long way and made our lives much easier.

That being said, I do not anticipate big advancements in LMS going forward. The consolidation of the industry, in my view, is stifling innovation. The focus today seems to be more on acquisitions than on innovations that will improve learning. But hopefully I am wrong!

Like many, I still want my "jetpack." In terms of online learning, the "jetpack" that I continue to desire is a technology that will grade assignments. Though I am partially kidding, I do see grading as a limiting factor in terms of scaling up online learning in order to have a really significant impact. Part of this challenge stems from my beliefs that (a) everyone in the world has a right to a quality education, and (b) a quality education requires the feedback-loops provided through engagement and assessment. Thus, if we are going to offer quality education on a very large scale (billions, not millions) then online learning is likely part of the answer, and it will require efficient systems for offering feedback-loops. Thus, to answer the question, I am disappointed that we have not made more progress in this area over the last decade.

10. Let's just talk about the usefulness of some ancillary or adjunct aids—Skype, Second Life—what is the good, the bad, and the ugly about these aids or ancillaries?

In my view, most tools can be valuable in the right context. Skype, for example, is an exceptional tool for when I want to speak with a number of students, especially if some of them are far away. It is reliable and simple to use. Google Hangouts has some excellent features, but it is more complicated to use and less reliable, in my experience.

11. What have we neglected to ask?

I love this question and often end needs assessment interviews with it. There are two projects that I would like to mention, since your readers might find them interesting. The first relates to my primary research focus— needs assessments. I manage the Website *www. NeedsAssessment.org*, and on the site I curate a host of resources on the topic. Everything from short lessons-learned videos created by my students and interviews with learning experts, to continually updated bibliography pages on the books, articles, and theories of needs assessment.

The second project is *www.WeShareScience.com* . This project evolved out of my interest in reading research from varied disciplines but not always enjoying the complexities of research articles when I really just wanted the summary. After discovering that many research journals are now asking authors to create short video abstracts for their articles, I decided that there should be a site to aggregate these for curious researchers from various disciplines. The site is now in its second year and we have over 1500 video abstracts posted and nearly 1400 videos transcribed, so users can easily search within the content of videos to find what they are looking for. ☐

Educational Technology Points of Inflection

Michael D. Bush

Importance and Implementation of Learning Analytics

Introduction

The importance of collecting and analyzing data on interactions with online learning activities has been clear for many years. We did not have a term back in the day, but today the term learning analytics basically describes what we were proposing. An article from the *Los Angeles Times* dated September 25, 2015 confirms in my mind that we were on the right track. This story recounts how the nation's second largest school district, with 1,124 schools, 655,000 students, and 31,748 teachers (Los Angeles Unified School District, 2015), is slated to receive a "refund" from Apple and Pearson for the Pearson iPad curriculum that the school system says "its teachers barely use" (Blume, 2015).

What is the connection between this story and learning analytics? Pearson defends its curriculum by asserting that "other school systems continue to use its online courses," which right away raises the question as to why things would be so bad in LA and not elsewhere. A senior attorney with the school district provides a clue by stating that their goal for future projects would be to make sure schools are ready to use technology before they receive it. Unfortunately for Pearson, we can guess that the lack of hard data prevented them from assigning blame to this factor rather than

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accepting that their curriculum was to blame.

A publisher such as Pearson can easily assert that their curriculum is being used in other school districts, but without data, it would be impossible for them to defend its quality with an equal degree of confidence. Learning analytics derived from use by actual students, however, would give them the means to defend themselves.

Pearson would also be well served if it were able to assert that students who use their product are more successful than students who don't, but arriving at that conclusion is not an easy proposition. This problem has existed for as long as educational research has existed, underscoring a true conundrum: How to empirically justify changes in educational practice.

A huge part of the challenge resides with the fact that humans will learn no matter what, which explains the well-documented phenomenon of educational research known as the "no significant difference phenomenon." This concept, as it relates to distance education, has been enshrined in a Website originated by Thomas Russell, now an emeritus faculty member at North Carolina State University (see *http://www.nosignificantdifference.org/*). The site was created to serve as "a companion piece" to Russell's book, *The No Significant Difference Phenomenon* (2001, IDECC).

This phenomenon arises simply because the human organism is a veritable learning machine that will learn under a variety of learning conditions. The end result is that research that compares instructional Method A with Method B will most of the time come up with no significant difference.

This phenomenon illustrates the problem that Pearson would face in its attempts to provide empirical data to substantiate the value of its products. In other words, there is little chance that they or anyone else could design a study that would provide a meaningful comparison between the use of their curriculum and any other reasonable alternative.

We became convinced of the value of being able to analyze student response data 30 years ago at the US Air Force Academy (USAFA) as we were preparing to install what was the largest interactive videodisc learning center to be found on a university campus anywhere. During the run-up that led to that lab, we conducted studies that helped us see the value that could come from collecting data on the students' experience as they used the technology.

We summarized that determination with the statement that we wanted to use the students' experience to learn about learning itself. We concluded that the learning platform could become the vehicle with which strategic research could be carried out. Given the state of systems of the day, we had the motivation and the incentive, but we did not have the technological means to do what we knew needed to be done.

Learning Analytics in the Literature

Fortunately, the realization of our vision and the solution to the problem of Pearson and other publishers are both becoming a reality today in the form of "big data" and "learning analytics." Capabilities derived from these concepts provide the means to accomplish for online learning

what we were talking about at USAFA and the sort of research results that publishers need to ascertain the value of their products.

Unfortunately, although evidence is mounting that the concept of learning analytics is important for educational researchers, its importance is not reflected in the educational research literature (Bush, 2015). Luckily, searches in other domains have proven more fruitful, if not abundant.

As terms go, "big data" seems to be fairly self-explanatory, but defining "learning analytics" turns out to be a bit more problematic. The *Wikipedia* article on the topic states that "The definition and aims of Learning Analytics are contested" (Learning analytics, 2015). A report by EDUCAUSE (van Barneveld, Arnold, & Campbell, 2012) examines a good number of definitions of analytics and provides this:

> Learning analytics in the academic domain is focused on the learner, gathering data from course management and student information systems in order to manage student success, including early warning processes where a need for interventions may be warranted here. (p. 6)

These authors cited Brown (2011), who they say "distinguished learning analytics from other types of analytics by virtue of the fact that learning analytics is focused specifically on students and their learning behaviors" (p. 6).

One example of the type of data that is collected when learners interact with learning content using technology, with the interactions being captured and stored as digital log data or "learning traces"(Verbert, Duval, Klerkx, Govaerts, & Santos, 2013, p. 1500). These traces can then be retrieved and analyzed with the goal of identifying patterns of learning behavior (Gašević, Dawson, & Siemens, 2015). Ideally, the types of analyses that will be possible will also address the need raised by the situation in which Apple and Pearson have found themselves with L. A. Unified, as well as fill the need we recognized at USAFA three decades ago.

Learning Analytics in Practice

The problem is that the collection of these learning traces is not as automatic as the above definition and other references might suggest. Indeed, our work at Brigham Young University has revealed that the traces left by learners on learning management systems are often insufficient to learn as much about learner interactions with online activities as one might hope. Specifically, the simple reporting of scores or even answers to specific questions together are insufficient for drawing very many useful conclusions regarding learners and the activities in which they engage.

Our first approach for solving this problem was to insert software commands in the online learning activities we were developing. By the time this work was well underway, we had become aware of coming standards such as the Experience API (xAPI) from the Advanced Distributed Learning (ADL) Initiative (formerly the Tin Can API). We later became aware of the development of the Caliper Learning Analytics Framework from the IMS Global Learning Consortium.

Our project schedule was such that we needed to move forward with software development, and unfortunately, the

most developed specification we could find was the Activity Stream specification that had been developed by Facebook. Despite the fact that it had not been developed for tracking learning activities, it seemed sufficient for our needs at the time. Without a doubt, its implementation helped us be successful in analyzing learning behavior in a couple of important studies on how learners interact with our software.

Using this approach presented us with the challenge of a very rudimentary process of collecting data in Excel files and developing unique software that could handle the reduction of the data to be analyzed. The problem was that the developed software was unique for each individual study. Needed was a more generalizable solution.

Knowing that something more sophisticated was needed, we recently investigated xAPI and Caliper, the latter of which initially attracted our attention. It seemed to be a better fit for an educational context than xAPI, given that xAPI consists of very general definitions for its data format. On the one hand, xAPI attempts broad applicability in settings that run from training to education by only specifying an [Actor], [Verb], and [Object]. On the other hand, Caliper defines metric profiles for certain types of educational activities. These profiles include types of verbs and objects that can occur in various contexts, which suggests a more direct applicability to a variety of educational settings. More recently, additional developments support the applicability of Caliper, with one writer (Feldstein, 2013) declaring that:

> [The IMS's New "Caliper" Learning Analytics Interoperability Framework] represents the functional core of something that my SUNY colleagues and I used to refer to as a Learning Management Operating System (LMOS), and is something that I have been hoping to see for eight years, because it promises to resolve the tension between the flexibility of lots of separately developed, specialized learning tools and the value and convenience of an integrated system. (para. 1)

Unfortunately, once again the requirement to adhere to a project schedule prompted us to adopt xAPI for our next round of development. As our work began on that particular phase of our project during the summer of 2015, we found more general support for xAPI than for Caliper. This reasoning was confirmed by other researchers (Santos *et al.*, 2015), who provided additional substantiation for the decision that are based on several architectural considerations. We are comfortable with this decision at present, especially given that the Caliper framework specifies xAPI compatibility.

Conclusion

To conclude, learning analytics, as implemented by xAPI and Caliper, stands ready to help address several current problems in educational research. It will help us move beyond Method A versus Method B types of research designs, a transformation that will improve our chances for learning about learning. Furthermore, publishers like Pearson would be able to rely on detailed data regarding the use of their curriculum in successful as well as failed settings like Los Angeles. Such data would help insure that materials address the needs of learners and make it easier for publishers to first determine, and then defend, the value of their offerings. The end result will be a win-win-winsituation for content developers, educators, and publishers. □

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Forthcoming Articles

Among the articles scheduled to appear in this magazine are the following:

Chris Dede: "Next Steps for 'Big Data' in Education."

George L. Gropper: "How to Determine If the Focus on Media Is Misplaced."

Cathleen Norris & Elliot Soloway: "Twelve Factors Leading to Fundamental Pedagogical Change in a Primary School: A Case-Study."

Lance Strate: "Fatal Amusements: Contemplating the Tempest of Contemporary Media and American Culture."