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SMALL DATA
FOR BIG CHANGE
What does it mean for teachers?

You know "big data"—petabytes of digital information, smart machines calculating with algorithms what's likely to happen next. That's how global financial markets are run today. Personalized advertisements pop up on your smartphone screen based on data from your web browsing history, or millions of others like you. Even in professional basketball, coaches set their game plans based on millions of data items caught by cameras and sensors about players' behaviour on and off the court. The story goes that Google's big data knows you better than you do.

It is also well known that big data is a good servant but a bad master. First of all, a fundamental purpose of big data is to have enough information and process it fast enough to predict what is likely to happen next. This is called predictive analytics and is the great promise of big data. This may be worthwhile in meteorology or a corporation's strategic planning, but it certainly may lead to odd situations in health care or education if not handled sensibly.

Second, when masses of data are collected in school by sensors, such as motion detectors, cameras and microphones capturing every child's facial expression, social interaction and gestures every day, all year round, decisions made by smart machines may lead to unethical experimentation on students or even Orwellian surveillance of individuals' privacy.

Big data is also emerging through digital testing platforms and adaptive learning analytics systems (digital tutors); as masses of student testing data grow, so does the desire to harvest it for patterns.

Finally, big data normally reveals only correlation between events, not causation. Correlation is important in understanding these relationships, but it doesn't mean that one thing would cause the other.

There are high hopes among some that big data will eventually fix (and increase corporate profits from) education systems. If you think, as I do, that the *data science* alone will not do that, then you may want to turn to something else. How about small data? It emerges from the notion that in a world that is increasingly governed by binary digits and cold statistics, we need information that helps us to understand better those aspects of teaching and learning that are invisible or not easily measurable.

Teachers know the importance of human observations, face-to-face conversations and critical reflections in making sense of what goes on in classrooms. Standardized tests or opinion surveys may help to identify some general trends, but they are not able to reveal deeper secrets of pedagogy. Therefore, small

data can be a good tool to find out what works best and why in schools.

Does this sound familiar? Indeed, small data has always been part of the process for experienced teachers, doctors, social workers and psychologists. It is not new, except the name. Danish management advisor Martin Lindstrom calls tiny clues that reveal big trends *small data*. In school, these small clues are often hidden in the complex fabric of values, behaviours and cultures that determine what teachers and students do in school. Understanding this complexity, in other words, being sensitive to weak signals and small data, must become a priority for improving education.

What does all this mean for teachers, you wonder? First, when teachers around the world are increasingly exposed to the promises of big data and are asked to work in "data teams" in their schools, they should remind the big data advocates of the importance of small data, not as an alternative but as a complement to evidence-based practice and good data in schools. To make small data an active part of teachers' professional repertoire, it should be turned into concrete, productive actions and part of the culture of the school.

Second, teachers could consider some of the following practices that include collecting and using small data in their work.

1. PEER COACHING FOR PROFESSIONAL LEARNING

Peer coaching is a confidential process through which small teams of teachers work together to reflect on their current teaching practices; refine, improve and develop new skills; learn from one another; teach together in classrooms; and take part in school improvement together. Peer coaching provides teachers with an environment in which it is safe to test new ideas and try new practices. Absence of fear and anxiety helps teachers also to see more clearly those tiny clues—or small data—in teaching that may lead to understanding something that can unlock further professional learning. Systematic attention to finding small data in interaction between teachers in school may therefore enrich the current cultures of collaborative practices in school.

2. USE OF AUTHENTIC ASSESSMENTS IN CLASSROOMS

Increasing reliance on external standardized assessments and algorithms to attempt to quantify what students have learned in school has weakened the role of classroom-based, teacher-made assessments. In some parts of the world, teachers don't need to study educational assessment and evaluation in university because their students are assessed by external tests and/or individuals who are far away from the classroom environment.

One productive use of small data is through authentic student assessments that utilize judgments made by both teachers and students. Student self-assessment, whether it is a portfolio or reflection, is a great way to allow students to explain and speak about their learning. Students' narratives often include tiny clues — or small data — about their learning or your teaching that may uncover important features about improving what you do in school.

3. DISCOVER STUDENTS' BELIEFS ABOUT THE TOPICS YOU'RE TEACHING

I taught mathematics in school for many years. I soon realized that there are many students who don't like mathematics, let alone think it is interesting. Early on I learned that probably most of my students had their own ideas about mathematical concepts and phenomena. These beliefs are difficult to capture without helping students turn them into tangible representations like stories, drawings or conversations.

Back then I systematically collected small data (although I didn't call it that) to understand students' beliefs about the mathematical world. Research showed me that students' conceptions of mathematics, however erroneous, are often very difficult to change. Data from standardized tests cannot inform a teacher about these important hidden cognitive forces. Therefore, it is small data that can help teachers understand why some students don't learn as well as they could in school.

My main method of understanding what students were thinking was having them draw an image of a mathematician at work and write a description of the image they'd drawn. I remember one student drawing an aged man in old clothes and describing mathematicians as usually fat, unstylish males with no friends (except other mathematicians), no romantic relationships or social life, with wrinkles in their foreheads from thinking so hard and very short tempers.

It is easy to see that anyone having such a vivid image probably wouldn't be interested in mathematics or be excited about becoming a mathematician.

So what can be concluded from all this? Small data can be a powerful idea and a response to increasing attempts to pursue data-driven policies and learning analytics in schools. But small data takes time.

In Alberta and in many other places, teachers at all grade levels spend a lot of time in classrooms on administration and bureaucracy, so when they are asked to do anything that is above and beyond what they already do, a common complaint is that there is no time. While teachers are masters of using small data and improving the quality of teaching, they need more time to work with their colleagues so they can worry less about whether their students will make the grade in the next high-stakes standardized test.

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