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Sir Isaac's Dog: Learning for Adaptive Capacity

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Lessons from Newton

Sir Isaac Newton had a dog named Diamond. History tells many stories about Diamond, some of them quite tragic. The story I want to tell, though, is a heroic and somewhat comic journey. It is a story that shines light on a path that might lead toward a generative future for public education in the US. I can't claim Diamond's story as mine, and I have to admit I don't know where it came from, but it has become integrated into the way I think about learning. It is also a wonderful metaphor for how human systems dynamics[1] and the Generative Learning Center support systemic change for education. Diamond's story begins with a critical distinction.

There is a significant difference between learning Newton's theorem and learning Newton's dog. When you learn the theorem, the expectation is that you will end up with something that is as close as possible to what your teacher had. Furthermore, we expect your teacher to have something that is as close as possible to what Newton (and every other physics teacher since) has had in mind. You know you have learned about a theorem when you can replicate it. The measure of success is fidelity. The best pedagogy is drill and practice. Standardized tests are excellent assessment tools. Theorem learning is a wonderful and necessary process for all the ideas that older generations want to replicate in younger generations. It is a perfect method when we choose to define success as fidelity to the patterns of the past.

On the other hand, when you learn Newton's dog, the expectation is that you develop the ability to 1) recognize Diamond; 2) interact with him; and 3) get better at recognizing and interacting with him over time. A teacher of this kind of learning recognizes and interacts with Diamond and also gets better over time. You know you have completed this kind of learning when you can recognize, interact, and continually adapt to Diamond and all his other doggie friends. The measure of success is adaptive

[1] www.hsdinstitute.org

capacity. The best pedagogy is adaptation, and adaptive action is also the best way to assess performance. Learning Newton's dog is about engaging with an ever-changing environment in ways that are creative, courageous, sustainable, and sensitive. When the goal of education is to prepare the younger generation for a complex and emergent and unpredictable future, we must teach them Newton's dog.

For generations, some educational theorists and philosophers, as well as gifted teachers, have recognized the ways in which learning is a process of complex adaptation. Adaptive learning—learning the dog—has found a temporary home in some districts and in some classrooms when powerful leaders succeed in setting conditions that support it. The problem is that these shining examples have been limited to local and short-term effects. Because they depend on special individuals and special conditions, they usually cannot be transported or do not reliably take root in other contexts. Our systems have not found a way, as yet, to take philosophy and wise practice of adaptive learning and embed or sustain it in institutional infrastructure.

This little story of the theorem and the dog captures a whole range of challenges for school reform as we know it. These challenges, I believe, are the ones that have frustrated good-hearted people and stymied enormous change efforts over the past generation. Perhaps the distinction can help us find a new path—a more generative and adaptive path—into the future of education for our children.

Lessons from the Dog

By all reports, education reform has been stuck for decades.[2] One promising approach will flourish and fade, while another comes onto the horizon. Old ideas become new again, venture forth with new names or new technologies, and fail just as completely as they did before. Intelligent, committed people struggle to think and talk about change in ways that reflect basic assumptions and inform more effective practice. Clearly the challenges for educational reform come from many and deep conflicts in the philosophy and politics of teaching and learning. Perhaps a complex theory base—drawn from the field of complex adaptive systems and including Newton's dog—might offer a simpler and more promising path toward new horizons in education.[3]

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[2] Refer to any of the recent reports from public and private sources about the failure of education reform in the US.

[3] See Olson, E. E., & Eoyang, G. H. (2001). *Facilitating organization change: Lessons from complexity science.* San Francisco, CA: Jossey-Bass/Pfeiffer.

Concepts and practices based on complexity theory and chaos science have been shaping change management in business and industry for the past decade.[4] Here, I will explore a few of the implications of the theorem/dog metaphor and invite you to add others that emerge from your own theory and practice. I will also present a simple and elegant approach to adaptive learning in and for schools and share a case story about how the approach is setting conditions for generative transformation in a particular district.

No Naughty or Nice—It Is About Fit

A world that equally honors both ways of learning—replication and adaptation—opens a whole range of educational opportunities. Such an opening is only possible, though, when we take three steps. First, we must convince ourselves that there is "no naughty or nice." Both theorems and dogs are important if our children are to thrive in the world of the future. We need to instill some fundamental principles and basic skills through public education. We also need to help students develop the capacity they will need to adapt to a world that is beyond our imagining, and possibly even beyond theirs. Second, we must develop institutions that are capable of teaching our children both how to replicate and how to adapt. Our policies and procedures, physical infrastructures, professionals, governance structures, and financial and informational resources must be designed to be adaptive. They must be flexible enough to find the best fit for function, whether the situation requires pre-determined consistency or emergent variety. They must support the right kind of learning at the right times and places. Third, we have to be able to recognize—as individual teachers, board members, principals, staff, parents, and students—when each of the approaches is more appropriate and be prepared to move easily between them as circumstances and expectations change. We must learn to recognize, interact with, and improve our abilities to recognize and interact with all facets of our educational systems.

Many of the most innovative school reform efforts choose either the dog or the theorem and demonize the other. This leads to solutions that are only good for some students, for some tasks, for some of the time. They don't build system or personal capacity to support excellence in both methods, and they certainly don't instill the ability to judge when one or the other is more fit to the educational purpose.

[4] Eoyang, G. H. (2011). Complexity and the Dynamics of Organizational Change. In P. Allen, S. Maguire, & B. *McKelvey (Authors), The SAGE handbook of complexity and management.* Los Angeles: SAGE.

Values, Ethics, and Fit

The process of adaptive learning leads individuals and systems to fit with social and cultural environments, but it does not lead to relativism or a loss of values and ethics. On the contrary, adaptation requires dialogic engagement, negotiation, and resolution of many different tensions, including those between an individual's values and action, the values and expectations of others, and the connection of ethical actions with the good of both individual and community. Exploring and integrating individual and community values into the learning contents and contexts is an important key to learning to recognize, interact with, and continually improve the health and productivity of our educational institutions and communities.

Standardized Individualization—An Educational Oxymoron

While theorem learning depends on replication and repetition, dog learning expects and responds to infinite variety. Recognizing, interacting, and improving are competencies that are never the same twice. Every instant, every situation, every context is unique, so patterns in such complex and adaptive environments never repeat. Master teachers have known this truth forever. They adjust their teaching strategies to meet the unique needs of each student. Often the adjustments seem intuitive to teachers who have learned adaptation through trial and error. Sometimes these critical adaptations are supported by district policy, departmental procedure, curricula, and textbooks. More often, however, they are not supported because our educational institutions have been designed to optimize theorem teaching through standardization and consistency.

Theory and practice of dog learning have not been well integrated into educational institutions or plans to change education for a very good reason. However much a change effort encourages individualized or personalized action, the effort itself is based on a replication of a theory, so it proposes a single solution across diverse contexts. Even when the objective is to implement adaptive learning, we approach it as if we wanted our education institutions to learn our (of course new and improved) theorem about adaptation. What we create, then, are solutions that expect replication, even when conditions are radically different. Because we understand and feel competent in principles of replication and fidelity, we use them to implement strategies that we intend to be flexible and adaptive. The result is that even our most enlightened efforts at school reform fail to fit the educational contexts and needs of diverse districts, buildings, or classrooms.

A New Kind of Rigor

A dual purpose education, that satisfies both fact and facility, requires two kinds of rigor. We understand and implement rigor for replication through validity and reliability. We talk about "gold standards" and look for benchmarks to satisfy our hunger for repeatable and reliable outcomes. This is great, but a view of learning that includes both replication and adaptation requires something more. It points to a different form of rigor, one that is about pattern coherence and fit with environmental demands. The field of evaluation has taken up the challenge to explore systemic and emergent evaluation and to give us models and methods for working with rigor in this new and more uncertain world[5]. Their work is far from complete, but their adaptive approaches are evolving over time and becoming more fit with the theory and practice of real world educators.[6]

Challenges of measurement and evidence have always plagued education reform efforts. On the one hand, standardized measures give us some hope of rigor and replicability. On the other hand, the world of real learning is simply not always consistent and reliable. Perhaps, with this dual model of teaching and learning, we will find better ways to fit our assessment to both the standardized and the emergent nature of our teaching and learning work.

Disparities and Systemic Bias

Teaching by replication is, by definition, biased. You replicate the things you want to keep unchanged in the culture. Somebody has to choose what to keep, and that person or group is always the dominant one. I have no judgment about this, it is simply a logical consequence of the desire to perpetuate anything. The Royal Academy laughed at Newton. Europeans colonized the New World. Evolution was challenged in the Scopes trial. Children were turned away from school doors. Girl Scouts learn a code of ethics. High school seniors read Shakespeare, and sophomores study biology. Each of these situations perpetuates some pattern of the past, based on a prejudged position of the dominant culture.

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[5] Patton, M. Q. (2011). Developmental evaluation: Applying complexity concepts to enhance innovation and use. New York: Guilford Press.

[6] Williams, B., & Imam, I. (Eds.) (2007). Systems concepts in evaluation: An expert anthology. Point Reyes, CA: EdgePress of Inverness.

In so far as one role of education is to perpetuate and stabilize our way of life, it is necessarily biased. The problem is that if we see education, or changes in education, only as a process of replication, then we will continue to be plagued with the cultural disparities that we abhor or deny today. On the other hand, adaptive education is, by nature, sensitive to individual or local or cultural differences. When we can see adaptive learning as one necessary and equal component of our educational system, then the antidote for disparities will be built into our system automatically.

Challenge of the Interdependent Pairs

It is not a coincidence that a promising path to education reform emerges from the connection between two seemingly opposite functions of learning. Most complex problems, especially those that seem intractable, rest upon one or more paradoxes that will never be resolved.[7] In human systems dynamics, we call those paradoxes interdependent pairs, and we find them at the center of the most challenging problems of our time. Many examples show up in the education reform literature: Individual or system; consistency or diversity; local or national control; student or professional choice; relationship or hierarchy; adults or children; communities or classrooms; autonomy or dependence. Each of these is an interdependent pair because the extremes are logically opposed to each other, but both extremes are necessary to the system. If any of these pairs collapsed one pole into the other, we would have a school system that was even less satisfactory than the current one. Imagine a "system" based solely on individuals, diversity, children, communities, and autonomy. Lord of the Flies[8] would seem tame in comparison. On the other hand, a system that was completely driven by systemic needs, consistency, national control, professional choice, hierarchy, adults, classrooms, and dependence would drive us toward the totalitarianism of 1984[9].

In the education system we have now, these polarities generate a constant tension. The issues are problematic because neither extreme will serve us well. Any answer that seeks to satisfy one extreme brings up an immediate argument from the other side. We have seen how such conversations drain the energy and creativity out of change efforts. Adaptive learning presents an alternative.

Individuals and institutions are given the freedom and capacity they need to assess their current environments, negotiate relative interests and needs, and select and implement a response that fits in the "here and now." Their decisions are framed and informed, but not dictated by, the most critical interdependent pairs. They choose, for a given question

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[7] Johnson, B. (1992). Polarity management: Identifying and managing unsolvable problems. Amherst, Mass: HRD Press.

[8] Golding, W. (1962). Lord of the flies. New York: Coward-McCann.

[9] Orwell, G., Orwell, G., & Orwell, G. (2003). *Animal farm*; 1984. Orlando: Harcourt.

in a given situation, where the solution should fit between the two polar extremes. Each result emerges from a transparent conversation about the costs and benefits at any balance point between the two ends (or some place in the middle of) the spectrum. Leaders of adaptive learning do not, however, find themselves stuck with a new solution that is mistaken or an old solution that is stale. They are never stuck anywhere because they continually recognize, interact with, and improve how they recognize and interact with their environments. In an adaptive and generative learning ecology, the interdependent pairs inform, rather than derail, shared decision making and action.

Not All Coherence Is Consistency

As a metaphor, the theorem and the dog are stuck pretty much at the level of the student's learning, but it is possible to imagine the same kinds of learning dynamics at other systemic levels as well. Might a teacher learn to recognize how a student struggles, interact effectively to support the struggle, and continually improve how he or she recognizes and interacts with students? Might a principal recognize excellent teaching, interact in creative and supportive ways, and continually improve skills to shape a generative learning environment? Might a parent, board member, janitor, bus driver, or food service supervisor recognize an environment that was conducive to learning, interact with it and with each other to establish and maintain productive patterns, and focus on shared learning through action in every interaction? Might an entire school system and all its infrastructure be designed to support improvements in recognition and engagement?

If replication were the only way to think about learning, it would require enormous resources to establish and maintain a system where everyone and every system worked together in concert. Indeed, reform efforts have taken on this challenge and failed to be implementable or sustainable. On the other hand, if the entire school ecology is created to support learning and teaching as adaptive work, it is only natural that the chair of the board could adapt as often and as well as the janitor and that the systems they create would support adaptation as well. The result would be a highly flexible, and still coherent and self-monitoring, community that was prepared to deal with whatever it might encounter.

Questions Not Answers

Education reform efforts that propose answers—whatever the answers might be—are doomed to failure in a complex and ever-evolving social and cultural landscape. On the other hand, when both replication and adaptation are included in an educational approach, questions become much more important than answers. Inquiry must lie at the center. Questions are carried from context to context, but the answers emerge from local conditions and dialogue among local stakeholders. *What* knowledge and skills should be replicated, and which should be adaptable? *What* is fit to purpose for a student or community at a given time and place? *What* surprises are showing up in the environment that require new strategies or open new opportunities? *What* patterns do we see? *So what* are the untapped resources in our communities and among our students? *So what* might these resources contribute to our educational purpose and outcomes? *Now what* can we do, individually and collectively, to enhance the learning ecology for which we are responsible?

Recognize, Interact, Get Better

It is one thing to say that students and the schools that educate them should engage in adaptive learning, it is quite another to operationalize such a mandate in ways that are practical and powerful in the real world of schools and schooling. We believe, and our experience is beginning to confirm, that human systems dynamics (HSD) provides a simple and elegant pathway into adaptive learning. After a brief introduction to HSD and its models and methods, I will share our findings at one school district where the Ball Foundation is providing resources to help these ideas take root to build adaptive capacity in personal, professional, procedural, and policy systems.

Human Systems Dynamics

The field of human systems dynamics (HSD) draws on a variety of disciplines to help people see, understand, and influence the patterns that self-organize in social systems of all kinds.[10] The HSD body of theory and practice incorporates insights from wise practitioners about what works; philosophy and cognitive science about what it means to know; nonlinear dynamics, particularly complex adaptive systems, about dynamics of emergence; systems theories about the relationships among wholes and their parts; organization and management theory about change in social and institutional systems.[11]

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[10] Eoyang, G. (2001). Conditions for self-organizing in human systems. Unpublished doctoral dissertation. Union Institute and University.

[11] Holladay, R., & Quade, K. (2008). Influencing patterns for change: A human systems dynamics approach for leaders. United States: CreateSpace.

The purpose of HSD is to build adaptive capacity, so that individuals and groups can consciously engage with their evolving environments. Prediction and control are not an option in the midst of chaos, but HSD models and methods help discern emerging patterns and support adaptive action. Our network of professionals has incorporated, adapted, and created models and methods that offer options for action to influence change in a wide variety of complex social systems. These tools offer concrete and practical paths to knowing Newton's dog. They also embrace the importance of Newton's Theorem. Two concepts are at the core of HSD theory and practice and the application of HSD to systemic change in educational systems. Those two ideas are *patterns* and *Adaptive Action*.

Patterns

HSD acknowledges many different system dynamics, and therefore many different ways of teaching and learning. On the one extreme, system conditions are closed, influenced by few variables, and dependent on clear causal connections. Under such conditions, system behavior is easy to predict, control, and replicate. To teach Newton's theorem, we assume such a closed and predictable universe. Teaching and learning about these systems expect reliable replication.

On the other extreme, system conditions are open, shaped by an unknowable number of factors, and dependent on mutual causality. Under these conditions, it is impossible to predict system behavior, but observation, meaning making, and adaptive action are possible.

We characterize the essence of emergent meaning in terms of patterns: Similarities, differences, and connections that have meaning across space and time.[12] Even in the most disrupted and uncertain situation, one can discern and engage with emergent patterns and, over time, improve the ways that you observe and interact.[13] Newton's dog constitutes just such an emergent and surprising systemic pattern, and we come to know him through Adaptive Action.[14]

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[12] Eoyang, G. H. (2010, June 21). *Human Systems Dynamics Professional.* Lecture presented at Certification Training in The Retreat, Minneapolis, Minnesota.

[13] Since 2003, HSD Professional certification training has focused on teaching people to see, understand, and influence patterns in complex human systems.

[14] Eoyang, G. & R. Holladay. (In press). *Adaptive Action: See, understand, and influence organizations.* San Francisco: Stanford University Press.

Adaptive Action

I have already pointed out that adaptive learning is inquiry based, locally determined, focused on fit and coherence, infinitely variable, based on and responsive to diversity. It would seem impossible for any public institution to establish and maintain a system complicated enough to support such teaching and learning, but all is not lost. The nonlinear sciences and emerging knowledge about self-organizing systems provides an alternative explanation and different options for action.

A complex adaptive system consists of a cluster of semi-independent agents that are free to act in unpredictable ways, but their interactions form system-wide patterns. Over time, the system-wide patterns influence the agents' behavior, and the pattern is reinforced. A clique (of students, parents, or teachers) is a simple example of a complex adaptive system. Individuals make choices, the group forms, and the group dominates individual behavior. All social systems, including educational systems, are full of examples of such self-organizing patterns.

While emergent patterns can be quite powerful, any individual agent can take action to disrupt an emergent environment. How? First, they observe the patterns that are emerging around them and ask, "What?" is happening. Second, they consider a variety of explanations for the patterns and consider, "So what?" the pattern might mean in relation to a shared purpose or task. Third, they select one action from among the many options and decide, "Now what?" to engage directly with the pattern as it changes. Finally, they begin the adaptive cycle again by observing the results of their actions, and ask again, "What?" is emerging as the system responds to my action?

In HSD we call this cycle, and the pattern-spotting models and methods that support it, Adaptive Action. It may look like other learning cycle processes from the past, including the total quality PDSA (Plan, Do, Study, Act) and processes of action learning, and in some ways it is. It is different, though, because it is optimized to support adaptive learning in engagement with complex systems. Adaptive Action is:

- Framed as questions, to hold the teacher/learner in inquiry.
- Common, simple language to be accessible to anyone.
- Useful at every level and in any context of human systems—individuals, classrooms, buildings, districts, boards.
- Expected of every individual, in every role across the system.
- Grounded in capacities to see patterns clearly, engage in useful dialogue for meaning making, and select actions that optimize the self-organizing power of the system.

Simple, elegant, powerful Adaptive Action, when implemented throughout a system, sets conditions for adaptive learning that is inquiry based, locally determined, focused on fit and coherence, infinitely variable, based on and responsive to diversity, AND simple. In addition, and perhaps even more important, Adaptive Action supports replicative learning. If What? and So what? reveal closed, focused, simple systemic relationships, and if replication, consistency, and reliability are called for, then the Now what? will be designed for prediction and control. While engaging in Adaptive Action, systems can teach and learn both Newton's dog and Newton's theorem, and decide which fits the purpose in a particular situation. Adaptive Action builds individual and system capacity to recognize the need for both, to execute either one, and to develop judgment for which is most fit in a given circumstance.

New Haven—A Case in Point

In New Haven Unified School District (NHUSD), in Union City, California, an experiment is underway to do just that—to use Adaptive Action to teach both Newton's theorem and Newton's dog. New Haven is collaborating with the Ball Foundation and the Generative Learning Center of the Human Systems Dynamics Institute to set conditions for adaptive learning throughout their system. Their experiment began less than a year ago, and the results are promising.

The first step was to frame Adaptive Action as both the content and process of systemic transformation. Three simple, direct, and powerful questions simultaneously capture the processes of teaching and learning: What? So what? Now what? Administrators can use Adaptive Action to set conditions across the system, to manage, and to lead. Teachers can use Adaptive Action to collaborate with their peers and to diagnose and support learning for each child, as well as to satisfy mandates. Staff members can use Adaptive Action to optimize resources and processes to support the mission of all—setting conditions for adaptive learning. Board members, parents, and students can use Adaptive Action to see and influence the patterns that enable and reinforce learning. Our experiment at New Haven is in its early stages, but we already see people across the system using Adaptive Action to transform learning for children and adults and to transform the systems that support their learning.

With an adaptive definition of learning, the next step was to provide powerful, easy to use models and methods to operationalize the learning. We needed to make it easy to ask and answer the Adaptive Action questions in ways that inform meaning making and action. Over the years, the Ball Approach and human systems dynamics have created a suite of useful tools for educational transformation. A subset of those have been adapted (Adaptive Action, again) to fit smoothly into educational environments and to respond to educational challenges. Examples include models that focus on Adaptive Action related to patterns of conflict, freedom and constraint, simple rules, instructional decision-making, dialogue, planning, sustainability, communications, and group dynamics.

The third step was to share, model, coach, and reinforce Adaptive Action in the context of a community of learners. New Haven Unified School District was the first community to participate with us in this experiment of transformation through Adaptive Action. In previous years, the district developed a relationship with the Ball Foundation and had worked in partnership to improve the work of the district. Two instructional leaders from New Haven participated in a Human Systems Dynamics Professional (HSDP) certification training designed specifically for educators. On their advice, and with funding from The Ball Foundation, the district initiated an HSDP certification for 50 teachers, administrators, and staff from across the district. One board member even took vacation days from work so she could attend the class. Reunions, coaching, and shared practice followed the initial training, and 50 more people are currently participating in a shorter course designed for change agents in all parts of the system.

Even before the first session of the training was complete, the implementation steps ended; and the incredibly diverse, massively entangled, and totally transforming cycles of teaching and learning began. The system began to self-organize in adaptive patterns that acknowledged and resolved tensions that were unique to the district's historical, present, and future challenges. The changes continue to emerge in some of the most surprising places and ways. Every interaction with the district surprises us with stories about the speed, scope, and power of the Adaptive Action transformations.

I don't know if others would call this education reform or transformation or something completely different, but Adaptive Action by players across the district is setting conditions for individuals to learn; and as they learn, they improve the conditions for learning. Systems folks call this a virtuous cycle.[15] What we see is a generative cycle in which learning begets learning for individuals, teams, classrooms, buildings, and central office staff. Learning, in turn, informs systemic transformation at all levels of the institutional structure. Every level of the system is consciously assessing and improving every facet of the teaching/learning environment.

It is way too early to see whether and how these changes influence student achievement, but it is hard to imagine that they won't. An external evaluation will provide objective evidence about the change, but in the meantime the stories of transformation are thrilling.

- The School Board created its own simple rules, so Board members can use Adaptive Action in their decision making.
- The performance appraisal system for administrators is being revamped to support and reflect adaptive planning and learning.

[15] Senge, P. M. (1990). The fifth discipline: The art and practice of the learning organization. New York: Doubleday/Currency.

- A fifth-grade teacher helps students use Adaptive Action to assess and improve their own reading skills and class participation.
- Long-held divisions between staff members and administrators are being confronted and diminished.
- People report less personal stress, more professional resilience, and more fun.

In recent story-telling sessions, New Haven administrators, staff, and faculty reflected on the changes they've seen.

- "So we're not just looking at the issue at that one level but looking up and down and across the district."
- " . . . the change in the way people in the district think and interact has been pretty dramatic . . . . I think that there's a lot more focus on what we're doing, how we're doing it, and what impact and effect it's having."
- "My kids say what's true and useful in class. My kids will ask themselves, "Well, is this something true and useful that will contribute to the class?" They understand it."
- "So the "What? So What? Now what?" questions have been very helpful because I can help teachers develop skills that they can use without me."
- "I've had some positive interactions with the union, which were big issues and, knock on wood, we're on the same road now."
- "What I've been doing is trying to get to the core. What is the real serious issue going on so we can actually start to solve it?"
- "As a site, we're doing a focused discussion about students. . . We pick a range of students, and we meet and we collaborate about what's working, what's not working. What are some strategies that are working really well for this long-time English Learner? Or what can we do for these high-achieving students to further challenge them? . . . and we are having some great discussions."

Ultimately, parts of the New Haven community may accept and implement best practices or others' ideas for improving schools and schooling, but they will only adopt the ones that fit (or can be adapted to fit) in their unique community. When tried-and-true methods aren't available, they will discover their own ways to set the conditions for learning and ways to learn from the conditions they set.

Theories and Dogs

We have ample proof that the replication-learning approach to changing educational systems can create as many problems as it solves. We institute high stakes tests to be sure that every child replicates acceptable performance. We define a set of "best practices" and propagate them, even into situations where they do not fit. We enforce structured and repetitive learning strategies as if they were the best learning environment for all children. Alternatively, we open a wide range of choices and give kids total freedom, whether or not they want or need it. Learning by replication is good for some things, but it also locks us into answers that are not fit to purpose for every child in every place or every time. Even worse than that, debates about what should be replicated draw us into endless dialogues balanced between interdependent pairs of worthy outcomes. Should we support freedom or consistency, independent or team performance, cultural diversity or equality, or teacher-focused or student-focused learning? A replication-based educational approach has to decide. An adaptive one continually asks the questions and determines what fits best for each child in each situation.

Proof is accumulating that adaptive learning may form a foundation for change that is simple enough to disseminate widely and quickly; flexible enough to allow for standards and individuation in education; and generative enough to prepare all of us and all levels of a system for the exciting and uncertain future ahead. Perhaps, when we devote the time and resources to learn Newton's dog, we will be better prepared to choose and teach the theories that will serve all of us well.

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