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Cover photo by North-West University
Students on the Vaal Triangle campus in Vanderbijlpark, South Africa. Used with permission.

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Preface

Throughout the history of education, the journey to successful teaching and learning has been accompanied by meaningful, actionable and timely feedback. This personal feedback, along with many other data points from school safety to curricular efficacy, has then been aggregated and used by school leaders to determine the best path forward for systems. While the goals and contexts vary around the world, measuring outcomes remains critically important – even more so in a world where the population of school-aged students is outpacing the capacity of many school systems.

Today’s education systems are also tasked with capturing evidence of skills that have not been traditionally easy to measure at scale, including creativity, innovation and collaboration. Students will be participating in a connected and complex world, and these skills are necessary for their success at work and in society. Indeed, students must learn to be flexible and adaptive in an era of rapid technological change.

In the past, school systems have deployed technology in the hopes of keeping up with this rapid change. The problem is, school leaders and communities were measuring the number of devices they deployed to students instead of measuring the learning, economic and social outcomes as a result of the interventions. In response, HP created NETA, the National Education Technology Assessment Program, which ensures that schools are ready for change and that the right outcomes are tracked, measured and pursued. Through NETA, we provide actionable insights back to students, teachers and schools, while enabling predictive modeling for leaders of education systems. We are honored to have worked with school systems on NETA projects around the world to enhance our approach and improve the state of human capital development in these diverse communities, including Ecuador, India, Oman, Peru, Rwanda, South Africa, the United Arab Emirates and the United States.

HP is pleased to support the New Media Consortium in the creation of this Strategic Brief, which is designed to inform educators, policy makers and economists. HP would also like to express appreciation to education leaders like Karen Cator, Keith Krueger, Séan Rowland, Gavin Dykes, Wendy Drexler, Brian MacCraith, Larry Johnson, Tom Greaves and Brian Lewis, who serve as advisors and have been accompanying us on our journey to improve teaching and learning through innovations in assessment.
Executive Summary

In the 22 years since the world wide web was invented, the amount of information and the number of learning-related tools available to teachers and students has expanded to levels unimaginable two decades ago. Added to that incredible sea of knowledge is an ever-growing pool of data about each of us, itself increasingly available on the network. In school districts and education ministries around the world, there is an increasing interest in using these data — and in developing new streams of learning-related data — to assess student mastery and engagement, to measure and ensure the quality of schools and the technical capacity of school systems, and monitor the impact of national policies, goals, and initiatives.

A new vision of assessment is emerging around the concept of national learning “data ecosystems” that push information up from individual learning activities, classrooms, and schools, and merge it at key points with local and national economic, social, and technical data. The goal of this special report is to understand the promise that vision holds, to examine the challenges that must be solved and the systemic gaps that must be bridged, and to offer a set of guidelines and practical, nationally focused recommendations to senior educational leaders and policy makers.

The perspective of the authors is that it is critical that a framework be devised that aligns school policy, legislation, and funding with national goals and priorities, and used to assess progress toward those goals and priorities. A key component of this is to put policies and procedures in place to ensure that the tremendous potential of such assessments and data can be fully realized.

The essential purpose of such a framework is that it will provide a foundation to continuously assess the current state of national educational technology infrastructures and the readiness of key stakeholder groups — students, teachers, families, and others — to use and support the use of key educational technologies. Understanding these technical and human resources in depth is the starting point to build a national vision that can provide the roadmap for growth and evolution of educational technology use in learning.

Our recommendations, detailed in the last section of this brief, include building national policy frameworks that identify areas in which legislation, policy, or regulations are needed — and ensure they align with key national goals and priorities. Ultimately, the most important recommendation is for school policy makers and leaders to begin to think about education and the potential of technology-enhanced learning from a systemic level. From that perspective, there are significant reasons to embark on the development of data ecosystems.

The Dilemma

Governments face large challenges that often hinge on the quality of life for their citizens. Issues like under- or unemployment, especially for youth, have serious implications for the economic and social well-being of a country. These challenges require long-term thinking, as the solutions are tied closely to the effectiveness and responsiveness of schools and universities. For their own part, schools and universities are increasingly under pressure to demonstrate that they are indeed effective, and that graduates have the skills needed for a globally competitive workforce.

As the Internet as grown in capability and reach, educational systems have been jostled by what some see as disruptive impacts, but with the new tools come tremendous opportunities. New and expansive technologies that draw on the network offer new ways of meeting the needs of not just students, but teachers, school leaders and policy makers, parents, and families. The potential of the cloud, of increasingly capable mobile devices, and of “big data” are just beginning to be realized within most educational systems.
In the perspective of the authors, realizing that potential centers on the effective application of modern networks in learning, and the integration of new and existing data that can link education policy and practice to national goals and priorities, but the challenges are not simply technical. The political landscape of education is very complex in today's world. The impact of population growth, economic imperatives, and the expectations of parents and citizens has created what John Daniel and others have called the “Iron Triangle” — the interplay between access, cost, and quality that limits what can be done to help grow national economies and standards of living using traditional schooling approaches:

“Education ministers [all] want to increase access to education, improve its quality and cut its cost. We can represent these as three vectors. The ministers want to stretch the triangle like this to give more access, better quality and lower cost. But with conventional classroom teaching methods you can’t easily do that. That is why I call it the Iron Triangle.

“Pack more students into the classroom to raise access and you will be accused of damaging quality. Try to raise the quality with more or better teachers and learning resources and the cost will go up. Cut costs directly and you may threaten both access and quality.

“This iron triangle has created in people’s minds an insidious link between quality and exclusivity in education. That link has lasted for centuries, but finally there are signs that it is being broken.

“To stretch the triangle and achieve, simultaneously, wider access, higher quality and lower cost you need technology. The evolution of open and distance learning reflects the arrival of a succession of technologies that have helped to offer better education to millions of people through space and time at reasonable cost.”

A great many educators around the world agree that putting increasingly capable, always connected personal devices into the hands of learners, teachers, and families could potentially break the Iron Triangle once and for all. There is an increasing interest in using new sources of data to measure the learning experience and use that data to inform and even drive national priorities and goals. Advancements in big data, learning analytics, and econometric modeling are enabling highly visual digital dashboards that can support every tier of the learning system — from students to teachers to family members, and ultimately school leaders and policymakers. Using these dashboards, stakeholders can assess progress and strategies for meeting achievement goals. The United States Department of Education, for example, has its collection of data and statistics in a public-facing dashboard. There, a visitor can find charts and other visual indicators that demonstrate how far the nation has progressed toward its goal of having the highest proportion of college graduates in the world by 2020.

In a talk to the assembled faculty of Pepperdine University, Sir Ken Robinson laid out an existential challenge for universities looming in the near-term future. Projections are that between now and 2025 — the space of just ten years — the number of people expecting to participate in some form of higher education will increase from its current level of around 158 million students worldwide to about 263 million — an increase of sixty percent! Similar demand-based pressure on schools and school systems is inevitable over the next several decades, especially in developing countries as they look to education as the doorway to global competitiveness and economic growth.

National education ministries and school systems will be pressured to meet this demand and to not only produce educated citizens that can drive economic growth, the development of national capacities, and social mobility, but also expand access to an ever increasing number of learners.
As John Daniel’s comment highlights, the need to expand access is hampered by concerns about quality (we cannot serve these students only via online courses) and ever-rising costs (we cannot afford to build and staff the numbers of new university campuses and faculties needed). To meet the needs of the additional 105 million people, in Robinson’s view, we will need to open an average of nearly seven major universities (serving an average 30,000 students) every week for the next ten years!

In most countries, this will not be an easy task by any means. Issues like interoperability, privacy concerns, and creating fluid and easy access to learning-related data are not only challenging, but are complicated by local practices and cultural norms. The dilemma is threefold: how to solve these underlying issues so that classroom assessments are faster and easier, so that both formative and summative data at all levels is accessible, and so that these learning-related data can be merged with econometric and other national and international data sets and analyzed for previously hidden patterns.

To meet these challenges, we need new ways to capture and interpret data. We need to understand more about learning and how students progress. Learning goals and pathways need to align with national priorities and interests, but for most countries, there is much to be done to make that happen.

A candid and objective assessment of national capacity to do these kinds of analyses begins with an acknowledgement of the gaps in the things we can measure. For example, how can we measure teamwork, creativity, and other “soft” but critical skills? How can we equip teachers with techniques and tools that help them to engage every student and help them learn how to learn effectively?

**New Data Frameworks and Analyses**

A range of initiatives led by state educational technology directors in the U.S. are focused on data standards and interoperability issues that will help schools and school systems use learning data streams to track student progress over time. The importance of such work is hard to overstate, as the success of such standards is seen as the path to creating the expansive “big data” sort of information stores that can begin to reveal new insights into the learning process and how we assess it.

Advancements in big data and learning analytics are furthering the development of visually explicit streams of information about any group of students or individuals, in real-time. Ideally, these digital “dashboards” — websites and tools that present aggregated data in simple-to-understand frameworks — will better inform participants on every tier of the learning system, from policymakers to educators, parents, and students. The idea is that by visually presenting new streams of learning-related data, such dashboards can help school stakeholders more efficiently assess progress and develop strategies for meeting achievement goals at all levels. In an example that showcases how such an approach can inform national policy, the United States Department of Education presents a wide range of information on US schools and universities in a public-facing dashboard. There, a visitor can find charts and other visual indicators that demonstrate how far the nation has progressed toward its goal of having the highest proportion of college graduates in the world by 2020.

Europe is home to a considerable number of high-profile research projects, policy initiatives, and school-based efforts that are working on learning measurement challenges on a number of fronts, from advanced research into and applications of learning analytics, to specialized adaptive
learning software, to pedagogical innovation. The European-Commission-funded “weSPOT” project aims to strengthen scientific inquiry in classrooms and curricula in the EU by leveraging students’ personal curiosity and experience to deepen their conceptual knowledge. The project focuses its efforts on eight domains (food, biodiversity, earthquakes, sea, energy, school, innovation, economy) and has pilots and test beds in five European countries.6

As online learning environments increasingly accommodate thousands of students, researchers and companies are looking at very granular data around student interactions, building on the tools of web analytics. MyDistrict360, for example, provides a customizable portal for teachers and administrators to visualize student data and financial information, with the aim of enabling schools to more effectively provide personalised attention to students and forecast budgets.7

As the body of knowledge around learning analytics from projects and studies continues to grow over the next few years, school and government leaders will be much more informed about performance measurement statistics and how to use them to guide learning outcomes and educational policy. What is needed to take these efforts to the next level is a systemic approach, one that brings both new and existing sources of data, such as individual data from schools records, high stakes test results, school performance data, and more; when these are woven together with employment, economic, health, and other national level data, it will begin to be possible to track the impact of national education policy, and to track progress towards national education goals.

That is the essential goal of a new approach to measuring learning, economic and social impact embedded in the National Education Technology Assessment program being developed and tested by HP. In this three-phase approach, the initial focus is on establishing a set of heuristics for technology-enabled education reform known as the National Education Technology Framework (NET-F). The NET-F is a systematic, global review of legislation, policy, teacher training, physiology, NGO financing opportunities and incentives. There is no one-size-fits-all book of answers on how to improve human capital development, and there is no “guidebook” to national education technology – each community is unique. Instead of providing generic rules, the NET-F is designed to enable school systems to ask the right questions based on the experience of other nations and large school systems.

The second phase, the National Education Technology Readiness Assessment (NET-R), determines the cultural and technical readiness of schools systems to communicate, deploy and support education technology while aligning all members of the community on intended outcomes. The NET-R established a customized range of learning, economic, and social indicators to help ministries of education to document the gaps and challenges that need to be addressed prior to enacting interventions to affect reforms.

The technical portion of the NET-R evaluates the current IT environment within schools and school systems in the systems to determine existing capabilities to support internet access, availability of power and light, learning management system and the wide range of educational technology tools. Key questions include: Are the necessary systems in place to manage learning and student information, and to securely make it available in the cloud? Are schools physically connected to the Internet, and at what levels? And lastly, at what stage of development is the national backbone that would support such efforts?

The cultural portion of the NET-R measures the attitudes and current practices of students, teachers, parents (or guardians), employers and school leaders. This comprehensive battery of surveys is deployed to large groups, so that a statistically significant sample can be established. Since the NET-R process was created, over 10,000 respondents have provided their personal views on the role of education, the proper use of technology in teaching and the most important skills
for the jobs of the future. In Ecuador and Rwanda, the results have been eye opening for ministerial staff and decision makers, and reinforce the viewpoint that effective policy must be based on accurate information about national capacity for using new technologies for learning, and a frank assessment of where development and incentives should be placed.

With a clear vision in place that details the dynamic relationship between educational and economic policies, HP’s view is that setting programs into place to ensure readiness both in cultural and technological terms, deploying resources and support, and sustaining the whole effort will be much more objective — and much easier to accomplish — when an effective policy framework is in place.

The final piece of the puzzle is where real change can begin to happen. With the barriers of poor infrastructure and incomplete or ineffective policy lifted, it is then possible to put into place an assessment system that includes not only summative measures but also actionable data that can be used to ensure that access, learning, and achievement goals are measured and attained. This final phase, known as National Education Technology Analytics (NET-A) with Predictive Econometrics, then would apply effective metrics, data modeling, and visualizations to allow a holistic, near real-time view and analysis of national progress. The NET-A provides school systems with actionable data and predictions – it goes beyond “reporting the news” to establish correlative relationships among variables and predict outcomes, so school systems can mitigate major issues before they happen and create the most efficient policies and practices to address their most important goals.

Recommendations for School Policy Makers and Leaders

The challenges schools and school system face are large, and it is ever more clear that to overcome the dilemmas posed by Daniel’s Iron Triangle and meet the tremendous growth in demand, new ideas and ways of approaching learning like NET-A are needed. There are too many gaps in our current knowledge of most educational processes, and those gaps are disproportionately large in many emerging economies.

The role of educators at every level of the system needs to shift to a much more evidence-based approaches to teaching and learning. National leaders and policy makers need to advocate policies that can encourage the growth and greater use of meaningful data, while ensuring that privacy concerns are addressed proactively. School leaders need to be open to new ideas and to experimenting with new approaches across the entire scope of school activities.

Teachers should expect their roles to change as learning becomes self-paced and learner self-assessment a much more common occurrence, but at the core, the relationship between teacher and learner is perhaps even more essential as ever. Teachers play a critical part in clarifying understanding, ensuring progress, extending learning through the provision of engaging activities, and providing one-on-one and small group support. Some describe the shift in roles as moving toward something more like learning coaches, with the teacher’s focus on teaching students how to learn, as opposed to teaching them content. In this kind of setting, a blended approach to delivery, where students have full and easy access to the Internet and to tools as resources is seen as key. Parents have new roles as well, as do the students themselves. Both of
these groups will have a much greater influence on learning choices and pathways as learning is better measured and understood.

At the end, the overarching goal for schools is to create an environment where true collaborative learning becomes the norm, with everyone in the school community and the national and other political leadership invested in every child’s successful mastery and understanding of essential ideas, concepts, and skills.

In this paper, we have attempted to frame the challenges ahead for schools and school systems — and there are many commonalities here in all parts of the world. Most solutions are currently elusive because we simply cannot define the scope of the challenges that need to be addressed. We need more and better data, and more and better ways to understand and interpret what we measure. The five recommendations presented here are aimed at school policy makers and leaders who see education as the key to national development in both social and economic terms. The five are not necessarily a linear set, but do build on each other to craft a comprehensive data ecosystem to ensure that progress toward national education and other priorities is measured, monitored, and used to continuously iterate and improve outcomes at all levels.

1. **Continuously assess the current state of educational technology infrastructure.**
   The integration of technology-enhanced learning into schools is not a destination — it is a journey, and the reality of that journey is that there will always be new tools and new ways of doing things. Developing a national vision for the broad use of educational technologies starts with a clear understanding of the capacity of schools to use the full spectrum of tools available. These include learning management systems, assessment systems, support systems, incubators for testing and piloting new ideas — and of course infrastructure. Most schools and even universities are woefully under-resourced with bandwidth, both coming into and within school campuses. It is not enough to simply connect schools — it is critical to also grow fiber and other networks ahead of growth in school populations.

2. **Continuously monitor and assess the readiness of key stakeholder groups — students, teachers, families, and others — to use and support the use of key educational technologies.**
   Among the key indicators to monitor are attitudes toward the use of technology; skills need to continuously grow, and not just with basic hardware and software, but in using those tools in learning contexts in ways that augment and extend learning. Often overlooked is the role of the family and the resources students have at home — does the family have access to bandwidth at home? What devices do they own, and what is their comfort level with them? What resources are available to families to help them to also grow, as a key part of the school ecosystem? Also key is the culture of the school — is technology seen as a problem, or is it seen as potentially transformational?

3. **Develop a national vision that provides a roadmap for growth and evolution of educational technology use in learning.**
   The data and insights from assessments of infrastructure and stakeholder readiness will identify areas of strength that can be built upon and areas of need that should be addressed. A comprehensive vision, built with input from all the key stakeholders invested in the outcomes of schools and universities, will help keep these areas aligned with national priorities.
4. **Build a policy framework that identifies areas in which legislation, policy, or regulations are needed — and also aligns with key national goals and priorities.**

The goal of such a framework is to ensure alignment across all the rules and policies impacting the integration of technology-enhanced learning — from the building level to ministries of education. Such a framework will inform funding and incentive programs and position decisions within a strong rationale for improvement. An obvious area that must be addressed within every jurisdiction is to put into place policies that both encourage the broad use of student and school performance and learning data, but also make very clear how to protect stakeholders from misuse of those same data.

5. **Develop and implement a system to continuously measure and monitor progress.**

This begins with an analysis of relevant metrics and benchmarks that has a twofold purpose — to identify already existing data streams that can be tapped, such as econometric data, job and labor statistics, and health and well being measures. International benchmarks are critical indicators of progress that put assessments of school performance, national capacity, economic growth, quality of life, and other factors into context. Equally important is to select and implement data modeling approaches that can be used to transform data into actionable information. Visualizations, such as the United States Department of Education’s public-facing dashboard described in earlier. Charts and other visual indicators make it easy for anyone to see how far the nation has progressed toward its goal of having the highest proportion of college graduates in the world by 2020.¹⁸

Ultimately, the most important recommendation we can provide is to carefully consider education and the potential of technology-enhanced learning from a system level. In a competitive geopolitical context, nations must ensure that their most important natural resource – their people – have the skills needed to compete in a global, complex and technology-rich market. The risks are primarily related to failing to capture this transformational opportunity to expand access, improve quality, and save costs. We are finally at the point where the grip of the Daniel’s Iron Triangle may be loosed once and for all.

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End Notes


³ Sir Ken Robinson, Address to the Faculty of Pepperdine University, October 4, 2013


⁶ [http://www.go-lab-project.eu/partner/wespot-project](http://www.go-lab-project.eu/partner/wespot-project)
