly gamified experience--be that a formal school learning experience or a business and commerce experience. Games are rule based systems, not free play systems, so there will always need to be some structure to the environment in which the gamification experience is being employed, however, as stated above it must move beyond the points and leaderboards and should include elements that allow gamers to become immersed in the experience, and take ownership of what they are doing in the gamified experience. The ownership and immersion in gaming situations, through the concept of situated and embodied learning--learning that allows one to experience the event and activity--is also typically tied to the projective identity that a gamer develops within a game play experience, which allows the gamer to interface between his/her real-world identity (involving morals, ideals, etc) and the in-game virtual identity (pre-programmed traits, abilities, and controls) of the avatar (Gee, 2007) . Ownership and immersion are important concepts to consider for those who are examining the important game elements and mechanics that they plan to embed in their gamified experience.

Narrative and Quests

What ownership and immersion ultimately mean for the gamification of programs, websites, and products is that motivation and desire to participate must be inherent in the design. Good narratives, quests, and missions can allow this to come to fruition. Just as games drop gamers into a quest or a setting where they immediately feel useful and motivated to succeed, so too must gamified experiences. This is often done through providing a quest or mission to the players, thus giving them something that they can immediately begin to experience and work through. As Gee (2013) mentions, humans are really good at telling stories and working through narratives. According to Gee all life is a story and through story history gets told.

In gaming, this concept of narrative and story is tapped into when the gamer owns his or her experience as the story unfolds through game play. Salen and Zimmerman (2004) state the importance of narrative within gaming environments as, "Playing a game means interacting within a representational universe, a space of possibility with narrative dimensions" (p. 378). These narrative dimensions are directly tied to the concept of story that Gee (2013) indicated is so very important to life and history, which can also be suggestive of working closely with the concepts of ownership, immersion, and identity, thus also indicating that narrative is also tied to personal experiences and may be different for different players depending on their point of view and life experiences. Salen and Zimmerman (2004) suggest that good narrative structures within games provide tensions and poses problems in order to put players in a variety of situations and events, all through the personification or characterization of the event(s), and then move the player through various levels that allow gamers to progress through the game towards a resolution.

The concept of narrative is further solidified and instantiated through a feedback loop (Abrams & Gerber, 2013; Salen & Zimmerman, 2004), which is a systematic and iterative portrayal of one's progress in a gaming environment.

The Feedback Loop

The feedback loop is provided so that individuals can see and understand how their actions and movements impact their game play experience. From this information, players can then make changes that allow them to become more successful in the given game environment in which they are playing or experiencing. The feedback loop is made up of multiple elements, and Abrams & Gerber suggest that the four most powerful elements of the feedback loop when used in learning environments--be they educational or entertainment--are the objectives, health/life bars, in-game maps, and leaderboards. Objectives tell players what their mission is or what they are supposed to do. Health and life bars keep players informed of how many lives they have left, or how close they are to dying. In-game maps allow players to see where they are in the game world, as well as give players an indication of where the key areas are in the game, or where their enemies or other players might be located in relation to their current in-game location.

Leaderboards can be personal leaderboards or game leaderboards, and allow players to see their personal strengths and weaknesses within the game, as well as how they compare to other players. These elements work together in an iterative fashion, providing gamers with information as-needed and just-in-time so that they can make the decision that will result in the best situation for their current needs in the game. Good games provide players with a tutorial that allows them to understand through the feedback loop. What this means is that as a player begins a game, he or she begins to assume the character or avatar that they are representing (in the case of many games, but not all), however, during this process their play experience is mediated by a feedback loop that is gradually allowing the player to learn the proper mechanics of play, including the game controls, and getting into the storyline and understanding the objective for their mission. The game tutorial may also seem to be different from a traditional tutorial one would receive in a class or lesson, because the game tutorial often is actual game play that has a direct impact within the game, allowing the player to begin gaining and accruing points, or XP (experience points).

Power of Crowds

While not necessarily a required element of all games, often gamification is combined with crowdsourcing, using collective intelligence to solve complex problems and create solutions to mysteries (problems that scientists and researchers have pondered for some time). However, what should be noted is that all games are inherently social events. Games and gamers, whether the game is a single player game or massively multiplayer game, are built around communities of fans and players who engage in dialogue and discussion about their favorite game. This concept of the social gamer is powerful to consider when thinking through elements to build into gamified experiences.

Crowdsourcing is one such element that when brought into gamified experiences can be used for promoting social learning and socialization that often surrounds game environments. Crowdsourcing is often used in such a way to tap into the collective intelligence of a group and bring lots of minds together to think through problems. To engage players in crowdsourcing in such a way that it matches the highly social and collective intelligence nature of gaming affinity spaces, yet also matches the need of the gamified experience, it is important to ensure that the crowdsourcing experience that is being created has a real-world impact and connection. It is helpful in these instances if the player can see that what he or she is doing actually is making a difference in the real world.

Properly gamified experiences should improve the user experience (Deterding, 2011; Nicholson, 2012). Including elements that improve ownership and immersion, narrative, feedback loops, and crowdsourcing, move beyond the simple concept of badges and points and bring a deeper experience to the players who are participating in the gamified experience. However, it is important to note distinctions within gamification, and understand the nuances of gamification, game-based learning, and even edutainment.

Game-based Learning and Edutainment

Before going further into exploring how elements of gamification can be used within educational context, a deeper exploration of the nuances of how games in general are used in educational contexts. Gamification is not edutainment, nor is it games-based learning. Often it seems that the spaces of edutainment and games-based learning get mixed up in discussions dealing with gamification and people use the term interchangeably when they are discussing separate concepts of edutainment and/or game-based learning. These three concepts (gamification, games-based learning, and even edutainment) inform one another, however, it is important to note that gamification is a system that is used within the design of a product or curriculum and it can occur within edutainment and game-based learning. However, it is important to note that gamification is not dependent upon either game-based learning or edutainment to be developed on its own, nor does gamification as a system need to be employed within game-based learning or edutainment.

Edutainment

To explain further, *edutainment* was defined in the 1980's as the use of entertainment devices or activities to teach school-based and education subjects or concepts. A *Jeopardy*-style game created about the Renaissance period, *Math Blaster*, *Where in the World is Carmen San Diego?* and *Oregon Trail* were all examples of edutainment that have been used in schools. Often, but not always, edutainment includes flashy products created for the sole purpose of teaching a concept. Some edutainment products are more effective than other edutainment products, however, one thing that should be noted is that edutainment products generally are met with disdain from students as nothing more than a glorified worksheet or activity that has been put into an electronic format (Zichermann, 2011). When this happens, students subsequently reject the lessons that they are being presented. In fact, Zichermann pointed out that the last time that students and teachers agreed that edutainment was enjoyable was in the early 1980's with the game *Where in the World is Carmen San Diego?* and *Oregon Trail*. According to Zichermann, four billion dollars have been spent on edutainment since the days of *Where in the World is Carmen San Diego?* and not a one of the games has been successful in capturing students' attention as a valid gaming and learning experience. He attributes this to teachers and parents getting involved in the design of the products and removing any of the elements that made it a fun game-like experience.

Game-based learning

In a more recent trend, scholars have examined how a concept called *game-based learning*, which is learning through videogames, often commercial-off-the-shelf videogames (COTS) such as *Minecraft*, or serious games (games created that serve as simulations of real world events that have problem solving elements embedded) can be used to enhance student learning in class-related activities (Abrams, 2009; Gerber & Price, 2011; Gerber, Abrams, Onwuegbuzie, & Benge, 2014; Steinkuhler, Compton-Lily, & King, 2011; Squire, 2011), as well as have examined how these games impact a player's learning in out-of-school spaces (Gee, 2007; Gee & Hayes, 2011).

In game-based learning experiences, videogames, either COTS or serious games, are brought into classroom learning, or after-school spaces and tied in with standards or learning objectives. In a study conducted by Gerber, Abrams, Onwuegbuzie, and Benge (2014), they designed a reading intervention class in a low performing inner-city school with students who were English Second Language Learners. In their 18-week mixed methods study, they incorporated a modified reading workshop, in which students self-selected COTS videogames from the classroom library, engaged in game play of these games during class, selected reading material and engaged in peer and teacher conferencing. What they found was students engaging in a constellation of connections among various literacy elements, leading them into inter-textual and cross-literate meaning making. The students exhibited growth in their reading and writing habits, attitudes, and this was evidenced by increases on their state tests in reading and writing. Within game-based learning environments students often exhibit growth or increased engagement with the topic of study.

While game-based learning and edutainment are not synonymous with gamification, as mentioned previously, they all inform one another. However, one of the barriers that educators must overcome when considering bringing gamification into classroom environments is that gamification originally began as a method used in business and industry to increase productivity among workers, increase revenue in selling products, to gain new clients, and to retain existing clients. While there might be parallels in using gamification in industry and the classroom, educators, curriculum developers, and policy makers must exercise caution when bringing the same gamification concepts into learning situations that are used in industry situations, and they must fully explore both the affordances and constraints of gamification. This next section explores the perils and promises of gamification when concerned with its adoption into education and learning environments.

Video 1. Jane McGonigal's TED Talk: The game that can give you 10 extra years of life.
https://www.youtube.com/watch?v=lfBpsV1Hwqs

Translating Gamification to an Educational Arena

Perils

As stated above, when schools got a hold of the concept of using entertainment to educate, the idea of edutainment was born and has since received mixed reviews (Layne, 2011; Schell, 2010; Zichermann, 2011). In part, this is because some of the worst elements were the ones that the developers of edutainment focused most on--teaching of discrete skills without using proper game mechanics to make the idea engaging. In a sense, edutainment became the digitizing of worksheets. Gamification has the risk of heading down that path if the focus continues to remain on the "worst" part of games, that being the point system and leaderboard (Schell, 2010). Additionally, because of the point system, it has been argued that the motivation to participate will remain extrinsic and intrinsic motivation will cease to exist due to it never having been properly developed (Zichermann, 2011).

Additionally, in a recent 2012 survey conducted by the Pew Internet & American Life Project on the future of gamification, experts surveyed brought to the forefront the insidious nature of gamification when it is employed as a means to pit individuals against one another, and suggested that individuals will learn how to game the system in order to get the external rewards for their effort. Other experts pointed out that often, in gamified systems, individuals who are playing the game do not realize that information on their psychological state of play is being collected as back end data that can later be used to manipulate them through marketing schemes and other arenas that serve to benefit the industry over the consumer.

Promises

However, that is not to say that gamification cannot also hold promises. Games are fun and gamification, when employed judiciously and with the elements of good gaming can also be fun. As Koster (2004) points out, fun is and should be another word for learning. Good learning situations and environments are hard, but also fun and rewarding.

McGonigal (2011) sees the promise of gamified engagement in what she calls Alternate Reality Games (ARGs). McGonigal sees these experiences as having the ability to connect the world and solve some of the world's most complex problems. Indeed, gamification, when used properly can do this. An ARG uses an interactive narrative in a real world setting and delivers it in such a manner to improve the life of the individuals who play the game and it inspires them to continue with the changes that they have made long after the game has ended. An ARG always has real world implications and can change people's lives for the better. In her second TED Talk, McGonigal described an ARG that she designed at a point in her life when she was suffering from recovery from a head trauma. The ARG that she created was called *SuperBetter*. In this ARG, Jane McGonigal created a game that allows individuals who had been diagnosed with severe and debilitating injuries, diseases, or health issues a game that allowed them to remain curious, optimistic, and motivated even in the most dire of circumstances.

One of the most important concepts and promises that can be seen in using gamification is the power to engage and motivate people, and the power that gamified experiences have in tapping into collective intelligence. When social innovations occur because of the reliance on cooperative and collaborative efforts, like *Foldit* we see one of the most powerful possibilities for this type of learning experience. *Foldit* was a crowd-sourced game experience that drew over 46,000 players who within ten days solved the mystery of how a key protein may help cure HIV-- a mystery that had thwarted top researchers and scientists. No matter how that is looked at, that is a powerful message for the promise of gamification.

Future in Education

As to the future of gamification in education educators need to be wary of using the most basic of game mechanics (the points and the leaderboards) and examine what makes truly successful game experiences so very successful. They must examine that which they want to gamify, and realize that videogames, and games in general, are in the simplest form an immersive experience, and that experiences are different for every person who encounters them. Games need to be better understood, and in line with what Zichermann (2011) has posited, in the future, if gamification is to be successful, both industry and education will need to hire individuals who are oversee the production of these experiences to ensure that the experiences that they are trying to promote are the actual best experiences for students based on sound theory and research in human psychology, both in social awareness, cognition, and learning theories.

Gamification is not easy and should not be used as a bandage to fix an already broken system or cover up and make a problematic program attractive to users. Education is messy, and games are messy. As such, in order to tap into the most powerful way of using gamification in learning situations, like schools, we need to return to the works of play theorists Johan Huizinga (1950), Richard Caillois (2001), and

Brian Sutton-Smith (2001). There needs to be a deeper examination of Gee's (2007) 36 Learning Principles inherent in videogames. This examination will allow educators to discover that gamifying education must take a different track than gamifying industry. These differences will emerge as educators become more cognizant of their own learning when they are also invested in game play. One cannot create a gamified experience without first having experienced a game. As such, in order to gamifying education and learning experiences, educators, curriculum developers, and policy makers involved in educational decisions should invest a healthy amount of time in playing games.

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Using Early Warning Signs to Predict Academic Risk in Interactive, Blended Teaching Environments

Julie Schell, Brian Lukoff, Cassandre Alvarado

Introduction

Growing evidence in higher education suggests that interactive teaching leads to more robust student learning outcomes than lecture-based instruction (see Crouch & Mazur, 2001; Hake, 1998; Lasry, Mazur, & Watkins, 2008; Nicol & Boyle, 2003). This phenomenon transcends geographic and disciplinary boundaries, and institutions across the globe are investing in initiatives to support interactive pedagogical models (Becerra-Labra, Gras-Marti, & Torregrosa, 2012). As online learning becomes more accessible, interactive teaching often includes web-facilitated and blended learning (Allen & Seaman, 2014) to drive engagement. As a result, instructors can drive student success more effectively in and out of class.

In what seems to be universal pushes for technology-driven educational reform there is one reality that is under-studied and under-acknowledged: Even in classes where master instructors use interactive methods with the most effective online tools, there remain students who do not succeed. This is the research problem of this study: even when state-of-the art pedagogies and technologies are used, there are still students who do not succeed. For example, there still exist students who do not exhibit sufficient levels of gain in conceptual understanding of subject matter, academic performance, engagement in course activities, and beliefs and attitudes about academic competence. In this paper, we define those underachieving students in interactive classrooms as at-risk. As educational reformers continue to emphasize interactive, blended learning as a critical element of change in higher education, the lack of extant effort to address the needs of *at-risk* students in such environments is an important research problem. Is there something educators can do to help these at-risk students? That is the underlying question of this study.

In the *NMC Horizon Report 2014 Higher Education Edition* (Johnson et al., 2014), the authors lament that higher educators have not yet "embraced" the potential to use extensive educational data generated by students to improve college student success. In this paper, we demonstrate how we used on and off-line data to chart a path early on in the semester for improving course-level student success in a blended, flipped physics classroom. The purpose of this study is to offer an evidence-based process for identifying characteristics correlated with student academic underachievement at the course level in blended, interactive teaching environments that qualify as ***early*** warning signs and to recommend early intervention points. We hypothesize that students' beliefs that they can reach a high level of achievement in a course, defined as their self-reported, perceived academic self-efficacy, will have a strong relationship with later course performance, as will a number of other simple measurements that are available in the first few weeks of instruction. We explore this hypothesis with the purpose of presenting a simple process that instructors can use to identify at-risk students in interactive, web-facilitated and/or blended classrooms early in the semester so that their teachers may intervene and address the specific needs of potentially at-risk students in interactive classrooms.

Conceptual Framework

The concepts that frame this study are as follows: interactive teaching, blended learning, self-efficacy, and Peer Instruction. We describe our research-based definitions of these concepts below.

Interactive Teaching

The pedagogical approach in such classrooms is generally based on constructivist theories of learning: "the contemporary view of learning…that people construct new knowledge and understanding based on what they already know" (Bransford, Brown, & Cocking, 2000 p. 10). Interactive teaching is a concept that lacks definitional clarity in the higher education literature. It is most often used in contrast to didactic, lecture-based teaching and researchers often attach the use of technology to conceptualizations of interactive teaching (see Sessoms, 2008). However, while there are numerous examples of interactive teaching that incorporate technology, there are just as many that do not; rather than technology serving as determinant in conceptualizations of interactive teaching, we posit that it is the pedagogical approach that is the most salient, defining feature.

In a typical classroom where interactive teaching is in use, an observer would witness numerous discursive actions occurring through multi-directional feedback loops among students, teachers, and other course staff. The pedagogical approach in such classrooms is generally based on basic constructivist theories of learning: "the contemporary view of learning people… that construct new knowledge and understanding based on what they already know" (Bransford, Brown, & Cocking, 2000 p. 10). Prevailing constructivist views of learning do not imply that "teachers should never tell students directly, but instead should always allow them to construct knowledge for themselves" (Bransford, Brown, & Cocking, p. 11), but rather that learning is a social and cognitive process that depends on the prior knowledge state of the student (Ambrose et al., 2010; Bransford et al., 2000; Darling-Hammond, Rosso, Austin, Orcutt, & Martin, 2003; Piaget, Green, Ford, & Flamer, 1971; Vygotsky, 1998). Constructivists also privilege the power of social learning theory (Vygotsky, 1998), which emphasizes the idea that "all learning…involves social interactions" (Vygotsky, referenced in Darling-Hammond et al., 2003).

Web-facilitated and Blended Learning

According to the report, Grade Change-Tracking Online Education in the United States (Allen & Seamen, 2014), web-facilitated learning is typically "a course that used web-based technology to facilitate what is essential a face-to-face course." An online course is one where at least 80% of the content is delivered online. The course we studied for this research was a blended, flipped classroom: "a course that blends online and face-to-face delivery", where between 30-79% of the content is delivered online, and students do engage in continuous learning before, during, and after class.

Self-efficacy

Theories of self-efficacy (Bandura, 1977, 2003) lay the groundwork for this study. We define self-efficacy as the belief that one can successfully complete a task (Bandura, 2003). Theories of self-efficacy suggest that the courses of action that individuals take in their lives are driven by their beliefs about their own abilities. In particular, researchers use self-efficacy to explain academic, career, and life decisions and outcomes (Lent, Brown, & Larkin, 1984; Multon, Brown, & Lent, 1991). The basic theory suggests that an individual's perceptions of their own ability or competence (i.e., their perceived self-efficacy), regardless of accuracy, will lead them toward specific courses of action and not others.

The present study was designed with self-reported perceived academic self-efficacy as a unit of analysis, whereby academic self-efficacy is defined by students' beliefs about their academic competence (Pajares, 1996; Pajares & Miller, 1994). In a review article, Pajares (1996) documented the literature demonstrating positive relationships between self-reported academic self-efficacy, academic performance, and choice of college major. In particular, Hackett and Betz (1989) suggested that self-reported academic self-efficacy is more predictive of mathematics interest or choice than actual performance (Hackett & Betz, 1989). We used the theory of self-efficacy to guide our investigation into early predictors of academic success or the lack thereof.

Peer Instruction

One interactive teaching method that has gained international prominence is Peer Instruction, developed by Eric Mazur at Harvard University in the 1990s (Mazur, 1997). Peer Instruction is often used with the web-facilitated pedagogy, Just-in-Time Teaching, to create a "flipped classroom," which incentivizes students to prepare before class by completing online pre-class assignments that require them to interact with the subject matter and reflect on their understanding prior to the class period. Instructors then use feedback from students' pre-class assignments to plan class time. During class, instructors pose a series of questions often, but not always, using web-facilitated learning tools, such as classroom response systems. These questions pushed to students through technology serve to elicit, confront, and resolve (ECR) their misunderstandings and misconceptions (Heron, Shaffer, & McDermott, n.d.). In Peer Instruction, teachers use short, conceptually based questions called ConcepTests to facilitate the ECR technique (Mazur, 1997). The implementation of interactive teaching throughout the course for this study, included facilitating Peer instruction using a cloud-based classroom response system called Learning Catalytics. Students use their own devices (smartphones, tablets, or laptops) to interact and response to the questions. While Peer Instruction does not require the use of technology, the basic protocol for in-class questioning with Peer Instruction using a web-based response system is as follows:

1. Instructor gives a mini-lecture on selected concept.
2. Instructor poses a question using Learning Catalytics, which delivers the question to each student's personal device.
3. Students are given time to think individually about their response.
4. Students submit first-round responses using their personal devices.
5. Instructor reviews first-round feedback and data using an instructor-only dashboard through Learning Catalytics.
6. Instructor uses Learning Catalytics to pair students with someone with a different answer. The instructor

encourages students and to either defend their answer or to convince them that their own response is correct.

7. Students submit second-round responses after discussion.
8. Instructor reviews second-round feedback using the Learning Catalytics dashboard.
9. Instructor guides a closure activity for explaining the correct answer.

Instructors elicit misconceptions in steps 1-4, confront those misconceptions in steps 5-7, and resolve those misconceptions in steps 8-9. (If too few or too many students answer correctly in the first round, then there may be no significant misconceptions, and the process would jump from step 5 to step 9.) By building on students' prior knowledge derived from pre-class reading assignments submitted online and engaging them in constant social learning opportunities, Peer Instruction qualifies as a leading, internationally recognized interactive, web-facilitated teaching method. Indeed, in a study of 722 physics professors, Henderson and Dancy (2010) found that Peer Instruction was the most well-known and most tried interactive teaching method, with "more than 64% of respondents reporting familiarity" (p.1057).

For over twenty years, studies in classrooms all over the globe consistently indicate that there are positive learning outcomes associated with Peer Instruction. Prominent research includes Fagen et al. (2002), which found from a study of 384 Peer Instruction users and 30 courses at 11 universities a positive correlation between Peer Instruction and increased scores on standardized assessments of conceptual understanding. Mazur (1997) reported that students performed better on both course-specific exams and standardized tests of conceptual understanding when taught using Peer Instruction instead of with the traditional method (see Mazur, 1997, p. 16). Smith et al. (2009) reported that in a Peer Instruction environment, "peer discussion enhances understanding, even when none of the students in a discussion group originally knows the correct answer." Watkins (2010) reported that Peer Instruction is correlated with increased persistence (staying) in science majors and a reduction in the gender gap and the gap between racial and ethnic minorities on tests of conceptual understanding in physics.

Despite its successes, there remain students in Peer Instruction and other constructivist-based, interactive, blended classrooms that do not achieve at the levels proponents of interactive teaching and blended learning hope for. In this study, we examine if we can predict students that are at-risk in blended Peer Instruction classrooms early, with the intention of using those early warning models to recommend early interventions to instructors utilizing Peer Instruction and other interactive teaching methods. In this study, we posit that pre-course self-efficacy may be one such non-content related early warning sign.

Methods

We studied N = 89 students in a medium-sized introductory physics course at a large private university in the Northeast taught using Peer Instruction and Just-in-Time Teaching by a highly experienced instructor. Most implementations of Peer Instruction facilitate the mechanics of responding to ConcepTests using clickers or other audience response systems; as aforementioned, the course we studied used Learning Catalytics, a cloud-based response system (developed by one of the authors) that permits the instructor to pose non-multiple-choice ConcepTests to students (e.g., sketch a graph) and then can use student responses to automatically group students for discussion.

Peer Instruction Self-Efficacy Instrument

To measure self-efficacy, both in general and in a Peer Instruction environment, we developed a set of 25 Likert-scale items aimed at measuring various qualities related to self-efficacy, including qualities that we believed would be unique to a Peer Instruction environment. These items were based on Fencl and Scheel's (2003) Sources of Self-efficacy in Science COurses (SOSESC). The statements, such as "When I come across a tough physics problem, I work at it until I solve it" were designed to gather data about students' self-reported beliefs their abilities in physics and in a Peer Instruction environment.

As this was the first time the instrument was used, this study simultaneously served as an opportunity to use measurements from this instrument as covariates as well as an opportunity to gather some initial validation data from the study. We later extracted two subscales that we used as variables in the study. The first subscale was a seven-item set that conceptually covered general self-efficacy; Cronbach's coefficient alpha reliability for this subscale was 0.85 when the scale was administered at the beginning of the semester (pretest) and 0.83 when it was administered at the end of the semester (posttest). The second subscale was a six-item set that conceptualized our notion of "Peer Instruction self-efficacy." Unsurprisingly, since the notion of self-efficacy in a Peer Instruction environment is a new concept, this subscale proved to be somewhat less reliable, with coefficient alpha values of 0.53 for the pretest and 0.68 for the posttest. The fifteen items used in these subscales (as well as the other ten items that were ultimately not used in this analysis) appear in Appendix A.

Data Set

Our data set included all performance data for students over the semester, including:

- Summative assessment data collected over the semester, including scores on problem sets (eight over the course of the semester), three midterm exams, and the final exam.
- Pre and post-test scores on the Conceptual Survey of Electricity and Magnetism (Maloney, O'Kuma, Hieggelke, & Van Heuvelen, 2001), a conceptual inventory measuring understanding of fundamental concepts in electricity and magnetism.
- Pretest and posttest data from a non-cognitive assessment, developed by the authors, to measure students' self-efficacy in a Peer Instruction environment as well as attitudes towards science and education. Seven items measured general self-efficacy; Cronbach's coefficient alpha reliability for this subscale was 0.85 for the pretest and 0.83 for the posttest. Eight items measured Peer Instruction self-efficacy; this subscale proved to be somewhat less reliable, with coefficient alpha values of 0.66 for the pretest and 0.73 for the posttest.
- Formative assessment data consisting of student responses to ConcepTests asked by the instructor in class. These

questions were administered using Learning Catalytics and consisted of a mix of constructed-response and multiple-choice questions.

Results

The predictive models are shown in Table 1, along with the R2 value and the root mean squared error (RMSE) for each; this latter value gives roughly the "expected error" from using the model to predict final exam score given the predictors.

Model 1 demonstrates that just knowing students' conceptual understanding at the beginning of the semester is surprisingly predictive of their final course grades, with 29% of variance explained and a RMSE of 6.9. Adding in knowledge of students' self-efficacy at the beginning of the semester (Model 2) adds significantly to the model, raising *R*2 to 34%. The coefficient for CSEM score is (unsurprisingly) positive in Model 1 but remains positive in Model 2, indicating that conceptual understanding at the beginning of the course is positively associated with final grade even among students with the same level of self-efficacy.

Model 3 indicates that Peer Instruction self-efficacy does not add to the predictive quality of the model above and beyond CSEM score and general self-efficacy. (Surprisingly, Peer Instruction self-efficacy did not correlate at all with final grade; $r = 0.13$, $p > 0.05$.) However, Models 4 and 5 demonstrate that by adding early indicators of student performance it is possible to substantially increase the predictive quality of the model. Model 4 adds as an indicator the number of Learning Catalytics questions (ConcepTests) answered correctly in the first three weeks of instruction, while Model 5 replaces that with students' average scores on their first two problem sets, which also occur within the first three weeks of instruction.

Since Model 5 is a stronger predictor of final grades than Model 4, early problem set scores are retained in the later models. Models 6-8 add in successive scores on the three midterms. Not surprisingly—at least in part because midterm scores are a significant part of students' final grades—the addition of each midterm to the model substantially increases the model's predictive quality. We include these last three models in part because of the impact on the coefficient for self-efficacy: it decreases upon addition of each midterm exam score to the model, eventually becoming non-significant. This suggests that over the course of the semester, students' self-efficacy—which begins the semester simply as a thought process—starts to crystallize into better or worse performance; students' midterm grades essentially are likely accounting for students' prior self-efficacy. A similar pattern is evident with students' CSEM scores, which may be the result of the same sort of process: students' background knowledge about the subject domain starts to show up strongly in their exam performance.

Finally, Table 2 shows two models that regress final grades on gender and (in the second model) self-efficacy at the start of the course. These analyses show that male students had course grades that were on average almost 5 points higher than those of female students, but that the difference becomes statistically insignificant when controlling for self-efficacy.

Discussion

Our first set of analyses demonstrate that it is possible to use a simple set of early measures, content and non-content related—accessible within the first three weeks of the semester—to predict

Table 1. Regression models predicting final course grades

	Model 1	*Model 2*	*Model 3*	*Model 4*	*Model 5*	*Model 6*	*Model 7*	*Model 8*
CSEM score	0.24***	0.20***	0.20***	0.17***	0.14**	0.07	0.04	0.04
Self-efficacy (pretest)		2.89*	3.34*	2.14	3.39**	2.41*	0.92	0.40
Peer-instruction self-efficacy (pretest)			-1.11					
Early Learning Catalytics responses				0.33**				
Early problem sets					0.83***	0.57**	0.34*	0.30*
Midterm 1						0.64**	0.31	0.30
Midterm 2							0.81***	0.73***
Midterm 3								0.18*
R^2	0.29	0.34	0.35	0.42	0.53	0.60	0.75	0.77
RMSE	6.9	6.7	6.7	6.3	5.7	5.3	4.3	4.1

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 2. Regression models predicting final course grades as a function of gender and self-efficacy

	Model 1	*Model 2*
Gender	4.69*	2.45
Self-efficacy (pretest)		3.82**
R^2	0.07	0.15
RMSE	8.49	8.19

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

final course performance with some reasonable level of accuracy. This result suggests that instructors ought to make this information known to students, ideally through a computerized early detection system that automatically alerts instructors when the model predicts that a student may fail the course. Such a system ought to also be available to students, both to help students stay on track in the course and to help students learn and internalize the important metacognitive skills of self-monitoring.

Our analysis of the relationship between gender, self-efficacy, and course performance suggests a different understanding of the gender gap in physics. Female students' lower levels of self-efficacy (a mean of 3.2 on a 5-point scale, compared to 3.8 for their male counterparts) suggest that self-efficacy differences may be at least partly responsible for the gender gap. This suggests that an important next study is to examine in detail what factors lead to the gender gap of self-efficacy in science.

The success of the very short (seven-item) self-efficacy measure suggests that there may be other noncognitive characteristics that might also be predictive of later student performance. We were surprised to discover that students' self-efficacy of their performance in the Peer Instruction environment did not help to predict students' final grades, especially since both general self-efficacy and students' actual performance on the ConcepTests both were highly predictive. One avenue of future work is to refine our instrument for measuring Peer Instruction self-efficacy so that it might be more predictive of final grades. Another is to examine other noncognitive abilities that can be measured early on and that are predictive of course outcomes (e.g., study skills and habits, attitudes towards learning and the discipline, etc). Even though our analysis was retrospective and does not demonstrate causality between self-efficacy and course outcomes, the results do suggest that the development of an intervention to help improve students' self-efficacy may be worthwhile, especially for women. Further, given that our study was conducted in one classroom at one institution, future work that replicates and expands on these findings across a range of disciplines and institutions would be valuable in helping to shape what a successful intervention would look like.

Conclusion

This study demonstrates that there remain students at risk in interactive teaching, blended learning environments, even those taught by master teachers, but that there are key early warning signs that are easily identifiable. The major findings of this study suggest that simple, easy to measure methods can reasonably predict student achievement in interactive teaching environments that feature blended delivery, offering an opportunity for faculty to intervene early with students who are at risk along content and non-content related dimensions.

Pertaining to non-content related dimensions, with Bandura as a guide and subsequent research studies as further support, we propose that in order to demonstrate academic achievement, at-risk students must also believe they are "capable of identifying, organizing, initiating, and executing a course of action that will bring about a desired outcome" (Bandura, as cited in Ambrose et al., 2010 p. 77). The impact of perceived self-efficacy raises interesting questions about strategies for early intervention with students in interactive teaching environments. Given the impact of self-efficacy on final course grades, even in light of prior knowledge, we posit that perceived self-efficacy described by Bandura (2003) creates either bridges or barriers to the construction of knowledge and ultimately academic success. It is not clear how a positive self-efficacy assists in knowledge acquisition and transfer or academic success. What is clear from this study, however, is that while they may be important in general, an exclusive focus on content interventions for at-risk students in interactive teaching environments—such as tutoring or extra study sessions—may fail to address a key, non-content-specific element of student success: self-efficacy. Self-efficacy specific interventions may be particularly important for women. Future research should examine specific tools for intervening on the non-content, attitudinal level of self-efficacy as well as at the content level for students, such as emphasizing the importance of homework. Because the Peer Instruction Self-Efficacy Instrument was used for the first time in this study, future work must include validation. For concurrent work exploring interactive teaching using this instrument see Miller, Schell, Ho et al. (in press).

This study demonstrates that even in interactive teaching environments using state-of-the art online tools, there are students who remain at risk of not reaching key academic milestones that may determine how they proceed in their academic careers. It also offers a practical procedure for identifying risk factors and points of intervention. International educational reform efforts recommending interactive teaching methods, such as blended Peer Instruction, should venture forward with understanding of, acknowledgement of, and clear strategies to help groups of students who may otherwise be left behind.

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Appendix A : Self-efficacy items

1. I have taught or tutored a class before

2. I enjoy learning about science
3. I enjoy learning about physics
4. I often do well in science courses
5. I often do well in non-science courses
6. I identify with students who do well on exams and quizzes in science courses*
7. I expect to receive an A- or higher in this course*
8. I am confident I can do the work required for this course*
9. Doing laboratory experiments and write-ups comes easy to me*
10. I am often able to help my classmates with physics in the laboratory or in section
11. I usually don't worry about my ability to solve physics problems*
12. When I come across a tough physics problem, I work at it until I solve it*
13. I get a sinking feeling when I think of trying to tackle difficult physics problems*
14. I like hearing about questions that other students have about the reading
15. I am usually confident of my answers to the EARS† questions before I talk to a neighbor**
16. I am usually confident that I can convince my neighbor of my answer to EARS questions**
17. I know how to explain my answers to EARS questions in a way that helps others understand my answer**
18. My peers know how to explain their answers to EARS questions in a way that helps me understand their answer**
19. Listening to my neighbors talk about their answers increases my confidence when responding to the same EARS** question a second time
20. Practicing answering EARS questions in class makes it easier for me to do physics problems at home**
21. I can communicate science effectively
22. I can communicate physics effectively
23. I am an outgoing person
24. I often feel compelled to multi-task in science courses
25. I often feel compelled to multi-task in non-science courses

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* Used in general Self-Efficacy subscale
** Used in Peer Instruction Self-Efficacy subscale
† EARS was an early name for Learning Catalytics.

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Integrating Global Collaboration

Zhenlin Gao & Tom Green

Introduction

In the spring of 2011 I found myself lecturing at a number of universities throughout Southern and Central China. The topic was the rise of mobile technologies and how we, as teachers, need to learn how to teach the subject and how, as students, they need to look at the mobile space as an emerging medium. As is so common with these visits, I had the pleasure of meeting with the Deans and faculty of the Media Schools and a common topic of conversation was how our institutions could work together. Being a faculty member of the School of Media Studies and Information Technology at Humber College in Toronto, putting this sort of thing in place was not in the cards and my standard response to the question was, "This sort of thing is way above my pay grade." That changed, rather quickly when I met Wang Xiaojie, Dean of the School of Animation at Shenzhen Polytechnic (SZPT).

When he suggested the usual cooperation and I deflected the question, he made it quite clear he understood my position and that I should put my Dean in touch with him. Then I told him, as the meeting concluded, " Maybe we could do something with our two groups of students." That evening one of his faculty members- Zhenlin Gao, hereafter known as Jerry, contacted me and told me Dean Wang thought that our students working together was a great idea and for Jerry to make it happen.

It was the start of one of the most fascinating student-centric educational experiences Jerry and I have shared.

Planning

You just don't pull together students on opposite sides of the planet together and tell them to go create something. Jerry and I spent a good six months considering how this would work.

The underlying premise was: Our students will be entering a global collaborative work environment upon graduation. They will be working with people who live across the street, across the country and even across the globe. This project will, in a controlled manner, provide our students with that experience.

This premise actually was validated 2 years later by a commentary by David Helf and in the Chronicle for Higher Education when he asked, essentially, the same question we asked: "The brains of today's undergraduates—a product of a million years of hominid evolution—are instinctively collaborative, innately cooperative, and structurally wired for small-group interaction mediated by language and an awareness of the intentionality of others. What might happen if we structured our educational system to take advantage of these natural attributes?"

We were also encouraged to see collaboration appear in the *2014 NMC Horizon Report: Higher Education Edition*. One of the 6 key trends identified was the emergence of Collaborative Learning. In many respects this project reinforces the observation made that "universities are experimenting with policies that allow for more freedom in interactions between students working on projects and assessments."

The key questions (by both universities) during this planning phase were:

- How do we deal with differing skills and knowledge levels and facilitate a skill and knowledge transfer between the students?
- How do we accommodate the inevitable language, cultural and time differences – 36 hours- between the two groups?
- How do we manage academic credit?

First Steps

Not having any idea whether this would work or how the students would deal with collaboration, it was decided that rather than leap into the project with both students bodies we would conduct a limited test to learn how the students would work together and to identify any potential issues requiring institution resolution prior to a full ramp out.

In the winter of 2012, we asked 4 Humber and 4 Shenzhen Polytechnic (SZPT) students to participate in a test. The plan was rather simple:

1. Break into two teams comprised of 2 Humber students and two SZPT students.
2. Produce a collaborative web site within the space of 3 weeks.
3. Step back and watch the students work.

What we learned from this was:

- the students required minimal guidance from the institutions. They contacted each other and went to work.
- though we provided the two groups with Adobe Connect accounts, the students relied more on SSM, Skype and email than the Connect software.
- language issues were resolved by the students once they discovered such services as Google Translate and Babelfish were more hindrance than help.
- the students identified the skill levels in the groups and assigned duties accordingly.

The two groups completed their projects on time and each told us it was a unique experience that should be pursued further. At this point, Jerry and I reported the results to our respective Deans with the recommendation that the Collaborative Project proceed. Our Deans both agreed with our recommendation and it was determined the first Global Collaboration would be launched in the 2012 Academic Year.

The reason for such a long period between test and launch was due to Jerry and I carefully balancing what we had learned with the student course loads. There were differing skill levels between the two cohorts, which had to be identified and adapted to.

We also spent time wrestling with Academic credit. This was an interesting problem considering SZPT is a degree granting institution and Humber is a Community College offering two-year diploma level practical programs. On top of the academic and cultural differences there were institutional and governmental differences that had to be accommodated. After 6 weeks of trying to accommodate the various institutional and governmental needs, Jerry and I suggested that each institution apply its academic credits criteria to their respective student cohorts. Both Deans readily agreed to this solution.

The next issue was when to initiate the program. Again cultural difference and vastly different academic years came into play. Our Academic year begins in September and end in April of the following year with a 3-week Christmas vacation between semesters. SZPT has an Academic year that begins in September and ends in July with a one-month break for Chinese New Year between their semesters. As well we both had differing National holidays during our academic year. We both identified the October/November timeframe as the optimal time for the Collaboration. The first roll out, therefore, was October 2012 with a deadline for the projects on the first week of December 2012.

The project was assigned, the work teams established and the students went to work. In order to gather data regarding the effectiveness of the experiment Jerry surveyed his students before and after the project. Humber did not but, kept in almost daily contact with the Humber students and after reviewing the SZPT surveys the results were surprisingly similar for both student groups.

What we learned from the students before the first project was initiated:

- Both groups were very concerned about language differences.
- From the Chinese perspective, 95% of the students about to take part in the project did not see an opportunity to use English to communicate.
- Both groups were moderately (38%) to very confident (19%) they could complete the project,
- Neither group had any knowledge of the other's culture though the Humber cohort did include a few Chinese students.

Upon completion of the project SZPT surveyed the cohort and, again, the results between the two institutions were remarkably similar.

- Close to 78% of the students felt the project completed by their groups ran smoothly.
- The main obstacles encountered were Language, Time Zone, Communication methods and project Coordination were the top four. Culture, teamwork, skill and technical issues were below the previous four obstacles.
- 80% of the students said they would participate in future collaborations.

One added dimension to this project became evident after the Humber students graduated. A number of them reported that, during employment interviews, prospective employers recognized the value of the project on the student's resume and, in a couple of instances, was a primary factor in the student's subsequent employment. It anecdotally supports our contention that globalization requires collaboration and Global Collaborative Experience is gaining traction among employers.

The 2013 Project

In certain respects the student experience with the collaboration wasn't as positive as the previous year. As the project progressed through the October/November timeframe, the Humber students were discovering the enthusiasm and commitment levels of their SZPT partners were declining. In a November conversation with Jerry, when I became concerned, I learned there had been a policy change at SZPT regarding the academic credit where it was now regarded as extracurricular. This could be regarded as fatal to the experiment but, instead, it adds one of the most important data points to any academic institutions considering instituting a similar program: If students don't have "something at stake" – marks, academic credit- the incentive for success will decline. We had suspected this when we first started out in 2011 and it was not a surprise when it manifested itself in 2013.

To resolve this, SZPT has agreed to offer the Collaboration as an elective available to the entire School of Animation. This decision neatly resolves the academic credit and motivation issue and actually broadens the skills sets and project scope of the groups.

Lessons Learned

Globalization means Global Collaboration drawn from teams from varying cultures and with differing skill levels. From an academic point of view this new way of working cannot be taught … it needs to be experienced. Our students are graduating into this new environment and the experience gained during our project makes them much more adaptable to this work environment.

A student-centric focus helped bring this project to life. Both SZPT and Humber realized the experience was beneficial to the students and left the faculty to bring the project to life.Cultural and language difficulties decrease in concern among the students as they work together. Once both groups understand the task at hand they focus on the solution and find their own ways of bridging the cultural and language differences.

From an institutional perspective the financial cost of this project was essentially 0. Our job was facilitation but the main value, from an institutional perspective, was a deepening academic and personal relationship between the respective faculties and administration that may lead to other, more formal, opportunities.

As we move into the third year of the project we have agreed to tighten up the organizational aspects of the project (i.e., progress monitoring and assessment).

Conclusion

Pulling together two student cohorts from opposite sides of the planet and having them work together on a joint collaborative project is not difficult to accomplish. It requires a student-centric focus on the part of the institution and the institutional will to initiate a project that could fail. When I asked Jerry, during the planning phase of the project, what would we do if the project failed he made a very wise comment: "Then we learn something, don't we." This is important because you learn just as much from failure as you do from success and, in many respects, there needs to be an institutional will to accept failure, analyze the causes of the failure and adapt. These are points both Jerry and I made to our Deans and they accepted the possibility the project could fail and how we would adapt to this possibility. At no point did either Dean suggest we end the project if it didn't work out as planned.

Employers are becoming more aware of the effects of globalization on their businesses and that Global Collaboration presents unique management challenges. As the Humber students discovered, this is a unique experiential skill set that provides a competitive advantage in the employment market.

Distance Education or Global Collaboration does not necessarily mean formal academic courses. Our project demonstrated there is a distinct experiential aspect of distance education that is just as valuable as formal learning.

Video 1. What is a Home? A website documenting the global collaboration between Humbar and SZPT students. Go to umarbacchus.ca/collaborate/index.html

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Tom Green is Professor, Interactive Multimedia with the School of Media Studies at the Humber Institute of Technology and Advanced Learning in Toronto, Canada. He is also the author of over 15 books, with Pearson Education, Que, Peachpit Press, New Riders and Apress. He has produced several online videos for Lynda.com and Envato. Tom has also delivered expert lectures at such Post Secondary institutions as Shenzhen Polytechnic, Rochester Institute of Technology, Pasadena Community College, Central Academy of Fine Arts in Beijing, Ocean University in Shanghai, University of Wisconsin, The Sloan Merlot Consortium and EMMA Foundation Master Classes for Post Secondary students in Hamburg, Germany and Toronto. Tom also believes his students deserve to be taught by instructors who are regarded as experts in their field and whose knowledge of their subject is current with industry best practice.

Visualizing Knowledge Networks in Online Courses

Marni Baker-Stein, Sean York & Brian Dashew

As networking platforms have become more ubiquitous in the personal consumer space, data derived from social interaction is increasingly being used in the commercial space to analyze markets, make decisions, and develop new, personalized tools. However, even as social tools and design develop a presence in the learning space, research using social data to develop new understandings about knowledge production, teaching, and learning in online social learning spaces is fairly limited. This article is a practitioners' progress report on a research collaboration between Columbia University School of Continuing Education and Pearson Higher Education Technology, established with the goal of developing a framework and methodology for studying how social interactions and knowledge construction unfold in online courses that employ both formal and informal social learning activities. The work describes an emergent methodology for analyzing data produced by social and conversational interactions in online learning environments, using threaded discussion data from a group of students and faculty at Columbia University School of Continuing Education. It overviews the graph database schema and technologies employed, and describes examples of how the data is used to describe, differentiate among, and visualize individuals, conversations, and patterns of concept connectedness. Finally, it discusses relative strengths and weaknesses of the approach, suggesting ways it might evolve to improve our understanding of social networking and engagement in online learning environments, and how it can optimally impact student learning.

Keywords: *Social, analytics, knowledge, networks, visualization*

Note: *The figures labeled as* Interactive *may be viewed by downloading the* Internet Learning Journal *app from the iOS App Store.*

I - Introduction

With the rise of consumer-facing networking platforms like Facebook, Twitter, LinkedIn and Instagram, "social" has become a dynamic engine of commercial enterprise powered by huge amounts of data. This data is structured and presented in ways that drive the continuous development of real time, highly personalized tools for social and professional networking. And, perhaps even more critically, it has the potential to give us unprecedented insights into the social mechanisms that underpin cultural practices of learning and knowledge production.

However in research efforts targeted at understanding student success and learning in higher education and specifically in online courses and programs, we have only recently begun to explore the potential uses and impacts of "social". Learning management systems that support online instruction increasingly provide (or integrate with) social networking tools to facilitate community building and social knowledge networking. Yet related research efforts that seek to understand student behavior in online courses have focused primarily on attendance patterns and wayfinding behaviors, content engagement and assessment outcomes, leaving the social dimensions of these environments relatively unexplored.

It is often said that we value what we can measure, and we measure what we value. A review of the technology impacting the state of higher education instruction and research indicates both value and measurability may be shifting towards an examination of the social space as a powerful means of surfacing knowledge construction activity. The 2014 Horizons Report (New Media Consortium, 2014) lists the growing ubiquity of social media as among the drivers of change likely to impact education within the next two years. The report also lists two trends as three to five years away from having a significant impact on the state of higher education: the rise of data-driven learning and assessment, and a shift towards viewing students as creators of content. We believe these and other trends listed in the Horizons Report indicate the time is now to gain insights into the conditions that promote social knowledge networking in online courses and to identify practical methods to measure its impacts. With these goals in mind in 2011 the researchers launched a collaborative research effort between the Columbia University School of Continuing Education program development and instructional design team, and Pearson Higher Education Technology. Together, we defined an exploratory methodology and an initial set of logical questions to guide research-engaging data produced from the social networking environment of an online master's degree program offered at Columbia University. Our goal was to develop a framework and methodology aimed broadly at allowing us to better understand social interactions and knowledge construction in online courses that employ both formal and informal social and cooperative learning activities.

We will first elaborate our definition of Social Knowledge Networking (SKN) and the logic we applied in structuring our data and identifying the initial questions that grounded our research. Next, we provide a generic description of our emergent methodology for analyzing the data produced by social and conversational interactions in online learning environments. Then we present an overview of the graph schema and technologies we used, followed by results for each of our three research questions. Finally, we discuss relative strengths and weaknesses of the method, suggesting ways it might evolve to improve our understanding of how social networking and engagement work in online learning environments and how it can optimally impact student learning.

II - Analytical Framework

Our initial analytical framework incorporated relevant concepts from content analysis, knowledge network analysis, and conversational analysis into a custom model, represented in Figure 1.

A. The Knowledge Map

Foundational to this framework is the recognition that each course contains an underlying knowledge map. The map represents the conceptual skeleton of the course, including those concepts provided by the instructor via course resources, lectures, or activity prompts, and those introduced via discussion in the course. Part

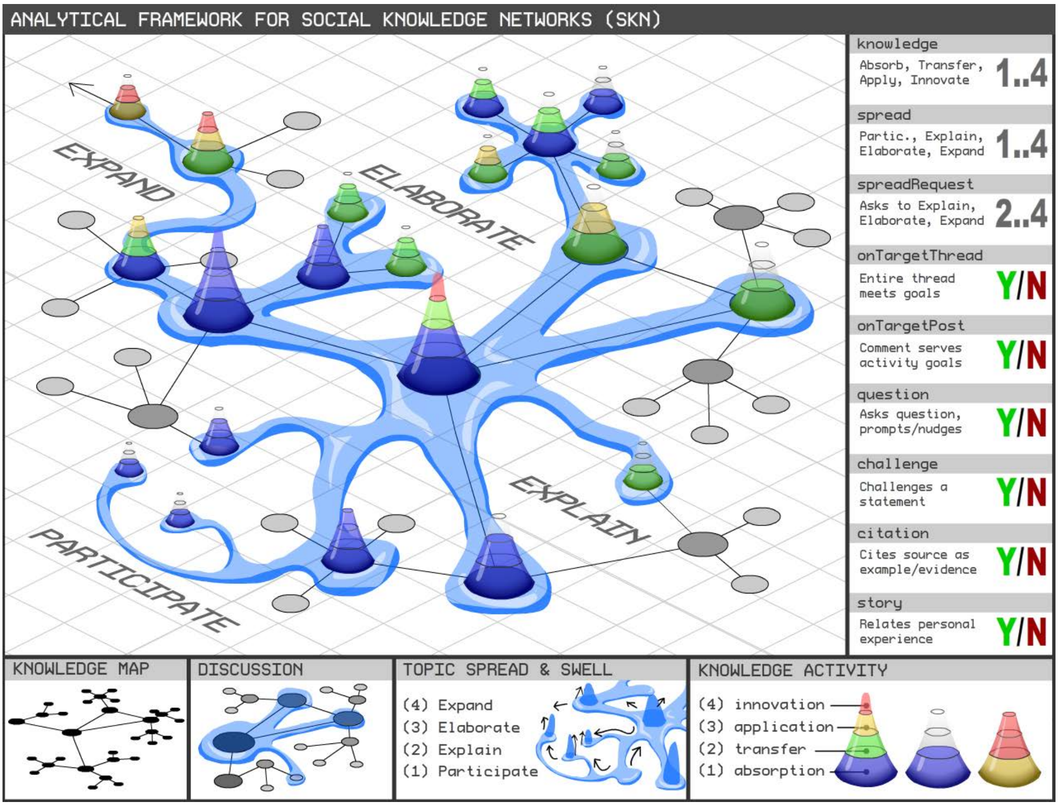


Figure 1. Analytical Framework for Social Knowledge Networks (SKN).

of our aim is to be able to understand and visualize the topicSpread of student and instructor-generated content from the course discussions across (and beyond) this map. In this paper we deal mostly with conversational concepts. Work on course concept structure and use of ontologies is ongoing.

Knowledge Activity

To characterize the focus of student and instructor-generated content in the context of each course discussion, we further wanted to be able to identify the level of knowledgeActivity that resulted from participant engagement. To this end we developed a custom rubric to align with the types of knowledge activities prompted by collaborative and discussion assignments included in the program under study.

Levels of Knowledge Activity:

1. Absorb: Determining the meaning of instructional messages and course concepts.
2. Transfer: Transferring an understanding between contexts or disciplinary environments.
3. Apply: Carrying out or using a theory, concept or procedure in a given situation.
4. Innovate: Putting elements together to form a novel or coherent whole or to identify an original product or solution.

Not surprisingly, knowledgeActivity is one of the most difficult attributes to code consistently and our understanding continues to develop as we dive deeper into our data and can see more clearly the types and nuances of knowledgeActivity occurring in our context.

C. Conversational Influences

To understand conversational influences on the topicSpread of course conversations, we implemented an approach suggested by a prior research partnership between Pearson Learning Solutions and Texas Christian University (Zelenka, 2012). This approach measures the conversational force of individual contributions to course discussions by extracting topics that appear in each response, and then considers the relationship of these contributions to topics already introduced in the conversation. The TCU/Pearson research team proposed that there are four levels of discussion thread contribution that impact topicSpread.

Levels of Topic Spread:

1. Participation: A student or instructor response does not cover topics
2. relevant to the discussion but merely states agreement or disagreement or offers social conversation.
3. Explanation: A response covers topics that have already been
4. introduced in a thread.
5. Elaboration: A response provides additional closely-related topics
6. about topics already introduced in a particular top-level threaded response.
7. Expansion: A response connects topics already introduced in the
8. discussion to distantly-related topics.

These codes are assumed to form an ordered hierarchy, with expansion representing the highest level of topicSpread.

As we read the data more deeply, we noted a number of common speech acts that seemed to be impacting the levels of knowledgeActivity and topicSpread across conversations in the learning community. One of these was a Topic Spread Request, in which a discussant would ask another person to Explain, Elaborate, or Expand upon some topic. If the response to such a spreadRequest was coded for topicSpread at the same level, we would consider the request to have been met.

Levels of Topic Spread Request:

1. Explanation: A discussant requests an explanation of topics that have already been introduced in a thread.
2. Elaboration: A discussant requests a response containing additional closely-related topics about topics already introduced in a particular top-level threaded response.
3. Expansion: A discussant requests a response that will connect topics already introduced in the discussion to more distantly-related topics.

The Columbia team had designed and written the courses and read the assigned readings. They therefore acted as our content experts when it came to applying topicSpread scores for our entire response set.

It should be noted that topicSpread is not intended as a way of valuing contributions, beyond the observation of whether new concepts are introduced, and how closely or distantly related they are to assigned content resources and prior discussion. For example, a topicSpread of Level 4/Expand might correspond with the use of an analogy that clarifies a course concept, or it could signal a distracting departure from relevant topics. Determining concept relevance is a significant area for ongoing research.

We added the following conversational moves in addition to topicSpread and spreadRequest:

- Question: Does a discussant ask a question?
- Personal Story: Does a discussant tell a story from personal experience?
- Citation: Does a discussant make reference to a book, article, or other work (citation)?
- Challenge: Does a discussant challenge another discussant?

D. Task Target and On-Targetness

To understand conversations in our formal learning environment, we also felt it important to consider the targeted behavior of the collaborative activity or discussion prompt. Activities (discussion prompts) were coded using the knowledgeActivity and topicSpread categories. For example, tasks might ask students to Transfer and Elaborate (knowledgeActivity=2/Transfer, topicSpread=3/Elaborate). General topical alignment was also considered.

Each discussant's comment, as well as the entire thread, was coded for whether or not it was on target in relation to the original task prompt. These binary attributes are called onTargetPost, and onTargetThread.

E. Metadata Attributes

Finally, we identified a set of quantitative attributes that provide more information about individual participants as well as the shape and structure of conversations themselves. These included:

- word count (of participants, conversations, and individual responses)
- number of posts (for each participant and conversation)
- number of unique participants (in each conversation)
- time stamp (of each participant's posts and the conversation as a whole)
- proximity of posts in time (of each participant's posts and for the conversation as a whole)
- level of the response tree at which a response is posted (responseLevel)

F. Intersectionality

We believed that our richest insights from this type of exploratory study would spring from our ability to identify and visualize the intersection of individual, conversational and content characteristics. For example, do certain combinations of individual students generate more 'productive' or 'successful' conversations? Are student and instructor questions treated differently? What kinds of instructor strategies might be effective in various kinds of conversations? How does the introduction of certain concepts or resources impact the depth or number of participants in a conversation? See Figure 2 for some examples of these intersectionalities.

With this emergent framework as our guide, we manually coded a data set of 948 threaded discussion posts for targeted attributes; designed a graph schema and graph database to aid in describing and analyzing the problem space; and began the project of designing queries and visualizations to facilitate analysis of the threaded discussion data from graph computing and Natural-Language Processing (NLP) perspectives.

G. Tools Development and Scalability

We decided to employ or build technology solutions where feasible, but to not limit our questions to what was possible with current technologies. We favored a data design that would speak well to our questions, even if at first it would require significant labor to op-

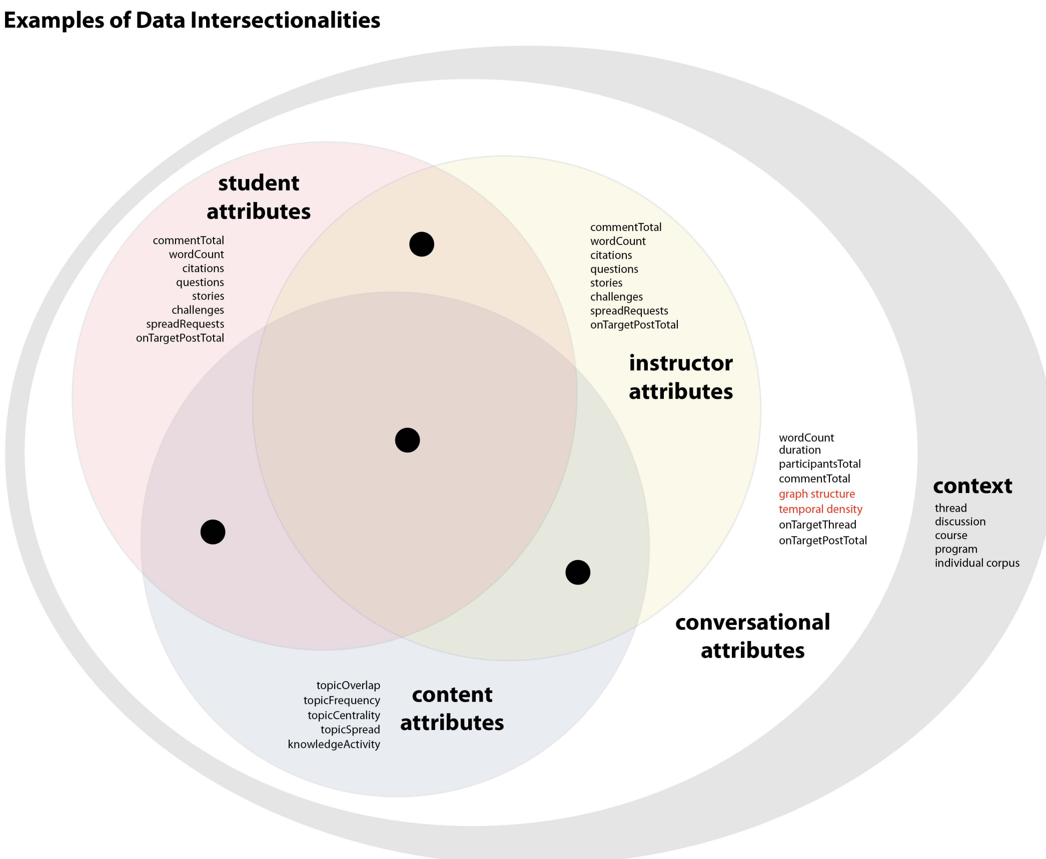


Figure 2. Examples of Data Intersectionalities.

erationalize and code the data. At the same time, we feel a sense of urgency to understand and improve social tools for learning, and have worked and designed with the goal of bringing research-based improvements to online learning environments at scale. Our ultimate goal is to advance the conversation about social media in education, speed the research-into-practice cycle, and support the development of effective, efficient, engaging, data-rich environments for social, cooperative, and collaborative learning.

III - Research Questions

In order to conduct sophisticated analyses of social interaction in online learning, we determined that we must first be able to identify, count, qualify and visualize individual behaviors and interactions among the network of participating faculty and students. We also wanted to visualize the traverse of anonymized faculty and student conversations across the content map of the course and program.

To this end, we formulated the following high-level research questions:

- RQ1: Can we identify, differentiate, and visualize individual characteristics and behaviors in an online discussion or course?
- RQ2: Can we identify, differentiate, and visualize conversation characteristics and behaviors in an online discussion or course?
- RQ3: Can we identify and visualize content focus over time in an online discussion or course?

Our research questions address fundamental challenges of doing sophisticated analyses of online discussions. Conversations have structural and other non-content attributes, but are also contexts where unique individuals come together and co-create a body of content. The problem of identifying and quantifying individual influence on conversational content and structure is a complex one, as is the problem of identifying how conversational structure and content might arise as a combined expression of the attributes and behaviors of multiple individuals. In the following sections we will describe our approach to each question, and discuss our findings.

IV - Methodology

In this paper, we present the current state of the qualitative, quantitative, and visual research methodology that has emerged over the past three years of collaborative work. The Columbia and Pearson teams adopted an iterative, grounded approach to data gathering and analysis, beginning with a thick, digital ethnography of discussions in several online courses. Methods included close readings of discussion texts, analysis of conversational moves and strategies, and detailed analysis of engagement with assigned and unassigned resources. We identified quantitative and qualitative attributes as described above in the Analytical Framework, which we then applied to the data on successive passes over a period of several months. The result was a set of rich, augmented discussion data containing both automated and hand-coded attributes for each discussion response, along with detailed digital-ethnographic field notes.

Then, in order to analyze the data from network and visualization perspectives, we employed a variety of software tools and techniques. These approaches included creation of a graph database with a custom schema designed to model threaded discussion data, a domain specific language (DSL) for exploring that data, and use of Natural-Language Processing (NLP) tools, network visualization tools (such as Gephi), graphic design software (such as Adobe Illustrator), and spreadsheets. We relied heavily on open source software, and wrote our own code as well. We were able to automate some tasks with custom scripts and parsers, while others required hours of painstaking, repetitive work. Thus, the present work is presented as a practitioners' progress report on the project of defining a set of Social Knowledge Networking attributes relevant to emergent digital pedagogies, and of devising ways to measure and reason about them. Our examples are intended to be illustrative rather than definitive. Our methodology is presented as one of exploratory inquiry, rather than as a proven, streamlined approach to answering the kinds of questions we engage here.

We draw our data examples from a single week of anonymized, small-group, threaded discussion data, consisting of one instructor prompt, seven individual thread response trees, and a total of 64 comments, over a period of four days. All names are invented code names, applied without regard to gender or course role. The seven students are Alakel, Danen, Fesler, Loret, Viska, Renlit, and Kerrad. Naya is the lead instructor, and Jakata is a TA. Radsel, a participant from another group, cross posts one comment in Fesler's thread.

For each research question, we provide a brief conceptual overview of our approach; a technical summary describing the processes and technologies involved; a situated example to illustrate an application of the model to real data; and a discussion where we explore Instructional Design insights and implications for future work.

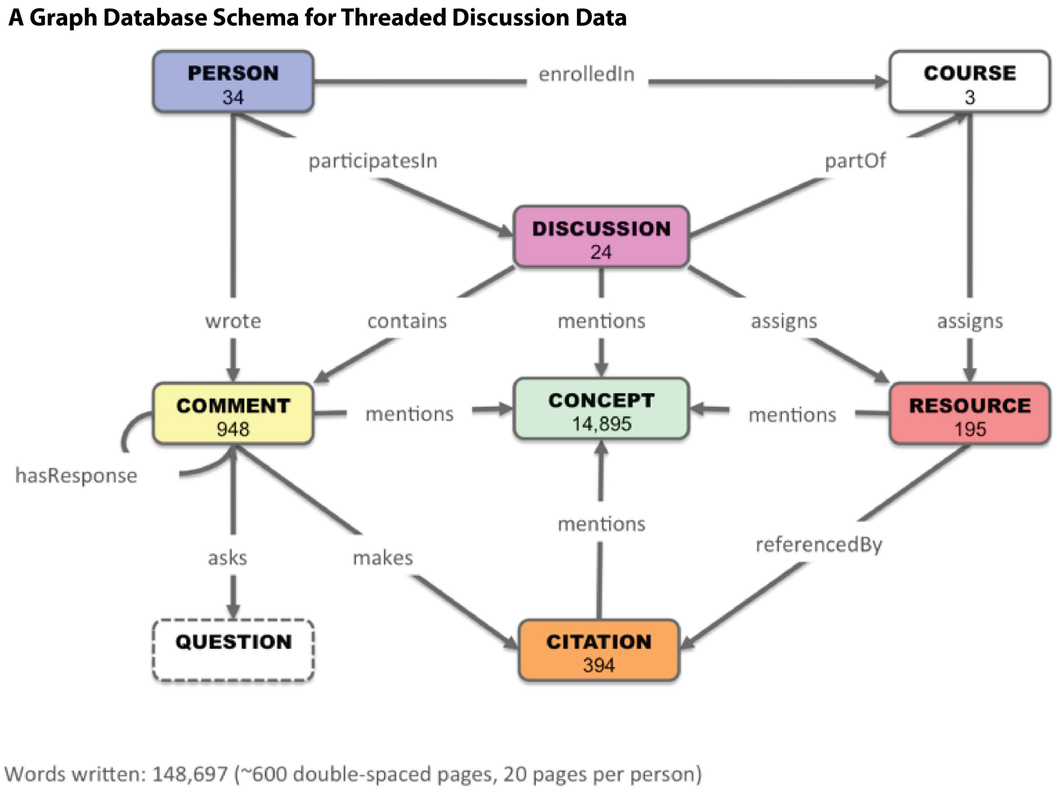


Figure 3. A Graph Database Schema for Threaded Discussion Data.

V - Graph Database Schema and Technologies

Because network thinking is fundamental to our approach, we will preface our data analysis with a conceptual overview of our graph database schema, and a technical summary of the graph technologies we used. We will reference this schema in our discussion of each research question.

A. Conceptual Overview: Graph Database Schema

We engaged with the applied graph science experts at the Aurelius consulting group, creators of the open-source TinkerPop graph computing stack, to model the conversational data as a network schema (a 'directed property graph'), build a graph database against that schema, and design a domain specific language (DSL) for traversing and interrogating the threaded discussion graph. We found several benefits to modeling the data as a graph, as shown in Figure 3.

First, as a data structure, the graph allows us to pose many questions in an exploratory and intuitive manner. Second, the familiar concept map construct eased discussion and reasoning about the data among more- and less-technical researchers. This was particularly important given that we expected to discover new and important questions over the course of the study. Finally, the graph-structured data is easily exported in forms that can be used with existing network visualization tools. This allowed us to use visualization as a first-class investigative tool over the course of the study, as well as a post-hoc story-telling tool.

B. Technical Summary: Graph Database Technology

For the analysis presented in this article, we populated a Neo4J graph database with our research data according to the schema described above. This research graph comprised roughly 46,000 vertices and 144,000 edges. We currently use the distributed graph database Titan to maintain our production dataset, consisting of approximately 400 million vertices and 1.2 billion edges. Because TinkerPop is graph vendor agnostic, we are able to use the same tools to manipulate both our Titan production graph and our Neo4J research graph. We built a custom DSL using Gremlin, the graph traversal language built into TinkerPop. The DSL composes custom graph traversals, queries, and calculations that can be executed in various contexts in the graph, such as for a whole course, a whole discussion, a single thread, or a group or individual over time. Queries can generate sub-graphs that can be used for visualization, or to test traversals, statistical methods, machine learning techniques, or other approaches. While we will provide limited examples to illustrate our approach, an in-depth discussion of these technologies is beyond the scope of this paper. You can learn more about them at http://tinkerpop.com, and https://github.com/tinkerpop.

Gremlin enables the flexible construction of traversals for exploratory data analysis in the graph. For example, where 'g' is the graph, and 'V' is the set of all vertices in the graph, the following Gremlin query would generate a list of all concepts mentioned by a person named Renlit over the history of all of Renlit's responses:

g.V.has('personName', 'Renlit').out('wrote').out('mentions')

In this manner, we can construct complex and unanticipated queries to explore and interrogate the data, and evolve new queries based on emergent understandings of the data. Query results are themselves graphs, which can be used for visualization and other analytical work. If an interesting metric is discovered, it can be codified as an algorithm, expressed as a 'step' and used inline with other Gremlin commands. For example, imagine we have created a method for determining whether or not a person is a 'Thought Leader' in a course, based on some graph traversal. We could express that algorithm in a Gremlin step called isThoughtLeader, and use that step to discover all concepts discussed by thought leaders as follows:

g.V.has('type','person').isThoughtLeader.out('wrote').out('mentions')

The output of such algorithms can be tested and used to inform learning environment design, or studied in conjunction with other factors in the course of ongoing research.

VI - RQ1 Findings: Can we identify, differentiate and visualize individual attributes and behaviors in an online discussion or course?

A. RQ1 Conceptual Overview

There are many kinds of learner data available, depending on the environment, activity, platform, or product under study. In a general conversational context, much of what we can know about a person is derived from:

- What they contribute: Number, size, content, and attributes of individual comments

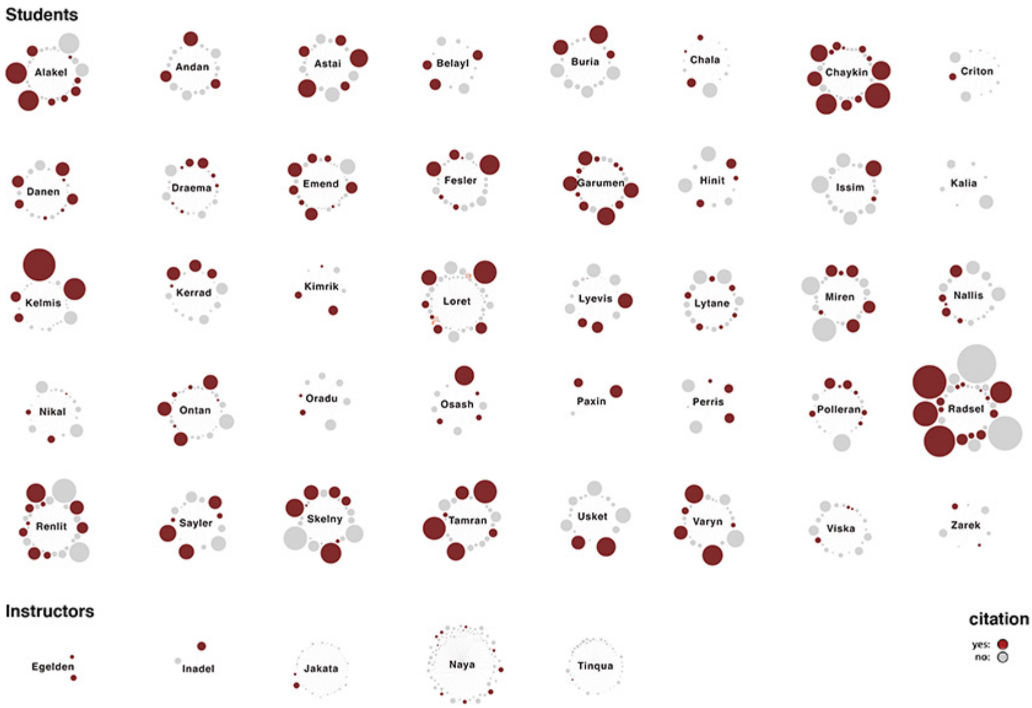


Figure 4. Comparative Corpus Diagram.

- How they interact: Timing and response tree depth of contributions, behavioral patterns, conversational moves and strategies, and individual influence
- With whom they interact: Which threads they contribute to, to whom they respond, who responds to them, and the identity, number, and variety of their co-discussants

Not surprisingly, multiple passes through the data revealed many insights and avenues for exploration that were not apparent during earlier readings. While it may seem straightforward to see how conversational and participatory elements manifest at an individual comment or thread level, it is much more difficult to understand the historical context of a contribution, or to consistently apply a discussion rubric over a large amount of conversational data.

We approached the problem of modeling and differentiating individuals using a construct we term a 'comparative corpus diagram,' an example of which is shown in Figure 4.

An individual's corpus is a collection of all responses they have authored in some context or time period. A comparative corpus diagram is a graphical and statistical representation of multiple individual response corpora, with responses sized and colored for various attributes and arranged for easy comparison among individuals. When we analyzed corpora coded for attributes from our SKN model, we found them to be a compelling supplement to the digital-ethnographic narratives of individuals and conversations in our data set.

B. RQ1 Technical Summary

A corpus diagram requires a graph containing a person, and all associated responses. We collected those responses by following all outgoing 'wrote' edges from a given person, as follows:

```
g.V.has('personName','Renlit').
out('wrote')
```

We wrote the results to an in-memory Tinkergraph, exported the data as GraphML, and imported to Gephi for further modeling. We applied a consistent set of visualization rules, such as node sizing based on wordCount, and color mappings for the values of various attributes. Finally, we applied a force-directed graph layout algorithm to the model to obtain a readable presentation. Based on that model, we used Gephi to export a separate SVG vector graphics file for each attribute's color scheme, and overlaid them using Adobe Illustrator. As a final step, we exported to PDF format while preserving top-level Illustrator layers, resulting in a layered PDF. We used these PDFs as data analysis tools, and to generate the comparative corpus diagrams presented in this paper.

C. RQ1 Example

The following figures use comparative corpus diagrams, coded for a handful of attributes, to illustrate a few similarities and distinctions among three participants: Renlit and Loret, who are students, and Naya, who is a lead course instructor. Each corpus diagram represents the entire history of each discussant's contributions over multiple weeks and courses, and is accompanied by a brief description of the participant based on our digital-ethnographic observation data. A brief comparison will illustrate how elements of these participants' digital-ethnographic descriptions can be detected using comparative corpus diagrams, and the potential of the approach to support identification and differentiation of individuals based on their patterns of discussion participation.

Figure 5 compares corpora for Renlit, Loret, and Naya, coded for usage of personalStories. Renlit's diagram shows the highest level of story usage across the entire data set, and reflects the digital-ethnographic description of Renlit's tendency to answer questions using personalStories rooted in a professional context. Loret shows story usage at a significantly lower level than Renlit, but more in line with typical student numbers. Naya, on the other hand, uses only one personalStory in a corpus of 91 responses, the largest corpus in the data set. Naya's responses are significantly shorter than most student responses, with an average wordCount of 61. We can't infer that all instructors in all situations will show such a marked difference from students in this regard, but in combination with other data points, these provide a promising starting point for differentiating participants.

Figure 6, coded for questions, reveals a striking correlation between Naya's corpus diagram, and the digital-ethnographic description of Naya as favoring short, probing questions as a participation strategy. A comparison of Naya with Loret and Renlit is also revealing. For stories, Renlit was prolific and Naya barely registered, with a gap of about 70%. For questions, the situation is flipped, with Naya asking many questions and Renlit asking relatively few, with a gap of approximately 50%. And in both cases, Loret is in between, in some cases appearing more like the other student, and in some appearing more instructor-like, as reflected in the digital-ethnographic description.

Figures 5, 6 and 7 are presented sequentially for comparative purposes.

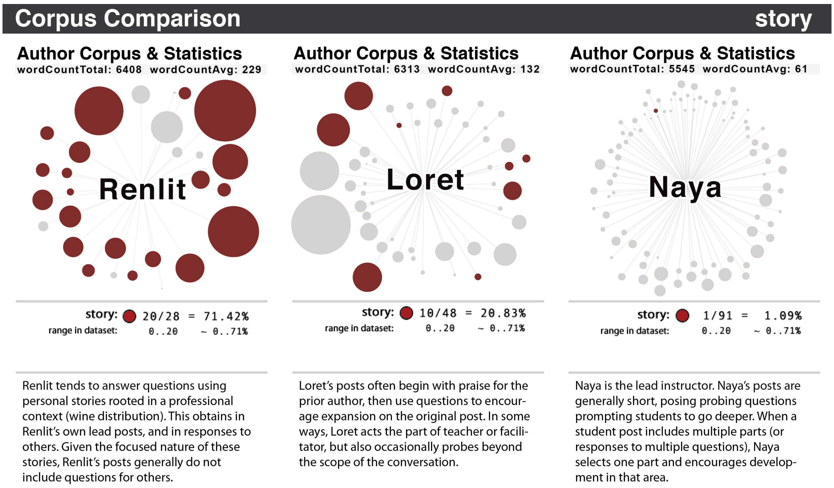


Figure 5. Corpus Comparison – story.

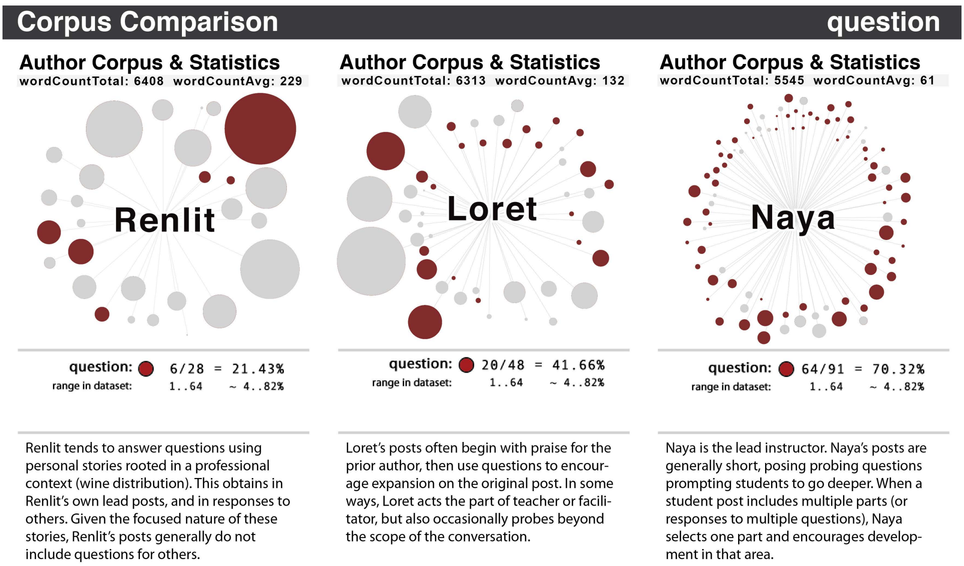


Figure 6. Corpus Comparison – question.

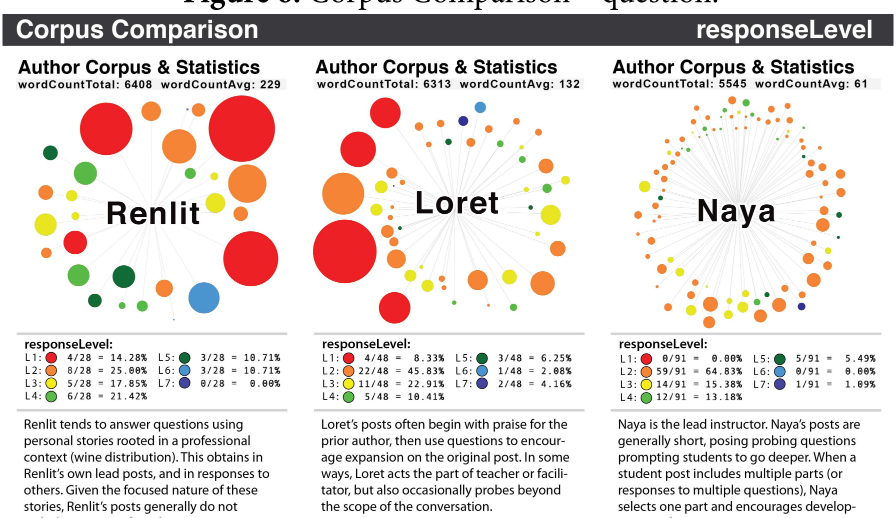
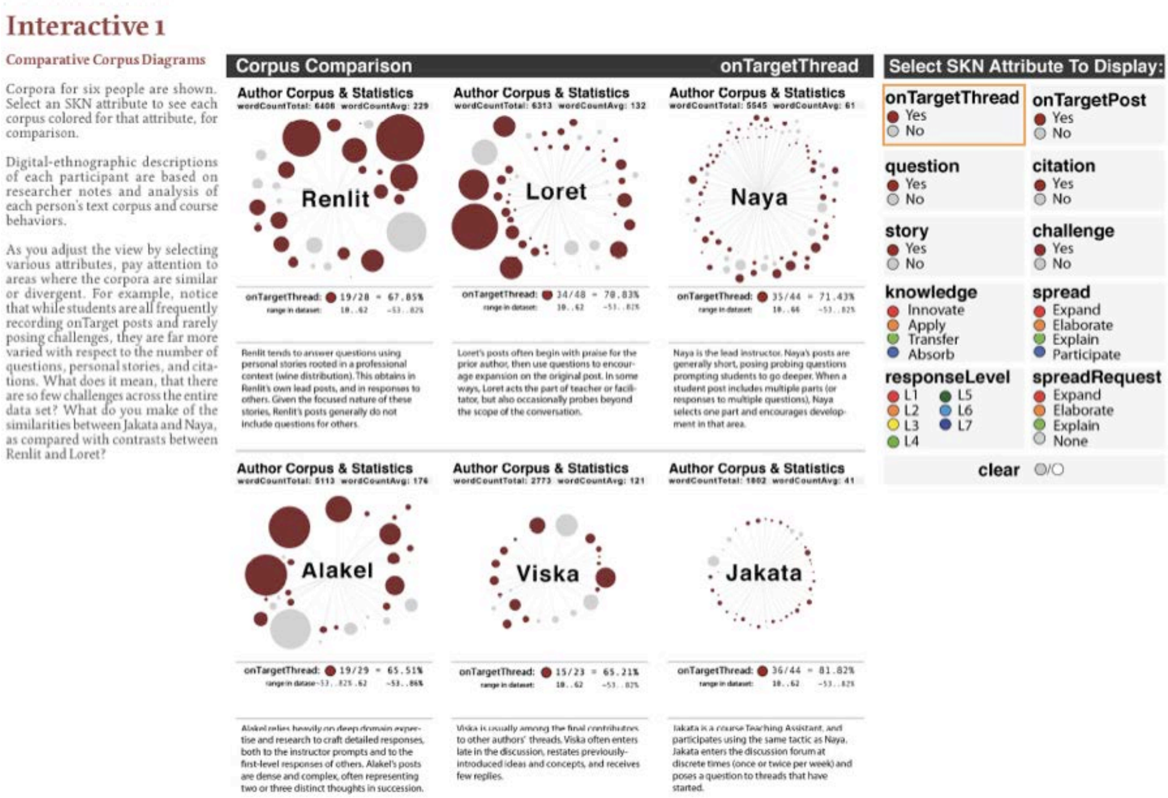


Figure 7. Corpus Comparison – responseLevel.



Interactive 1. Comparative Corpus Diagrams.

Finally, in Figure 7, we show comparative corpora for responseLevel – the level of the conversation tree at which the discussant contributes each response. The slightly cooler cast to Renlit's corpus indicates that Renlit tends to participate somewhat later in a thread than Loret – compare, for example, at L2 (orange) and L4 (light green). Note also that Loret and Renlit each have four responses at L1, indicating that they have each initiated four threads. Naya, on the other hand, has no posts at L1 because instructors do not typically respond directly to their own discussion prompts. This may seem self-evident, but it is encouraging to see an intuitive result illustrated so plainly in the data. Finally, to the question of Loret as a student who presents as instructor-like in certain ways, what happens if we disregard the L1 responses in the Loret and Renlit diagrams? The remainder of Loret's corpus falls somewhat between Naya's and Renlit's for wordCountAvg, as well as for the distribution of responseLevels. For example, Loret's proportion of L2 to L4 posts is much more similar to Naya's than it is to Renlit's.

D. RQ1 Discussion

A simple graph traversal, derived from the schema shown in Figure 3, can yield a participant corpus data structure that is amenable to visual and statistical analysis. The examples above show that comparative corpus diagrams can be used as exploratory tools for generating rough insights about individual differences among discussants, and as useful models to support reasoning about individuals. They

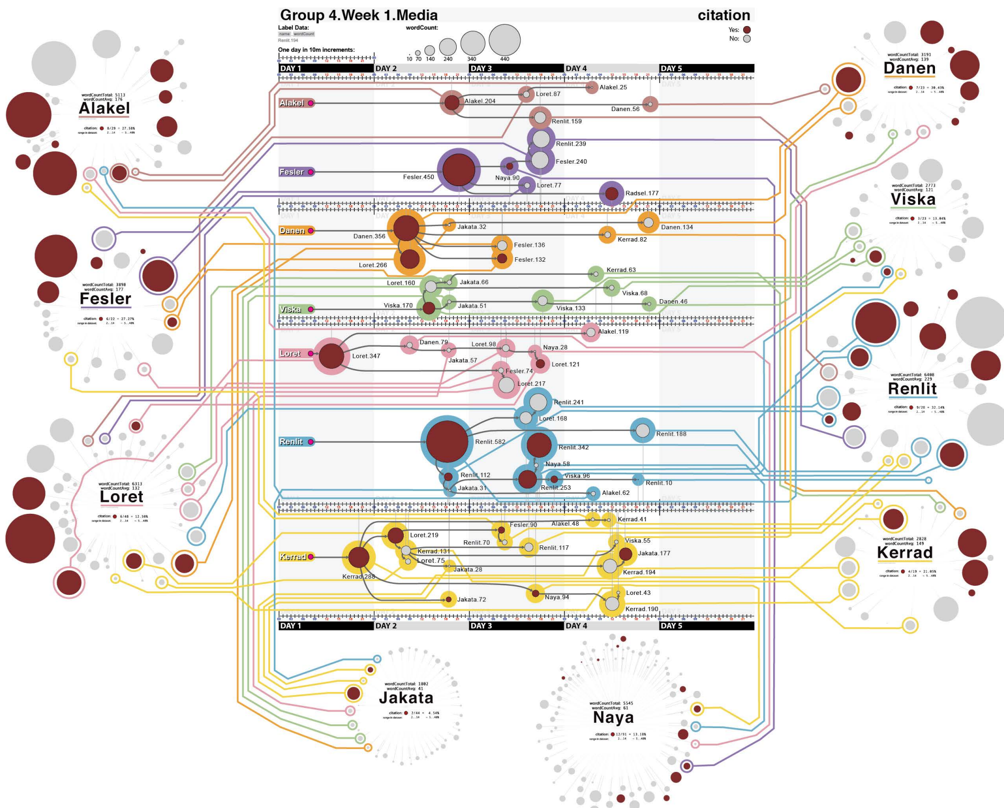


Figure 21. Instructor Participation Across Seven Discussion Threads. Instructor posts (Jakata and Naya) are highlighted, showing a distinctive pattern of posting across threads within a narrow time window

can provide valuable data and insights that instructors can use to help students, and that students and instructors can use to help themselves. For example, longitudinal analysis could show changes in the character of a student's corpus over time, or reveal instructor strategies and interventions that work more or less well for individual students. An instructor might realize she tends to interact more with advanced students, even though they are not the ones who need the most support. It is also important to note that automated metrics could be based on the structural and mathematical properties of the schema, so that even if the metrics are imperfect or approximate, they can provide a consistent yardstick against which to better understand, measure, and improve social environments for learning. Two instructors may come to different conclusions about a student based on their expertise and course requirements, but they would have the same tools and evidence available to support their decision-making process. A wide variety of education research studies could conceivably be conducted using a consistent descriptive baseline of participation metrics, conceptual content, social learner models, and comparative conversation analysis tools.

Access to such tools could also have powerful implications for instructional design and teaching practice. One instructor, upon viewing SKN data for a course, realized that although challenges are a desirable behavior for the course, they were seldom being used by students. The instructor subsequently added an activity that explicitly required challenges as an output of student work.

Visually identifying difference might also allow instructors to more easily target messaging and feedback to individual students. Figure 21 illustrates the relatively regimented participation patterns of the instructors in our data set, as compared with the more free-flowing timing of student contributions. Instructor corpora are also strikingly similar to each other, as compared with the diversity of student corpora. Though we cannot be sure of the reason for this regimented behavior, it is safe to suggest that as class sizes increase, it becomes difficult simply to read the massive volume of student contributions, much less to fairly assess contributions or craft individualized responses. Corpus diagrams could help instructors in large online courses by presenting high-level summaries and signifiers to help them target attention, participate more effectively, and perhaps gauge the effectiveness of various response interventions over time and at scale. These visualizations can not only provide instructors with a better understanding of student contributions, but also perhaps provide students and instructors with tools for perceiving, assessing, and focusing their own behaviors and interaction strategies.

Although there is not enough space to discuss it here, we have also experimented with creating a 'concept corpus' for each participant. This model connects a person directly to the concepts mentioned throughout their response corpus, producing a concept graph of that person's favored discussion topics over time, which could be used to recommend content, connect with peer tutors, or form effective work groups. 8.3. RQ3 Example describes the construction of a concept graph for a discussion thread, and Interactive 4 allows basic exploration of that concept graph. This example can be used to imagine how an individual concept corpus could be utilized.

VII - RQ2 Findings: Can we identify, differentiate, and visualize conversation attributes and behaviors in an online discussion or course?

A. RQ2 Conceptual Overview

In 6. RQ1 FINDINGS, we considered a collection of hand-coded response attributes across a discussant corpus as a means of representing, differentiating, and reasoning about individual discussants, using digital-ethnographic readings as an analytical anchor. The individual corpus, as the unit of analysis, was constructed based on the relations between a person and their associated response nodes in the graph. What makes that analysis possible is consistent and replicable corpus generation based on the underlying structure of the graph. Individual corpora may vary, but their underlying structural properties are the same.

Now, in 7. RQ2 FINDINGS, we investigate the interactional, influential, temporal, and co-creational aspects of individuals participating in discussion threads. We approach this problem using the same SKN attributes and digital-ethnographic descriptions, mapped onto the somewhat more complex graph structures of threaded discussion response trees. We also describe a graph-structural influence metric, called DiscussionRank, that can be used to gauge the impact of a response, response author, particular speech act, or other event on the evolution of a discussion thread.

B. RQ2 Technical Summary

For conversation modeling, we can use the Discussion--contains-->Response and Response--hasResponse-->Response relations in our schema to extract a basic subgraph of the desired discussion.

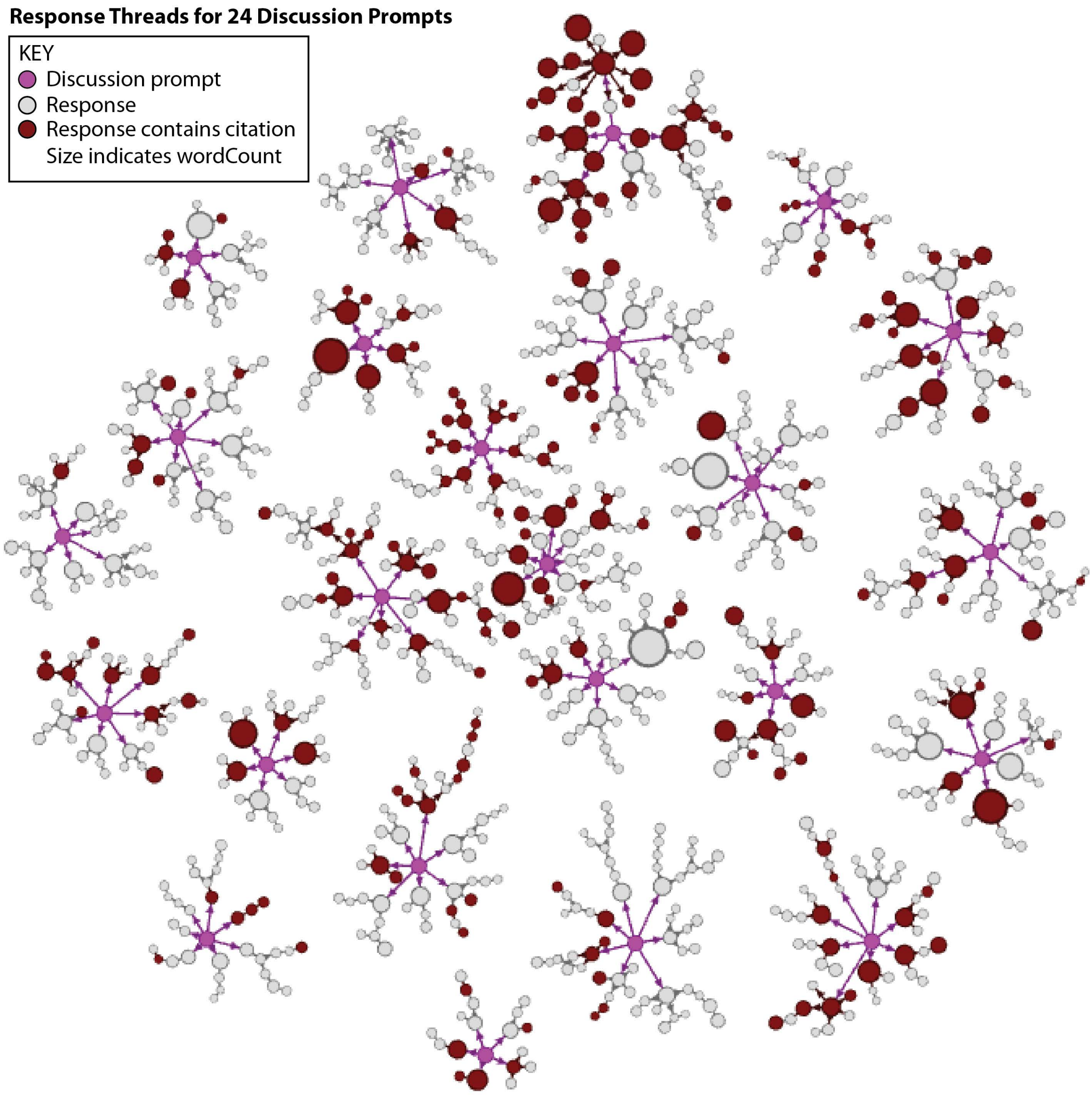


Figure 8. Response Threads for 24 Discussion Prompts.

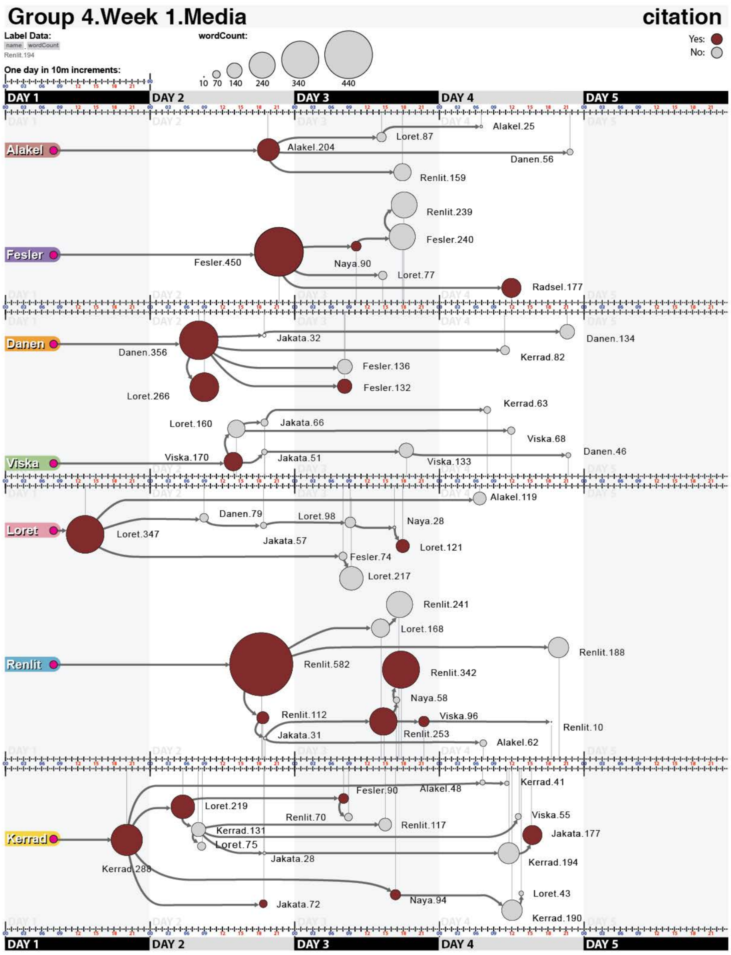


Figure 9. Graph timeline representation of a single week's discussion over a period of four days, in ten-minute intervals, coded for use of citations.

That subgraph serves as the foundation for further exploration, analysis, and visualization. While the graph structure of an individual author's response corpus is a simple, hub-and-spoke structure, the recursive, branching structure of a discussion thread requires a more complex traversal that, when expanded to return all threads associated with a collection of discussion prompts, yields a visualization like that shown in Figure 8.

While this early test visualization reveals notable structural differences across threads, and maps an intriguing geography of citation usage, the elements of time, authorship, and conversational content are notably absent. We will address time and authorship here, and explore content more closely in 8. RQ3 FINDINGS.

We had neither the resources nor the inclination to approach the problem of time-based graph visualization programmatically in the early phases of our research, and existing tools were too constraining. We therefore took an exploratory, design-based approach to modeling conversational graph structures in time, and performed it on a small data set to help us begin thinking about the problem. This visualization approach maps conversational terrains in a way that attempts to capture network structure, individual response attributes, attribute trends, and individual participation patterns over time.

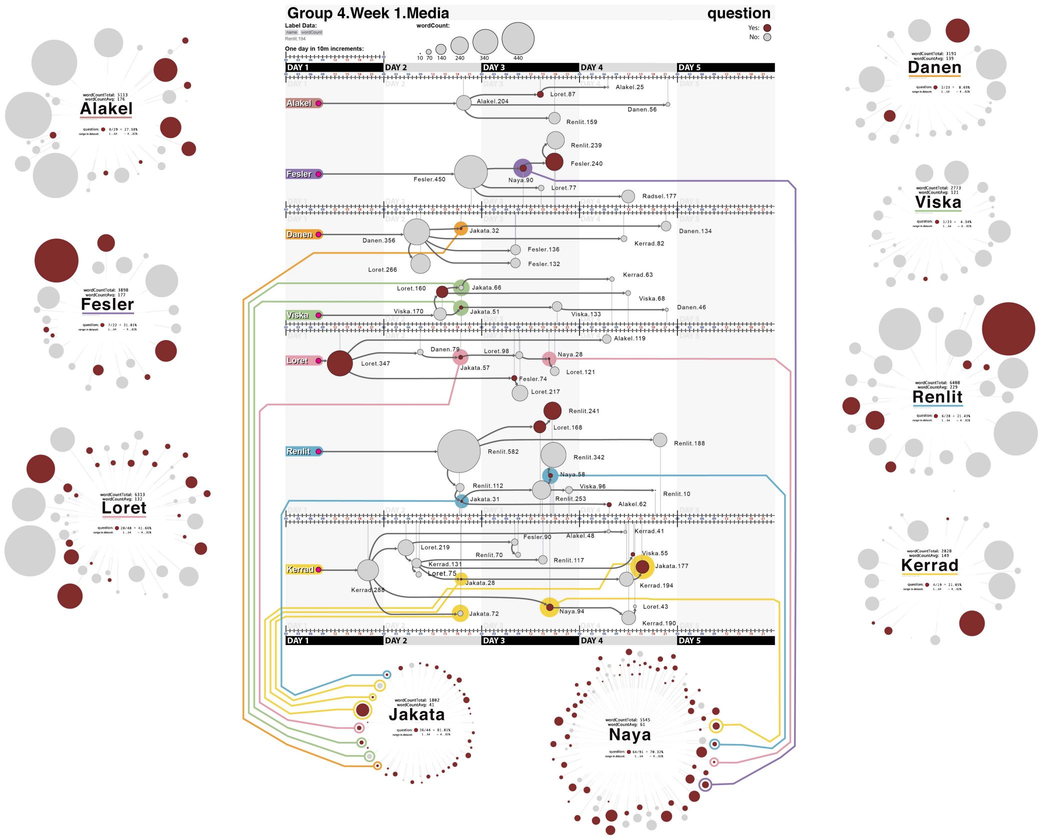
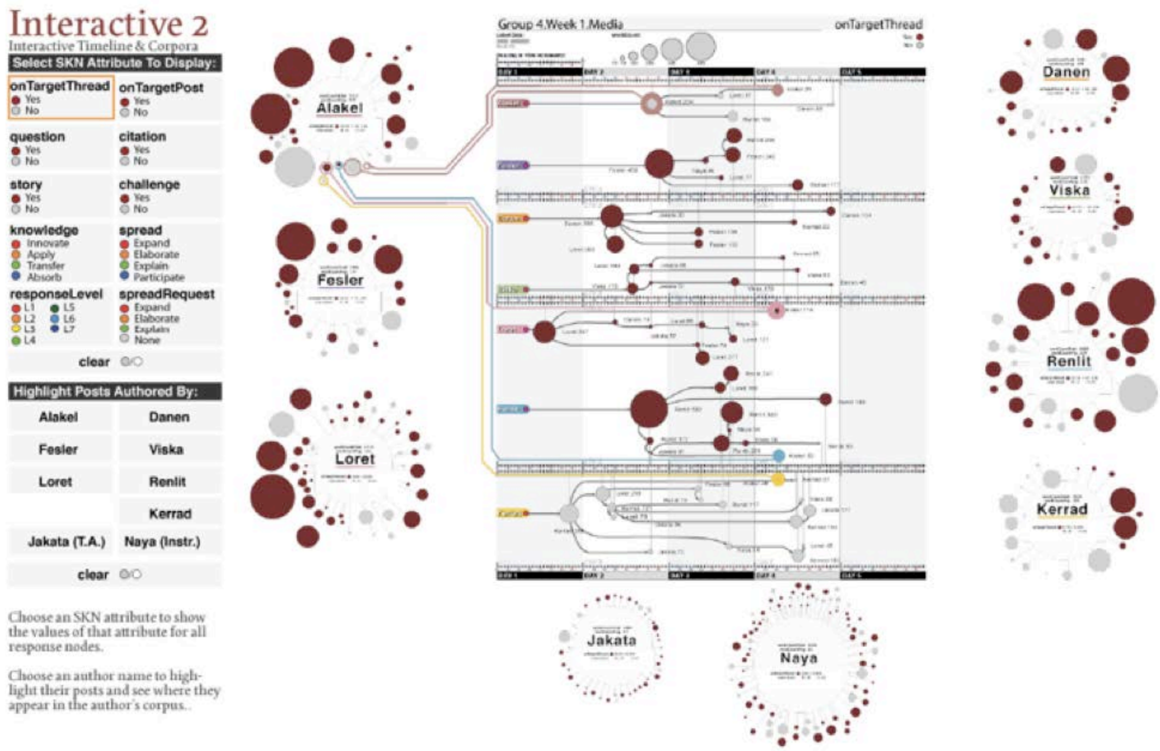


Figure 10. A sample view of the discussion shown in Figure 9, with author corpora added.

First, we used Gephi to size, color, lay out, and export the threads to SVG format, and imported to Illustrator layers, as described in 6. RQ1 FINDINGS. We arranged response nodes along a horizontal timeline of the week's discussion based on timestamp data, and labeled nodes with key data points such as author name and wordCount. We could then turn on or off the layers containing color-coded versions of the nodes, to reveal how the values of automated and hand-coded response attributes relate to the combined temporal and graph-structural model of a conversation.

Figure 9 shows the resulting visualization for one week of discussion. Next, we wanted to consider each participant's corpus as a context for their contributions to specific conversations. We added corpus diagrams around the timeline, and connected each timeline response to its position in the author's corpus, as shown in Figure 10.

In this visualization, each thread is assigned a color. Each response in the thread is circled in the same color, and a line of that color connects the response to its position in the author's corpus. This allows us to see, for example, how typical a comment is for that author with respect to size, quality, use of questions, depth in the discussion tree, etc. In addition, the colored lines emanating from a corpus diagram provide a quick view of the extent to which that author is participating in each of the week's threads. For example, Danen contributes two comments to Danen's own thread (orange), and one comment each to Alakel's, Viska's, and Loret's threads (brown, green, pink). These



Interactive 2. Discussion Timeline and Corpora

connections provide entry points for analysis of the structure and evolution of conversations across the data set. Interactive 2 enables you to browse a week of discussion data interactively, creating custom views like that shown in Figure 10. For example, you can turn on and off various SKN attributes, overlay connector lines, and explore participation patterns, structural elements, corpus statistics, and response typicality with respect to author corpora.

This is a good example of a tool that could be automated to give instructors quick and insightful views into ongoing conversations, enabling them to choose where and when to interact to best effect. Such a tool would provide an intuitive, visual way to explore and compare response attribute distributions, temporal patterns of interaction, conversation structural properties, an individual's influence on a conversation, or the possible impact of conversational features or events on subsequent discourse.

The DiscussionRank Metric For Conversational Influence

Graph traversals for reasoning about recursively-branching response trees will necessarily be more complex than those we used to investigate the simple hub-and-spoke structure of the response corpus. One excellent example of a graph structural property for measuring participation and influence in a threaded discussion is the DiscussionRank measure devised by Marko Rodriguez of Aurelius, as part of Aurelius' engagement with Pearson on this study. Roughly inspired by Google's PageRank algorithm, DiscussionRank measures author influence on a discussion thread based on a count of responses generated,

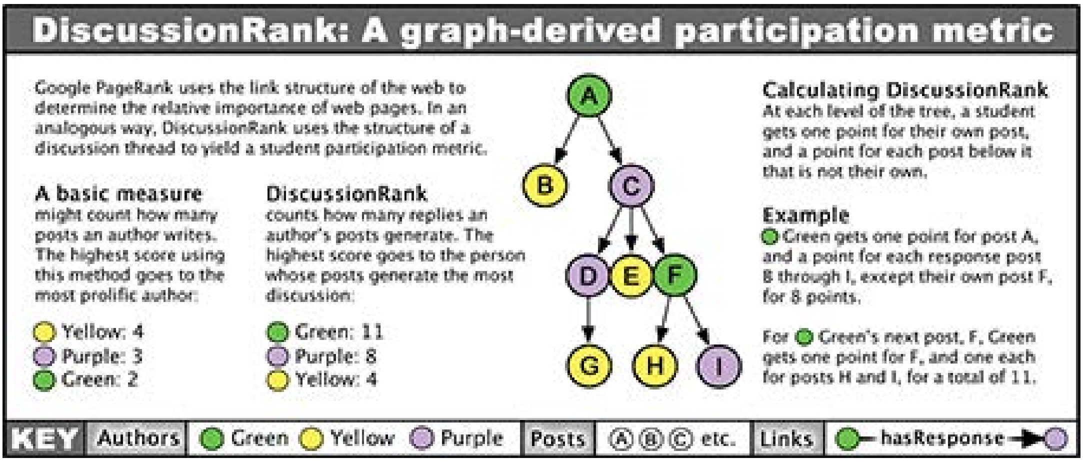
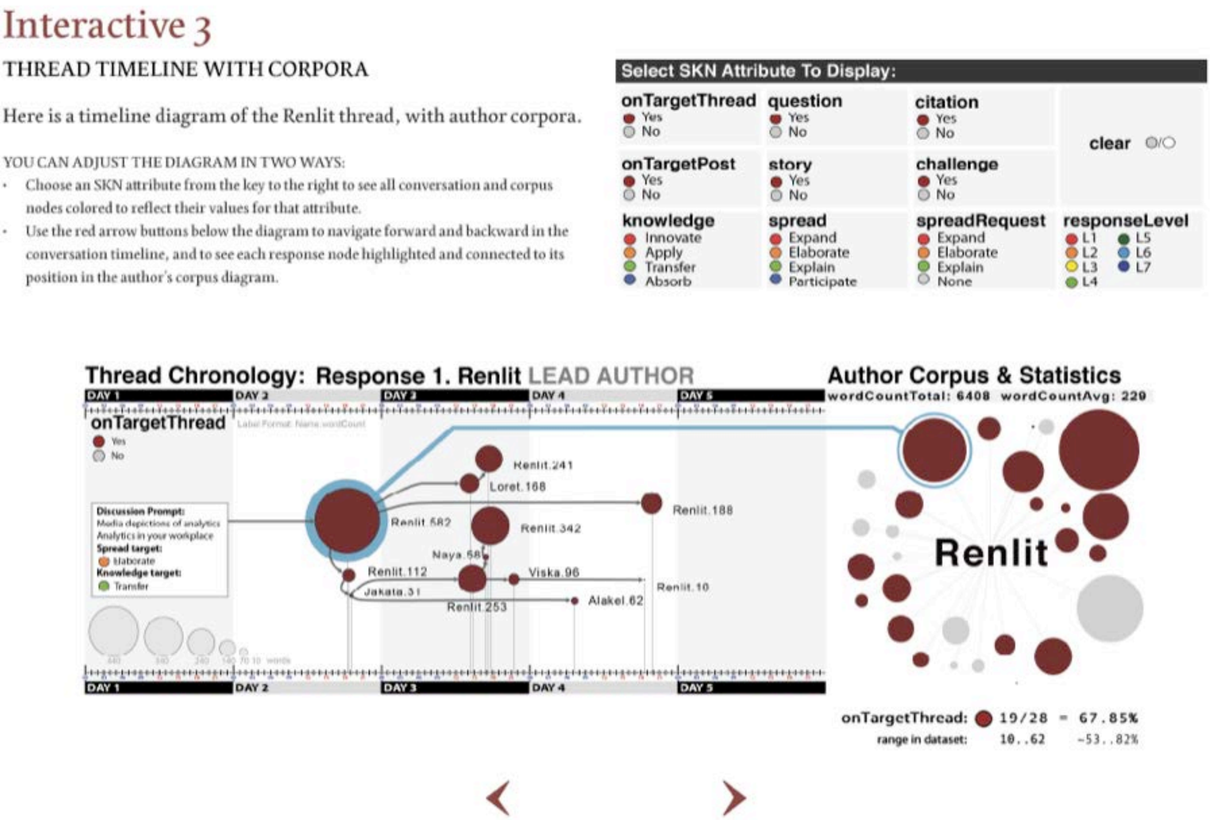


Figure 10. A sample view of the discussion shown in Figure 9, with author corpora added.

with a diminished weight for the author's own posts. At each level of the tree at which an author posts, they are assigned one point for their own post, and one point for each subsequent response that is not their own. The process is repeated until there are no more posts by that author in the tree. For a given thread, a person with a higher DiscussionRank score can be said to have generated more discussion than a person with a lower score. This metric does not claim to evaluate the quality or relevance of discussion. Just as PageRank (Page et al, 1999) considers a link to a web page as a vote of importance without otherwise judging the quality of the page, DiscussionRank considers a response to be a vote of importance for a conversation. The resulting metric serves as a consistent, replicable yardstick for investigating what happens when multiple individuals enter into conversation together, and against which we can compare other quantitative and qualitative measures. Figure 11 describes the DiscussionRank counting method. In the example shown, DiscussionRank flips the 'scoreboard' upside-down as compared with a basic measure based on the raw number of posts an author contributes.

In its basic application, DiscussionRank is assigned to a person: the author of the initial post. Thus we could compare Renlit's thread to Kerrad's thread (as we will do in 7.3. RQ2 Example), to assess which author's thread produced the most discussion activity. However, this metric can be extended and repurposed in interesting ways. First, the initial response node need not be the lead post. Imagine that both a student and a teacher post questions at the third level of a thread. One could measure DiscussionRank from each point to determine which person's post generated the most subsequent discussion. One could also analyze data over longer periods of time, in various situations, and under different activity structures, to see which individuals are more or less highly ranked under specific conditions. Secondly, DiscussionRank can measure not only the generative



Interactive 1. Thread Timeline with Corpora.

influence of an author on a conversation's structure, but also the influence of particular conversational features on a discussion, with or without regard to the author. For example, imagine that instead of counting DiscussionRank from the first post in a thread and comparing thread scores, we count from each post that includes a citation, and compare cited resource scores. If the DiscussionRank score after a citation to Resource A is calculated at 3, and the score subsequent to Resource B is 5, then Resource B could be said to have generated more discussion than Resource A. This method could be applied to other conversational features as well to help investigate their impact on conversation.

C. RQ2 Example: Chronology of a thread with author corpora

Our sample discussion data is from Group 4, Week 1, in response to a discussion prompt that assigns learners to discuss depictions of predictive analytics in the media, and to describe how predictive analytics could be or are used in their workplace. We will examine the thread for which Renlit is the lead author and posts seven times, with three other students and two instructors posting once each.

This thread is characterized by a strong primary line of discussion between the lead author and two instructors, in a question-answer-question-answer structure.

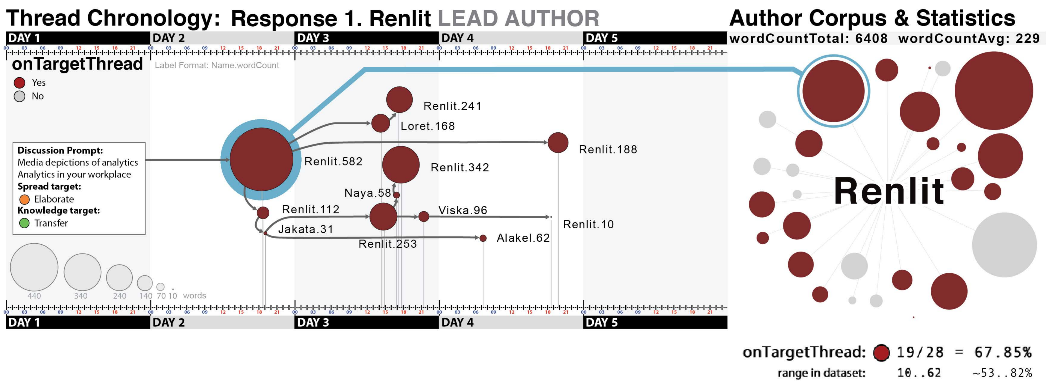


Figure 12. Thread Chronology. Response 1.

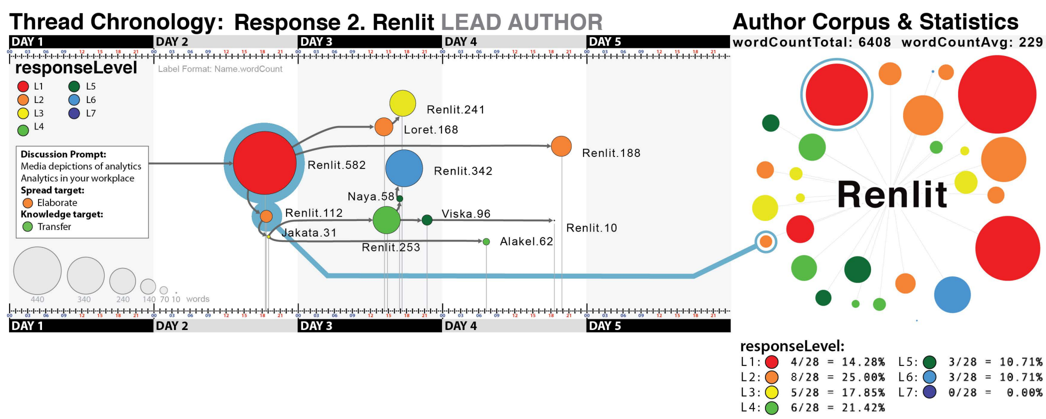


Figure 13. Thread Chronology. Response 2.

We will explore the main line of conversation here. There is another question-answer exchange with a fellow student, two less impactful side interactions, and a summative post by the lead author. These can be explored in detail using Interactive 3.

The following figures describe and illustrate structural, temporal, and SKN attributes of responses in the example thread. For context, we also provide some minimal narrative on the content of the conversation, based on our digital-ethnographic analysis. Rather than move through the entire thread chronologically, we will cover the main body of the conversation here, and leave other responses for discovery in Interactive 3. In the section on 8. RQ3 FINDINGS, we will use a concept graph to examine the actual content of the thread in more detail.

Renlit opens this thread with a detailed description of a media piece focused on analytics, as well as an in-depth description of analytics in the wine industry. The wine industry example contains anecdotes from Renlit's own experience, so this response was coded as containing a personalStory (Figure 12). Renlit's corpus diagram indicates high usage of personalStories across all threads – the highest proportion in the data set – and we can see that Renlit tells stories in most of the posts on this thread.

Figures 14, 15, 16, and 17 are presented sequentially for comparative purposes.

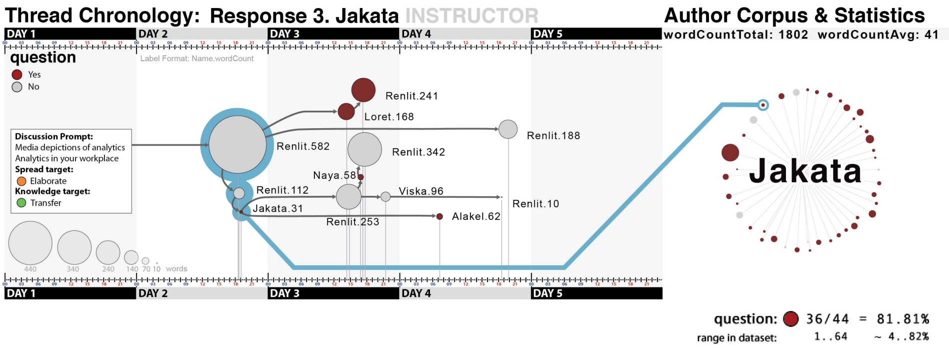


Figure 14. Thread Chronology. Response 5.

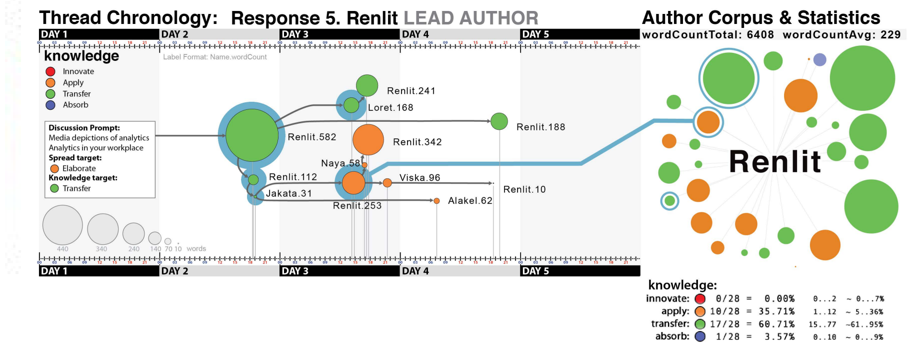


Figure 15. Thread Chronology. Response 6.

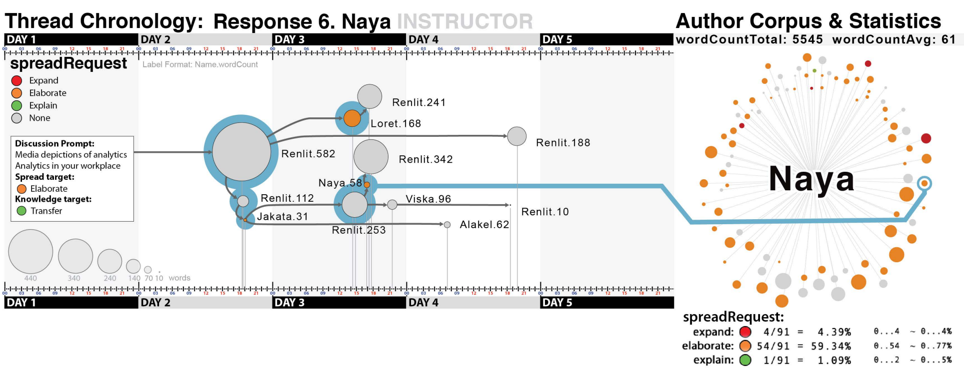


Figure 16. Thread Chronology. Response 3.

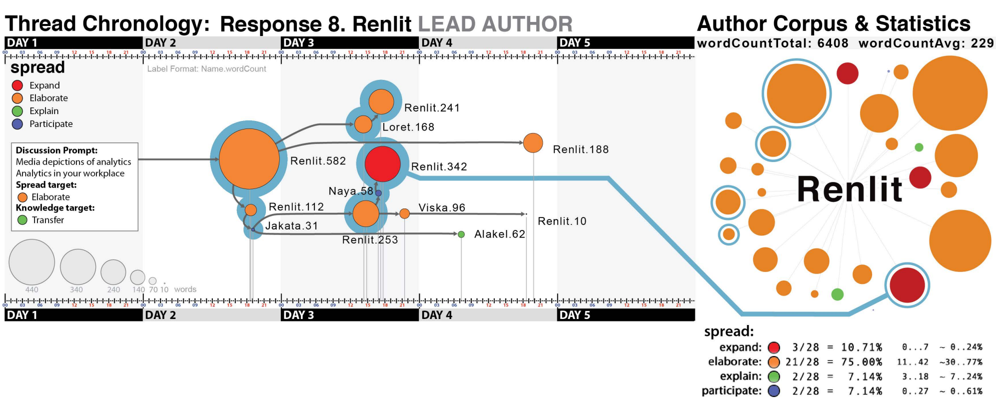


Figure 17. Thread Chronology. Response 8.

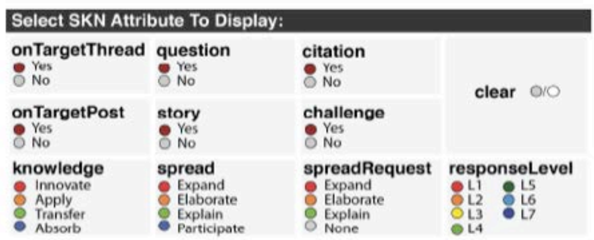
Interactive 3

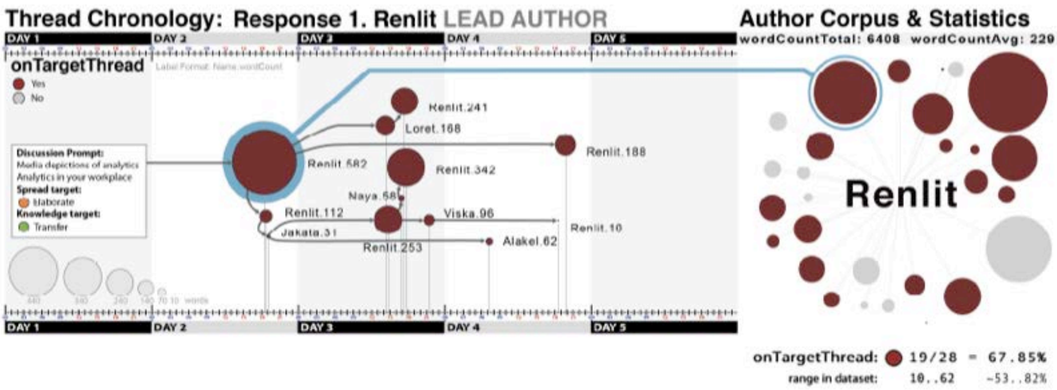
THREAD TIMELINE WITH CORPORA

Here is a timeline diagram of the Renlit thread, with author corpora.

YOU CAN ADJUST THE DIAGRAM IN TWO WAYS:

- Choose an SKN attribute from the key to the right to see all conversation and corpus nodes colored to reflect their values for that attribute.
- Use the red arrow buttons below the diagram to navigate forward and backward in the conversation timeline, and to see each response node highlighted and connected to its position in the author's corpus diagram.





Interactive 3. Thread Timeline with Corpora. onTargetThread chosen for Response 1.

In Response 2, Renlit responds to Renlit's own lead post with another media example. In the corpus diagram for responseLevel (Figure 13), we can see that Renlit's three longest posts are first-level responses, in keeping with the first-level post in the current example (Renlit.582). Response 2 (Renlit.112) is in the lower tier of Renlit's second-level responses by wordCount.

Renlit responds to Naya's question/spreadRequest nudge with another detailed explanation of analytics applications in the wine industry. Figure 17 illustrates that while most student posts in this thread are coded at topicSpread=Level 3/Elaborate, Renlit's final response in the question-and-answer chain with Jakata and Naya increases to topicSpread=Level 4/Expand. By this point, the conversation has become a technical and specific discussion between the lead author and the two instructors. It is interesting to note that both instructors have nudged the lead author deeper into material from the lead post, but neither has explicitly attempted to open the discussion to other participants.

Comparative Thread Analysis

We can compare and differentiate individual thread graph timeline diagrams just as we can individual corpus diagrams. Figure 18, Figure 19, and Figure 20 compare the now-familiar Renlit thread to the Kerrad thread, which took place simultaneously in the same discussion group and is pictured at the bottom of Figure 10. Figure 18 shows instructors Jakata and Naya each asking short, prompting questions (spreadRequest=Level 3/Elaborate) of both lead

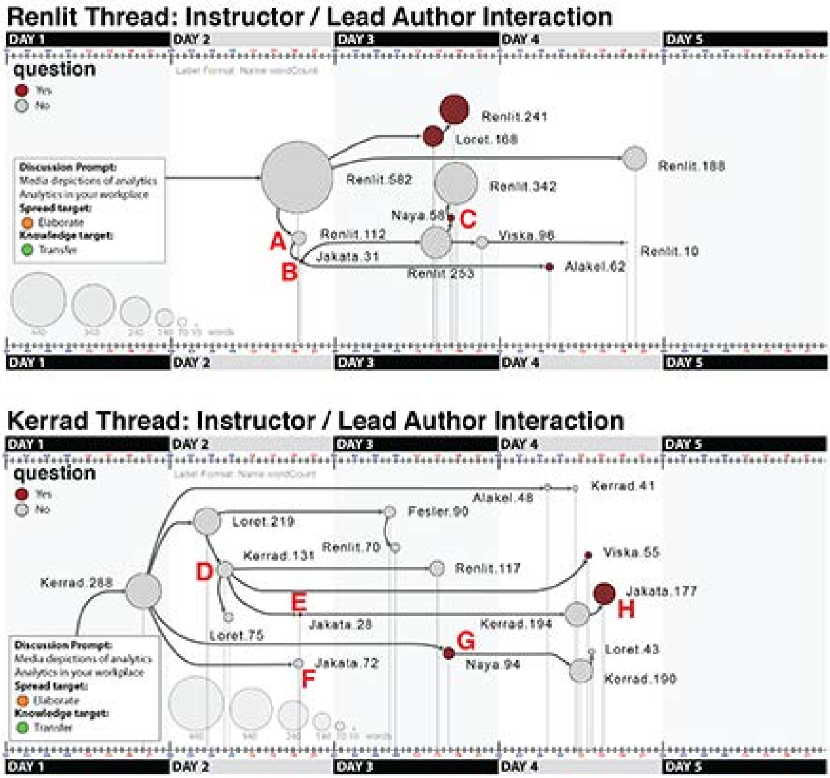


Figure 18. Comparison of Renlit and Kerrad Threads – question.

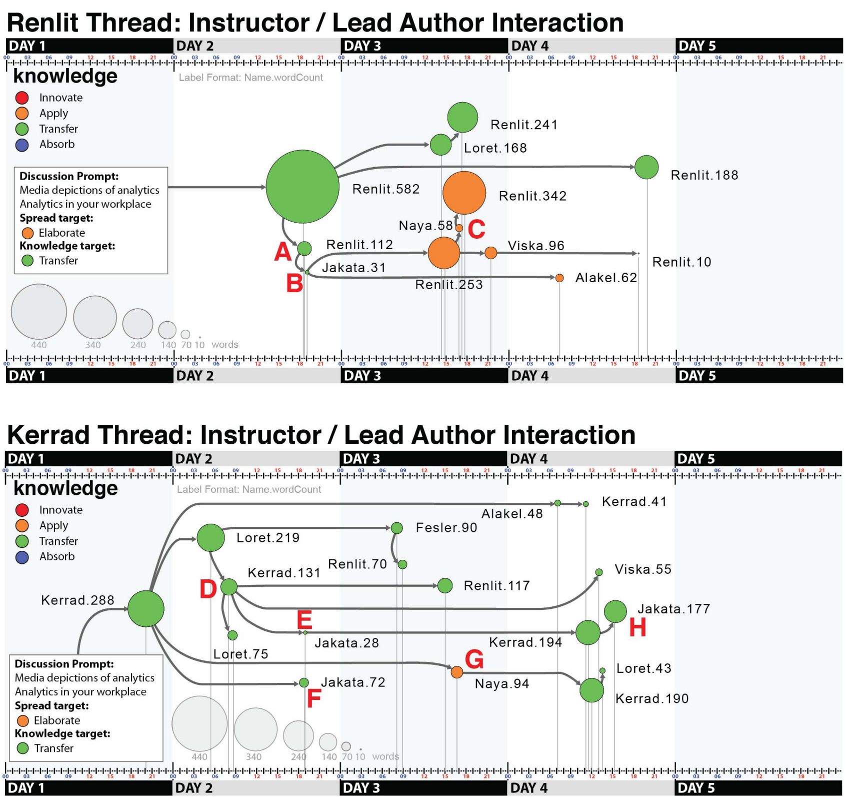


Figure 19. Comparison of Renlit and Kerrad Threads – knowledge.

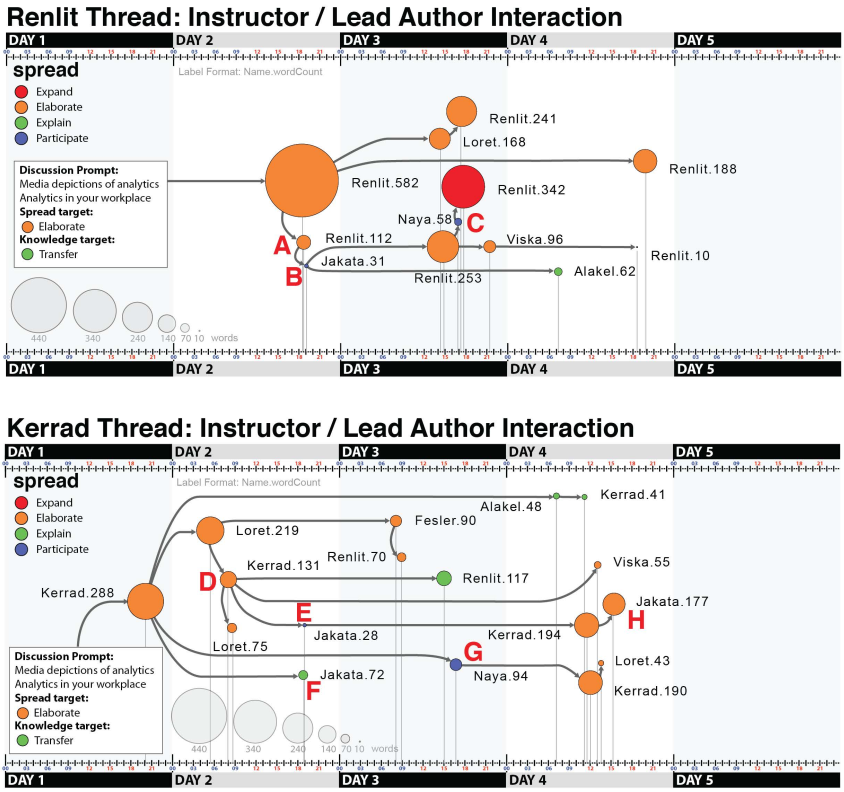


Figure 20. Comparison of Renlit and Kerrad Threads – spread.

authors, at the same time in each thread (points B and E for Jakata, and points C and G for Naya). Despite the similarity of the interventions, the subsequent values for topicSpread, knowledgeActivity, and DiscussionRank are distinct for each thread.

Figure 19 shows an increase in knowledgeActivity subsequent to Jakata's question at B, with no change after the partner post at E.

Figure 20 shows topicSpread increasing to Level 4/Expand after Naya's question at C, but no change after the partner post at G.

As a final point of comparison, we can use discussionRank to assess the generative influence of individual questions on subsequent discussion (see Figure 11 for an explanation of how to calculate discussionRank). For example, Jakata's discussionRank score is 7 at point B, and 3 at point E. The differences in knowledgeActivity, topicSpread, and discussionRank values for Jakata's questions at B and E signal some variation in influence, even given the similar instructional questioning strategy. There could be many reasons that similar interventions in similar contexts would produce varying results. In the case of the Kerrad thread, Kerrad expresses initial apprehensions about statistics and analytics. As a result, the responses from the rest of the group are focused on helping Kerrad to understand analytics in the context in which they were presented. By contrast, the Renlit thread is more focused and technical in nature. The Kerrad conversation remains more static at a level of explanation, whereas Renlit's thread shows more change. The ability to perceive such trends and distinctions in conversations using a set of familiar metrics could help instructors more effectively engage with, assess, and support learners in online social spaces.

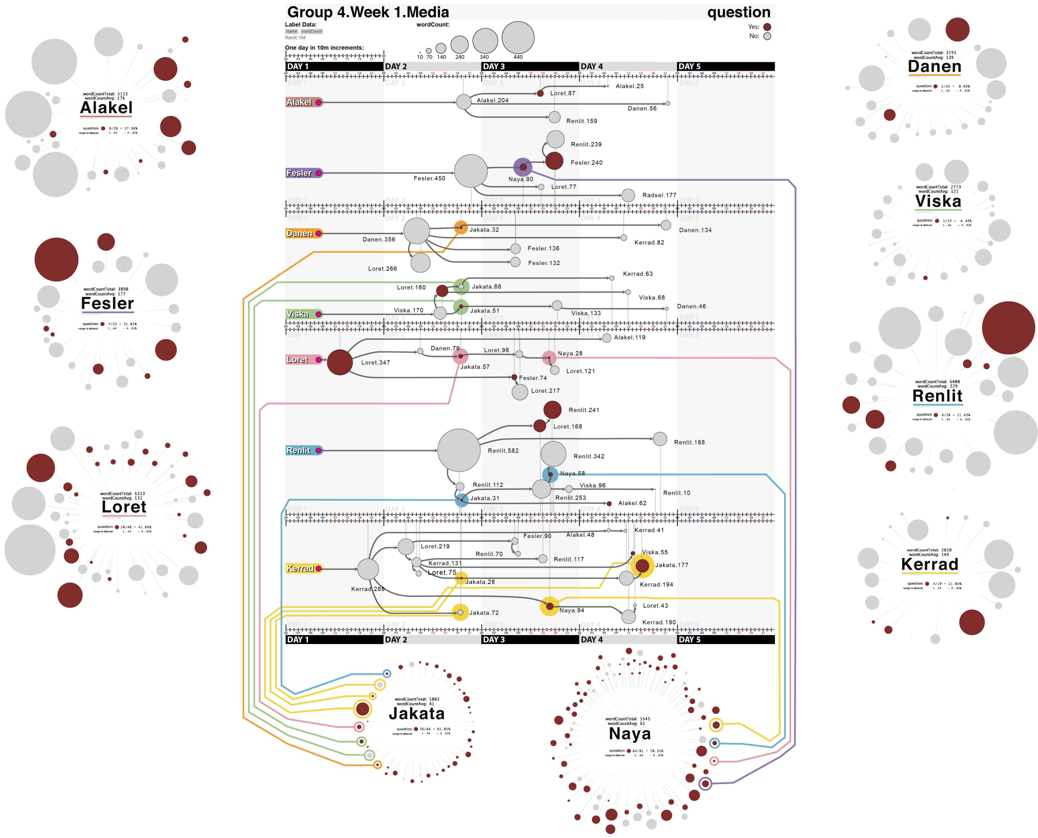


Figure 21. Group 4. Week 1. Media

D. RQ2 Discussion

The thread graph timeline visualization allowed us to see the corpus data in context, revealing both how individual attributes are expressed in a conversational context, and how others responded to these behaviors.

The timeline also helped us to see phenomena that were clear in neither the corpus visualizations nor the LMS discussion board display. For example, we have commented above on the influence of Jakata and Naya's successive questioning on the evolution of the thread. But also note the pattern of instructor participation across all threads in this week of discussion, highlighted in Figure 21.

Jakata's question is one of several of similar format posted across multiple threads within a 20-minute period on the evening of Day 2. Based on the data for the entire week, and taking into account Jakata's corpus diagram, this short, targeted nudge for elaboration appears to be a templated strategy for engaging in and promoting discussion. Naya appears to employ a similar approach, only later in the week. Note that the Alakel and Fesler threads at the top of Figure 21 are not yet extant during the time Jakata is posting, and Jakata never returns to post in those threads. The ability to identify this pattern does not necessarily invalidate the approach. Indeed, it appears to work fairly well for Renlit in this case, as a validation of Renlit's examples and as encouragement to use personal and professional experience as tools with which to engage with course concepts. But does the strategy work consistently in varying contexts, and for students who post at different times? And what of the other student participants? What strategies might an instructor employ to bring others into a discussion that centers around a participant's particular area of expertise? What more might an instructor be able to do with tools that support the ability to navigate, understand, and participate effectively in an unfolding discussion? We hope future research in this area will begin to address these and other questions, in service of improving effectiveness, efficiency, and engagement around social and cooperative learning activity in online environments.

Recall from our discussion of corpus data that we noted the consistency of instructor responses. The timeline data provides some insight into the impact of this consistent behavior. We used the binary attribute onTargetPost, for example, to search for instances where an instructor response to an off-target post led to a subsequent on-target post. In the case of the avowedly small data set we queried, this event took place only twice over three weeks of discussion. This points to a need for more effective instructor responses—assuming that onTargetPost is a valued attribute for a given context. Assessing the best response type for given post characteristics is another layer of future research that could emerge from this approach.

The timeline visualizations also helped us to recognize flaws in the structure of discussion activities. For example, a typical assignment asks students to respond to an initial prompt and then to post responses to a set number of other students. Yet the data suggest this type of activity structure leads to sprawl. For the week visualized and discussed in 7. RQ2 FINDINGS, a single prompt leads to 24 unique endpoints. This highlights the fact that 'social' learning assignments should be clear about the goals of conversation—converging, diverging, problem-solving, etc.—and specify writing activities that guide students towards these behaviors. We might even come to recognize particular data fingerprints associated with different social and cooperative activities, and distinguish between their more and less successful forms.

VIII - RQ3 Findings: Can we identify and visualize content focus over time in an online discussion or course?

A. RQ3 Conceptual Overview

We felt it was critical for our model to surface important concepts in a conversation, how the concepts are related to each other, and how they change over time. The topicSpread score provides one method of tracking changes in content over time: a rising or falling trend in the topicSpread scores for successive discussion responses can provide a sense of the degree of topical expansion or stasis in the discussion. However, topicSpread remains a numerical score, yielding no information about the actual topics under discussion. It is also a subjective, manually-applied score at present, and could be difficult or computationally expensive to replicate automatically. Below, we describe our initial efforts to understand the topical evolution of a conversation over time, including an examination of the discussion concepts themselves, as extracted using NLP and situated in our graph schema.

A. RQ3 Conceptual Overview

We began our investigation of topical focus using exploratory visualizations. We used our Gremlin DSL to extract discussion graphs that contained response nodes and concept nodes, and their connecting edges (re-

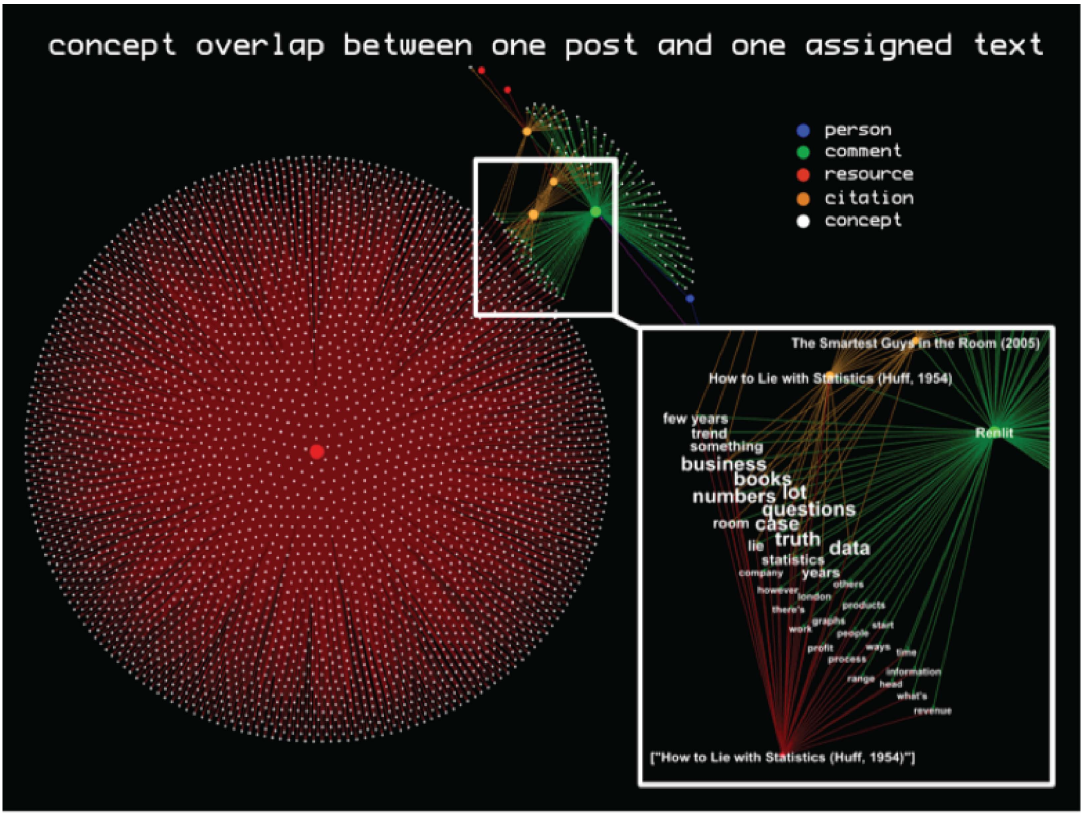


Figure 22. Concept Overlap Between One Post and One Assigned Text.

sponse--mentions-->concept). For some visualizations, we also added person, resource, and citation nodes. The addition of resource nodes, for example, allowed us to see the overlap between student-mentioned concepts, and concepts in assigned reading material, as shown in Figure 26. We applied force-directed layouts, with concept labels sized by the number of responses mentioning them (concept InDegree). Based on a close reading of the Renlit thread, we determined that the four major concept categories under discussion were Media, Analytics, General Business, and Wine. We then assigned each concept to one of those four categories, or left it unlabeled. The categories are color-coded, so that the resulting visualization (Figure 23 and Interactive 4) provides a rough understanding of the mixture of topic areas covered in each response. Unlabeled concepts were omitted from this visualization for simplicity.

While this approach to understanding topical focus admittedly has its attendant flaws and assumptions, we believe this kind of diagram can provide some insight into how we might gauge the prominence of individual concepts in a conversation; the categories of concepts under discussion; the emergence, progression, and disappearance of concepts over time; and the degree to which each participant contributes to discussion around a particular concept. The visual elements are underpinned by real graph relations, amenable to counting and interpretation by algorithms. One improvement we intend to make in ongoing work is to relate the discussion concepts to an ontology of the course domain, with the goal of understanding conversational content against the conceptual structure of course content.

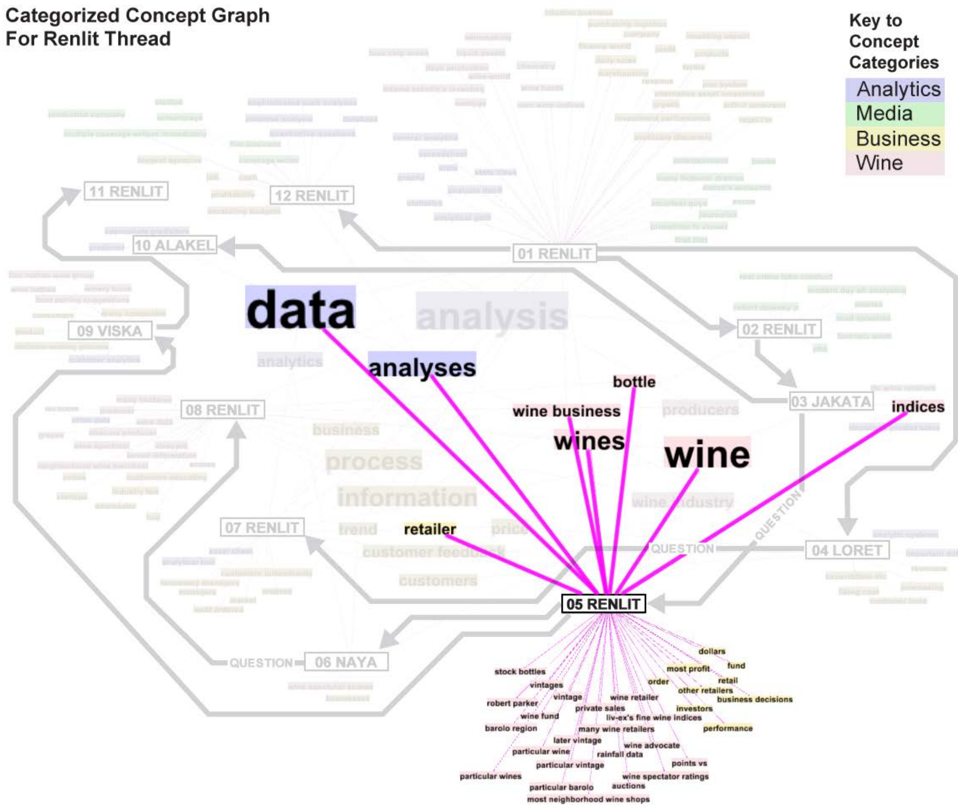
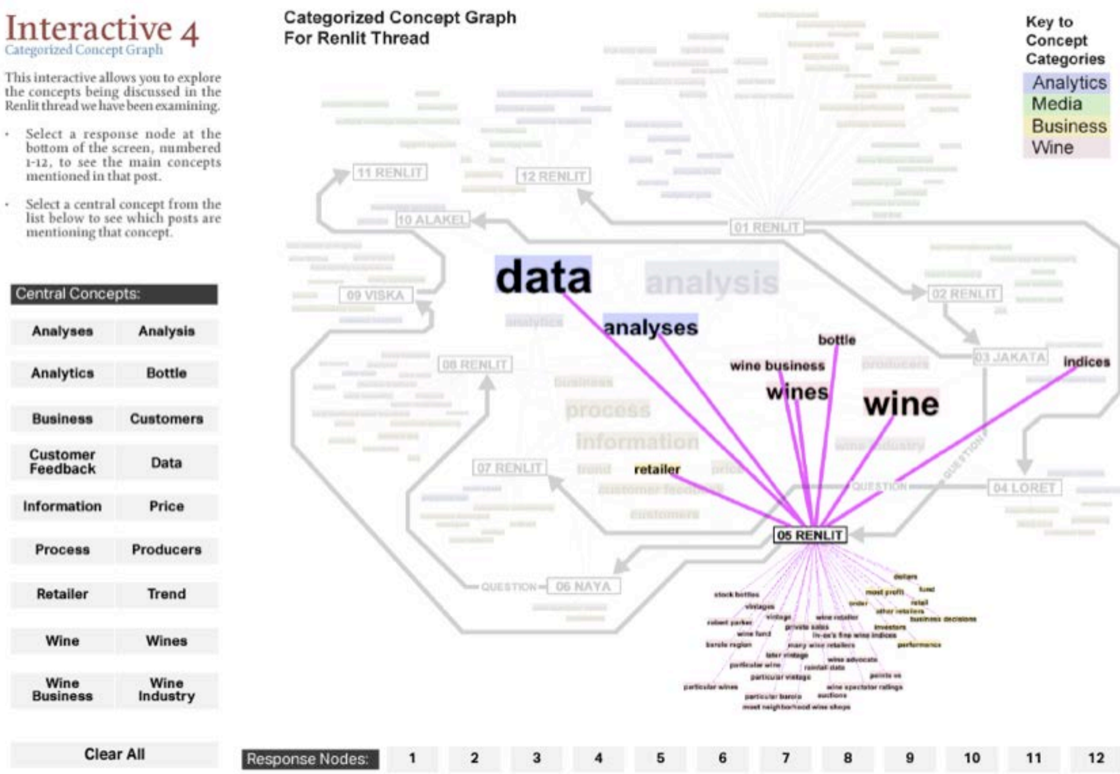


Figure 23. Categorized Concept Graph for Renlit Thread.



Interactive 4. Categorized Concept Graph showing Response Node 5.

C. RQ3 Example: Concept Progression and Concept Overlap

Below, we illustrate two approaches we used to explore topic focus over time: 1) Categorized concept progression; and 2) Concept overlap. We revisit Renlit's thread from 7.3 RQ2 Example, in which Jakata and Naya ask successive questions that lead Renlit to delve deeply into the technical applications of analytics in the wine industry. The discussion prompt assigned students to discuss media depictions of predictive analytics, and to describe how analytics are used or might be used in their own work or industry. Figure 22 shows the graph-based chronology for the Renlit thread from 7. RQ2 FINDINGS, for reference. Each response node is numbered chronologically, for easy comparison with the categorized concept graph in Figure 23.

Concept Progression

Figure 23 illustrates a categorized concept graph for a single discussion thread, with Renlit as the lead author. The twelve responses are arranged in a circle, each labeled with its chronological order in the discussion, and the author's name, ascending clockwise. 01 RENLIT is the first post, and 12 RENLIT is the last. The grey arrows describe the response tree structure, and indicate where questions are present. Edges are drawn between responses and the concepts they mention. If a concept is only mentioned in a single post, it floats to the outside of that post. If a concept is mentioned in multiple posts, it floats to the middle and is sized according to the number of posts that mention it (concept InDegree). We will call these multiple-connected concepts the 'central' concepts, and take them as a high-level representation of discussion content for purposes of analysis. You can explore the concept graph diagram interactively in Interactive 4. Select response nodes and central concepts in succession to get an idea of who is talking about what, and how much.

In 01 RENLIT, Renlit opens the conversation with a broad post covering all four main concept categories, including some media depictions of analytics, and a detailed example of analytics in the wine industry. The post is judged onTargetPost=true. After Renlit quickly follows up with another media example in 02 RENLIT, we are presented with three question-and-answer pairs, as shown in Figure 24. Renlit responds individually to questions from Jakata (03), Naya (06), and Loret (04).

In 7.3. RQ2 Example where we color-coded the timeline diagram for questions, spreadRequests, topicSpread, and other attributes, we pieced together the influence of Jakata and Naya's questions on the evolution of the thread. Now that we are able to view the categorized concept graph of the thread, we can see lexical clues to the content of these questions and their responses. For example, the digital ethnography indicates that 03 JAKATA poses a question about the use of indices in the wine industry. Note that the dominant Wine concept category (red) in Jakata's question appears to carry over into 05 RENLIT, where Renlit answers Jakata's question. We see a large cloud of new wine-related concepts connected to 05 RENLIT, including particular wines, vintages, stock bottles, rainfall data, neighborhood shops, Liv-Ex's fine wine indices, and Wine Spectator ratings, mixed in with some business-related concepts such as business decisions, investors, profit, dollars, and retail. The post also connects to several central concepts, including wine, wine business, bottle, data, and retailer. Analytics and Media concepts are absent. When we look at the distribution of concept categories over

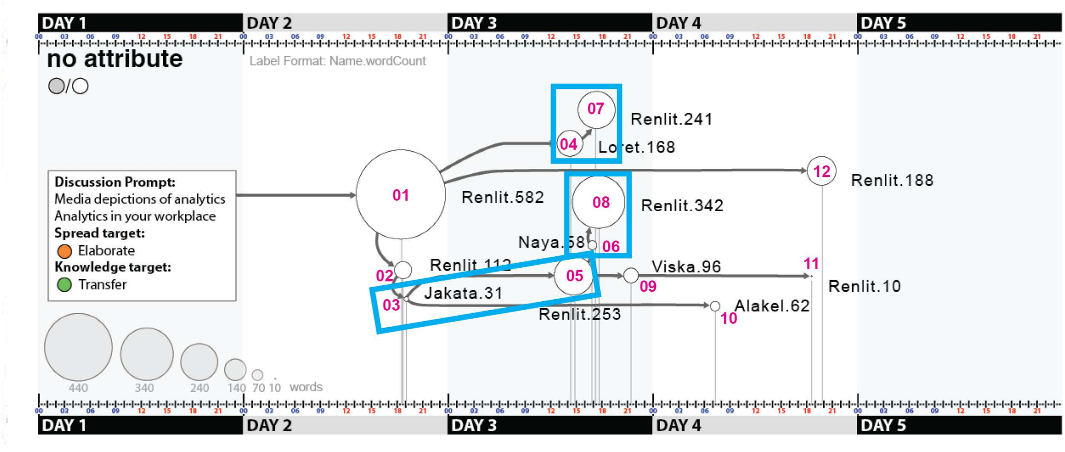


Figure 24. Question and Answer Pairs in Renlit Thread.

time, we can easily imagine that by focusing on Renlit's professional domain of wine distribution, rather than on the media depictions, Jakata's question has acted as a sort of conceptual filter that helps to shape and guide the subsequent conversation. Naya's subsequent question in 06 NAYA also focuses on wine, seeming to reinforce the effect in 08 RENLIT, where we again see Wine concepts dominate. We see a similar effect, in different concept categories, between Loret's question in 04 LORET, and Renlit's response in 07 RENLIT. Both responses are dominated by the blue and yellow Analytics and Business categories, with no reference to Media, and with some reference to Wine by Renlit.

Now, we can combine our insights from the timeline diagrams in 7.3. RQ2 Example and from the categorized concept diagram in Figure 23 and Interactive 4. 03 JAKATA, 04 RENLIT, and 06 NAYA all contain questions, and all issue a spreadRequest of Level 3/Elaborate. In each case Renlit's response contains a personalStory, and the topicSpread score for the response either meets or exceeds the requested topicSpread level (see Figure 17). And in each case, the dominant concept categories in Renlit's response match the dominant categories in the question. This appears to support a hypothesis that questions can act as important inflection points in a discussion, and indicates potentially interesting ways of finding and surfacing those inflection points to enhance learning and instructional effectiveness.

To round out our description of this thread with respect to topical focus, let's look at responses 09-12, in Figure 23 or in Interactive 4. In 09 VISKA, Viska contributes a short post describing the Lion Nathan Group's QR codes, in case Renlit is not aware of this. Note that this post, and Renlit's thank you note in post 11, are the only posts in the thread that do not mention any of the larger, central concepts. Alakel's post 10 ALAKEL is a short comment on analytics, which connects to only one central concept – data – and receives no reponse. Another interesting feature of this thread is Renlit's summative post, 12 RENLIT. Here, Renlit retreats from the increasingly technical narrative, and resets the topical focus to the Media, Business, and Analytics concept categories. The digital-ethnographic data indicates that Renlit is returning to the discussion prompt to ensure the thread overall has met the assigned goals. It is interesting to note that although Media concepts feature prominently in three of Renlit's seven posts,

	Total Central Concepts Mentioned	Ratio to Total Concepts	Ratio to Central Concepts Only	Wine-Related Central Concepts Mentioned	Ratio to Total Concepts	Ratio to Central Concepts Only	Business-Related Central Concepts Mentioned	Ratio to Total Concepts	Ratio to Central Concepts Only	Analytics-Related Central Concepts Mentioned	Ratio to Total Concepts	Ratio to Central Concepts Only
Renlit	18	0.110	1.000	6	0.037	0.333	8	0.049	0.444	4	0.024	0.222
Jakata	1	0.006	0.056	1	0.006	0.056	0	0.000	0.000	0	0.000	0.000
Naya	3	0.018	0.167	1	0.006	0.056	1	0.006	0.056	1	0.006	0.056
Viska	0	0.000	0.000	0	0.000	0.000	0	0.000	0.000	0	0.000	0.000
Loret	4	0.024	0.222	0	0.000	0.000	3	0.018	0.167	1	0.006	0.056
Alakel	1	0.006	0.056	0	0.000	0.000	0	0.000	0.000	1	0.006	0.056

Figure 25. Question and Answer Pairs in Renlit Thread.

no other participants mention Media concepts, and none of the thread's central concepts are Media-related. Nonetheless this thread was judged as onTargetThread=true, perhaps due to the deep dive into Renlit's professional experience, which was also part of the assignment.

D. RQ3 Discussion

The early topical focus visualization shown in Figure 23 was time-intensive and involved a number of manual steps, but it can serve as a roadmap for automated approaches. The underlying graph structure lends itself to automated data extraction and visualization methods, and can be used as input to statistical, algorithmic, machine learning, mathematical, and other modes of analysis. To illustrate this point, we will outline a simple, example metric for calculating individual concept overlap scores in a discussion.

The conceptOverlap metric emerged from our desire to somehow quantify the ways in which participants are connecting with each other against the backdrop of the discussion's concept graph. It is important to note that in this example we calculate concept mentions by post, not by author. If Renlit is the only participant to mention a concept, but mentions the same concept in multiple posts, the concept score will still increment. Properly weighting and interpreting such factors is an important area for future work.

The basic formula produces the ratio of the number of central (multi-connected) concepts mentioned by a person, to the total number of concepts mentioned in the conversation. To state it in graph terms: for a given author, count the number of concepts the author mentions where the concept InDegree > 1, then divide by the total number of concepts regardless of InDegree. We can also produce these ratios with respect to each concept category, to see how individuals are contributing to the relative prominence of central concepts. ConceptOverlap values for the Renlit thread are provided in Figure 25.

Upon further testing a score like conceptOverlap can be adjusted, weighted, and modified. For example, overlap values could be weighted depending on the number of participants mentioning each central concept, the associated level of topicSpread or knowledgeActivity, or concept relevance as determined by comparison with an ontology of course content.

Also note that conceptOverlap need not only be measured between individual posts. For example, it could also be measured between two individuals over multiple conversations, between an individual and the resources they cite, among members of a group, or among multiple conversations or courses. As mentioned earlier, such metrics could serve as a foundation for content, peer tutor, or study group recommendations. They could also serve to support instructor facilitation, student awareness and engagement, dimensions of assessment, comparative analysis for research, suggested conversational entry points based on personal interests, and more. As one example, Figure 26 illustrates concept overlap between the text of Renlit's lead post, and the text of How to Lie with Statistics (Huff, 1954), an assigned reading cited in the post.

Ongoing work in this area includes automated concept categorization, automated approaches to scoring topicSpread, mapping conepts to an ontology, and linking topicSpread scores to the actual concepts under discussion.

IX - Discussion and Implications for Future Research

The emergence of social tools in educational settings combined with a developing awareness of big data and visualization techniques mark a critical opportunity to develop techniques for collecting meaningful data that enable us to better assess social behaviors in online courses. This area has been previously under-represented in research, and conditions are favorable for us to develop a deeper understanding of the tools and pedagogies that support learning in social and cooperative online learning spaces.

Our research to date details a methodology for capturing individual and conversational patterns present in online Social Knowledge Networks. And although we are encouraged by the findings so far, we have gone deep but not broad. A more rigorous examination is required to draw clear conclusions about this work.

A. Learning Activity Design

We suggest that the most effective approach for assessing the productivity of a discussion is not a standardized "counting mechanism," but a tailored approach more dependent on activity type. A discussion in which students share their own experiences and engage in interviewing activities should have a different fingerprint than one in which students are working to develop a single solution to a problem. Identifying the anticipated data fingerprints associated with a library of activity types, and their variations, will be a critical step to defining student and instructional strategies for success.

B. Learner and Instructor Strategies

Similarly, whether learner and instructor strategy is effective depends at least in part on our expectations for the discussion.

We can also ask questions about how instructor strategies might vary depending on the students to whom they are responding. This connection, however, relies on us knowing more about the nature of corpora. In particular, does the character of a corpus stay the same across a student's academic career? Or does it change based on the composition of their cohort, their development through a program, or other factors? These questions may lead us to identify new metrics for predicting and supporting team and cohort success, and the ways in which individuals may influence one another over the course of their interactions. If we can begin to measure these influences, we might be able to establish and support successful cooperative and collaborative teams, learning communities, peer tutoring relationships, and more.

C. Tools and Platform

Another area of future research and development concerns Learning Management Systems and other platforms in which learning-focused discussions are hosted. The traditional linear, threaded discussion forum might make the effective facilitation of discussion difficult. Consider the case of Jakata's entry into the week 1 discussion: Jakata responds to all visible posts in a brief timespan but receives no notification of new posts after two new students respond. Further, these new posts are pushed to the bottom of a chronological display, meaning that when Jakata logs in, these responses may not be immediately visible. Rich opportunity lies in investigating the kinds of layouts, signals, entry points, notifications, and recommendations that give rise to more expressive and efficacious social learning environments.

D. Data Science, Automation, and Algorithms

The numerical, categorical, text, and other attributes of each response in a corpus or a discussion are available within the native graph structure of the data for detailed statistical, graph-structural, and other analyses, as well as for visualization. This enables a combination of high-level visual survey and detailed data analysis that we hope can help speed the research-into-practice cycle for online social and cooperative learning environments.

Of course this does not mean we have discovered how to reverse-engineer deep, digital-ethnographic descriptions from course or discussion data. Most attributes for this study were manually coded by human experts. However, if over time we can develop the capabilities to automatically apply some or all of these, or other, codes, we believe it will lead to valuable new ways of designing, describing, navigating, supporting, and evaluating social and cooperative learning activity in online courses at scale. Therefore, the Pearson team continues to evolve, scale, and automate this research-based graph database system for social and cooperative learning and discourse. For example, we have implemented experimental versions of: NLP-based question and citation identification; a preliminary topicSpread metric; a conversation influence metric; an ontology comparison model for understanding conversation concept structures; a measure of response reciprocity among a community of learners and instructors; and visualization components for viewing participant conversations and corpora in ways similar to those presented in this paper. Some of these features are currently available in experimental alpha release form to individual students and instructors using the OpenClass LMS platform, on the Learner Intelligence alpha page.

E. Closing Thoughts

We have suggested here that the confluence of data-driven decisions in education and the proliferation of social media tools make the time right for a deep exploration of how knowledge is constructed in online social learning spaces. Our goal, in particular, was to define a set of individual, conversational, and content-based attributes and behaviors that might support the formation of thriving social knowledge networks.

We have accomplished something of our goal, in that we have been able to identify and visualize trends and behavior in those three areas. We recognize, however, that the work is far from complete, and we hope that this paper serves as a catalyst for additional research into this important, emerging field.

We have described above some major themes and opportunities to guide our—and others'—future research. In summary, we believe the ability to answer these questions may have a transformational impact on institutions' fundamental approaches to teaching and learning. For example:

- Learning to measure and value individual patterns of behavior in the context of discussion and collaborative activities in online courses allows for more holistic assessment of student performance and potentially more proactive and actionable interventions to identify and assist at-risk students.
- Learning to identify, measure, and value conversation patterns in the context of discussion and collaborative activities in online courses, will assist in the development of new pedagogies, course and activity management strategies, and technologies aimed at increasing the productivity and positive impact of these activities in online courses.
- Learning to visualize topic spread and conversation swell around particular topic areas, and to evaluate them against structured concept graphs, will assist in the development of program, course, and activity design, adaptively matching students with helpful content, promoting lifelong learning behaviors, and more.

At the same time, we must be conscious of the ramifications of this work, and remain engaged with concerns and constraints around the use and stewardship of this kind of data:

- Concerns that models and typologies may originate in this kind of research and spur action on measures of student performance that are not yet well understood and that may change across contexts and across time.
- Concerns over reporting (to students, faculty, administrators, and systems) and the creation of records of fine-grained student performance that persist over time, as well as a multitude of other ethics and data privacy issues.
- Recognition that findings will precede mechanisms for implementation, and a commitment to supporting teacher educators, faculty and instructional designers in effectively and responsibly adopting new methods.
- Considering to what extent, when students become co-creators of course content, there should be oversight/monitoring/policing of the flow of information to assure that it is helping students rather than confusing or overwhelming them.

We hope this report will contribute to a responsible evolution of online and blended teaching and learning, through an increased awareness and understanding of the social spaces in which these increasingly occur.

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Some Pearson platforms and technologies referenced in the paper are Patent Pending, U.S. Publication No. US-2014-0272911-A1, and U.S. Provisional Application No. 62/072,932. Patent applications cover underlying methods and technologies relating to surfacing and implementing educational interventions at scale using network-based methods and analytics, not the specific analytical framework described in this paper. The goal is to support a diverse body of research and collaboratively produce work to improve the quality and effectiveness of social learning tools, platforms, and emergent pedagogies.