The Promise of Data, Connection and Openness

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Models, simulations and games show great promise in today's classroom, particularly in STEM. These digital environments all have one thing in common — they generate valuable data with the potential to transform understanding about teaching and learning.

Open educational resources and HTML5 technologies also open up new opportunities for synergy and integration.

On January 15 and 16, 2015, a diverse and passionate group convened to explore and unlock this synergy in an interactive summit at GitHub headquarters in San Francisco. They spent two days exploring the questions:

- What commonalities unite our development and research of data and analytics related to the use of simulations and games? What types of data are most valuable for what purposes?

- How can we ensure interoperability of games, simulations and learning environments, particularly in the case of open resources, standards and approaches? What data are most useful to share among these tools or environments? How does the existence of HTML5 enable or facilitate new approaches to this work?

- What tools, APIs and approaches are currently useful for analysis and data interchange? What challenges exist now? What commonalities can ensure synergy and integration among analysis tools and approaches?

- What areas still need to be explored, particularly in the realm of combining different data sources, tools and techniques? What additional considerations including privacy, federation, research considerations, etc. are involved in investigating these questions?

This white paper contains a summary of some of the outcomes of this inspiring gathering. Further documentation of the event and attendees can be found at concord.org/oer-summit.

We are entering a second grand era of educational technology. Educational technology has grown in scope and complexity, bringing with it new opportunity. Data and analytics hold promise for revolutionizing all aspects of learning. Common platforms permit openness and interoperability to create unexpected combinations. Exciting challenges on the horizon invite us to dive in and explore new, open innovations.

Educational technology needs to be seamless in its ability to piece together unexpected applications from diverse constituent parts, and to build and introspect into the rich learning experiences that result.

Following upon an incredible first act, beginning in the late 1970's and early 1980's and characterized by countless new ideas and a flurry of initial standalone examples of technology's promise, we are now entering a second era in technology overall and educational technology in particular. Wide consumer adoption has raised the bar for technology's ubiquity and usability across the board. Development patterns, supports and technologies have begun to come together, enabling us to develop new applications with striking ease. This coming era, characterized by convergence, combination and connections, holds intriguing possibilities.

We recently assembled a group of top researchers and software developers to share ideas and ask far-ranging questions about the next generation of technology. Our summit convened around central issues of data, openness and interoperability in the geeky and forward-looking GitHub headquarters in San Francisco. Attendees focused on the grand challenges and opportunities for research and software development in this new era. The results are an exciting instruction book for approaching the future.

Driving toward a new data future

It was clear to everyone gathered that data are poised to redefine learning in the decades to come. What is less clear is how these data can be best used, and by whom. The most obvious users of data in many applications are teachers—a proliferation of dashboards has come onto the scene in recent years, spilling heaps of data into the classroom and, presumably, into teachers' lives. But there is an immense amount we don't yet know about how to use data to help teachers, and this mountain of open questions far overshadows the few things we know.

We certainly know that we can collect data. However, research around how and when to provide that data is in its infancy. Indeed, it is becoming clear that presenting data to teachers creates its own pedagogical challenges. Dashboard designs may subtly or overtly impede teachers from directly attending to students during learning—these are among the pitfalls that await as we experiment with new forms and processes in the classroom.

We also know that simply collecting data is not enough. We know little about what kinds of data are most useful and how to use the data. We need to gauge what learners are doing with the complex and rich tasks assigned in classrooms. Thus, it will be essential to identify actionable data, and to then determine ways to help teachers use these data to enhance learning and to help designers guide curricular design.

But perhaps the primary area of uncharted territory revolves around presenting data about students' learning directly to the students themselves. Students' own data should be made available to them, in a way that can help them better understand their learning. Data should be selected, oriented and presented in such a way as to encourage reflection, spur persistence and build agency. Analytics and data should help education become more individualized, ensure that students are less marginalized and truly place the focus on the learner.

Interoperability and openness

Of course, data can be used in ways that are limited—or unbounded. Rather than piece together portions of code into amazing but sometimes clunky applications, we can instead join multiple applications into coherent combinations. In such cases, the whole is much greater than the sum of its parts. Consumer experience today provides a glimpse of this power, seamlessly connecting personal photo albums to custom-printed books, garage door controllers to mobile phone apps and credit card purchasing data to finance programs. Educational technology needs to be just as seamless in its ability to piece together diverse applications, and to build rich learning experiences.

With the proper interoperability enabled, the possibilities for educational technology begin to look almost unlimited. Such interoperability could provide connections across disciplines within a grade, foster coherence of content across developmental stages, or even provide an invaluable running record of learning across a student's entire educational career, enabling teachers to avoid the age-old problem of starting from square one with every new student each year. Ensuring sufficient levels of

interoperability across technologies could unlock new doors across conceptual, cultural and curricular realms.

Such a concept is highly exciting, but immensely complex. And many challenges stand in its way. Interoperability frequently runs counter to the business logic and priorities that drive the creation of today's widely used materials. As schools begin to adopt promising technologies, only to find teachers drowning in a sea of logins and passwords, they are demanding interoperability from vendors and publishers. The need for interoperability of content within school learning management systems is at a similar point. However, ensuring interoperability ultimately means demanding it of developers, a fact that introduces complex intergroup dynamics and can significantly slow uptake of promising possibilities. Groups such as Clever, with its role as a universal hub for solving login and interfacing problems, are beginning to meet some of these needs by providing bridging solutions that smooth the way.

Similar opportunities exist in other places—a universal hub could address many issues with data moving to and from technology-based STEM content, for example. Close coordination among makers of key modeling and simulation technology could help solve a piece of the puzzle, while providing patterns for design and modularity that others could follow. But none of the above will happen easily if the work remains hidden behind walls and guarded by proprietary instincts. At least a basic degree of openness is essential for interoperability to exist, and full openness is what fuels innovation.

What's next?

So how do we figure out ways that data can truly raise teaching and learning to new levels and set the stage for developing the needed critical mass of interoperability? First, we need discussion fed by real examples, and more exchange between software developers and researchers. Our summit was a good start, but it barely scratched the surface. Second, we need real examples as inspiration and blueprint—these are often the only things that truly open people's eyes and make the central needs crystal clear. A set of demonstration projects is essential, showing, for example, how learner data and interoperability could change the experience across all of middle school learning or across multiple STEM disciplines over an integrated high school year.

These are daunting tasks. But we as a community are well prepared. And we have a secret weapon. Because of the blinding speed of technology cycles, we have a unique opportunity, perhaps singular among revolutions. As we enter this second generation of educational technology, we walk forward together with many of those who helped create the original revolution. The resulting foresight, well informed by hindsight, provides clarity for our work. Emboldened by that knowledge, educational technology's second act is ready for all challenges. In the process, the future is not only coming into sharp focus, but beginning to offer us a breathtaking view.