

## **A Complexity Response to Funding Public Education**

Alexander R. Dawoody, Ph.D.  
Marywood University  
Scranton, PA 18509

## **A Complexity Response to Funding Public Education**

Alexander R. Dawoody, Ph.D.

### **Abstract**

Financing public education and assuring compliance in terms of achievement, accountability and access is a challenge both for governmental entities and school districts. Tying the federal dollar to criteria for academic progress yielded many reforms in public education, such as No Child Left Behind (NCLB). Unfortunately, these reforms failed to achieve their intended goals because of their linear approach toward problem-solving. Treating the financing of public education from a complexity perspective and utilizing approaches such as the Agent-Based Model not only would uncover the fallacies of the linear approaches but also offer new directions and possibilities toward progress that can utilize autonomy, interconnectedness, mutual causality and shared responsiveness. This article will offer such a complex approach toward resolving the linear approach in funding public education.

**Keywords** : Public Education, Agent-Based Model, Autonomy, Complex Adaptive System.

## **A Complexity Response to Funding Public Education**

### **Introduction**

Funding public education is a task that has always been left for the state and local governments. Revenues were often earmarked by property tax or other sources allocated within the general revenue. The disparity in revenue based on property value had created a disparity in funding public education. As a result, local school districts in lower revenue resources suffered in providing quality education for their students. To remedy this problem, the federal government stepped in to provide relief in a form of federal dollar. One of these initiatives was the Bush administration's No Child Left Behind (NCLB) program. This program ties federal dollar to performance. Schools with demonstrated success that are measured through students' tests are eligible for federal funding. Schools that are unable to meet these requirements will have their funding cut and may face closure. This linear approach in tying performance to funding, without realizing the complexity of the whole array of interacting forces that come into play within this performance is refocusing public education in the United States by shifting education toward test-based initiative, threatening of producing a cadre of students that will lack real life experiences based on real educational values. This paper will address the fallacy of such an approach and present in its stead a complexity approach dynamics in funding public education that will answer the dilemma created by NCLB.

When viewing funding public education according to the prisms of complexity science, we embark on a different perspective that will lead us to new possibilities we did not possess before. Within these possibilities we are able to respond to the challenges of today and prepare our education system to correspond with changes in its environment. Funding public education as a system has a better possibility for sustainability when observed as an interconnected matrix and web of association with each unit interacting within it as an autonomous agent, without any unit exerting control or constraint, with the entire matrix operating as an evolving dynamic system capable of responding quickly and effectively to unforeseen changes in the environment.

Sadly, the unintended consequences of NCLB and future comprehensive policies are deeply rooted in the linear political system itself and in the linear budgetary process in particular. To shift the dynamic from failure to success, the government must transform its thinking from a linear approach toward a systemic complex approach. In order to do so, funding of public projects and programs must encompass a new perspective that is invigorating, adaptive, complex and sensitive to changes in the environment. This new approach needs to encourage autonomous decision making and eliminate the outdated zygote of control, linear causality, predictability and the outmoded belief that long-term planning by itself will prove a match to the unfolding complexity of public education.

In a world of uncertainty, we can no longer rely on a naïve confidence that long term results can be accurately predicted. Instead, the emphasis needs to shift to a much greater flexibility which prepares any current structure to respond adaptively to unprecedented changes. When changes occur in the environment, we need to have organizations that can allow for changes to take place within their structure even to the degree, sometimes, of collapsing the existing order to make way for the new. This bold and courageous understanding will enable us to embrace change and emergence of the new. Indeed

we are finally beginning to recognize that stasis is not what s inevitable but radical, in the etymological sense of “getting to the root,” transformation is.

Wall Street Journal columnist Gerald Seib noted, “A political system that expects failure doesn’t try very hard to produce anything else,” (Seib, 2008: 1). The funding of public education, like any other public program, must be recognized as a political process. Budgets are political documents (Wildavsky, 1980: 16). For a budgetary process to work, incremental measures should be taken by the federal government instead of a comprehensive approach(Lindblom, 1959: 8). Whenever the federal government engages in a comprehensive systemic approach, the result often yields unintended consequences. Because of this, budgetary processes have often been measures to avoid failure. Such a mantra is rooted in the linear thinking of public policy and creates a form of self-defeating circular logic that has severe negative consequences.

Figure 1 illustrates the circular logic of NCLB that leads from one failed situation to another. When a school district is performing low due to lack of funding, teaching and technical capacities or curriculum (as it is showing in Stage One of the circle), NCLB will penalize this district for such a failure and federal funding will be withheld (as it is showing in Stage Two of the circle). This continues until performance is improved. To meet this challenge, however, school districts will have to rely on local funding to improve their performance (as it is showing in Stage Three of the circle), but when local funding is not capable of meeting the demands of improving public education or NCLB requirements, performance will further deteriorate (as it is showing in Stage Four of the circle), a condition that will lead to further decrease in federal funding (as it is showing in Stage Five of the circle), up to shutting down the targeted low performing school.



Figure 1: NCLB Circular Logic

## Complexity and Funding Public Education

Complexity offers a new direction. It is a perspective that opens up possibilities for consideration of multiple perspectives and unexpected order (Wheatley, 2006: 33). The model that best explains this new approach in funding public education is the Agent-Based Model (Gilbert, 2008: 13). Using this model, the federal government, the states and the school districts would become agents within a matrix and interconnected network. As Figure 2 illustrates, each agent will be autonomous and interact with its environment, other agents and networks. In this nonlinear point of view, each particular agent has the potential of influencing the entire network as well as other associated networks, benefiting from the so-called “butterfly effect” in which a single event can be dramatically magnified into an exponentially increasing dynamic. Within this transformation, both the agent and the network will go through self-reorganization and restructuring in order to cope with the changes in the environment (Goldstein, 1994).

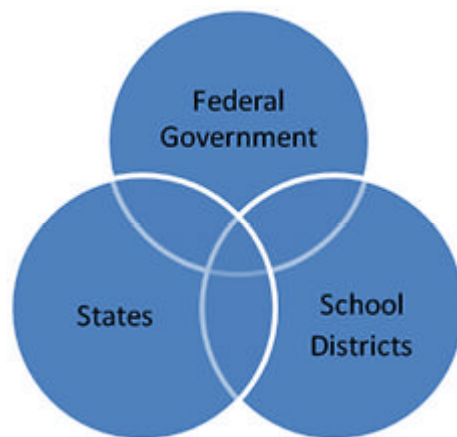


Figure 2: Funding Public Education as an Agent-Based Model

The relationship between the agent and the environment will operate on the basis of mutual causality, with one factor impacting the other, producing feedback that is either positive (more changes in the environment leading to more changes in the system’s structure, and fewer changes in the environment leading to fewer changes in the system’s structure) or negative (a change in the environment initiates a change in the opposite direction within the system’s structure, with more changes in the environment leading to fewer changes in the structure and fewer changes in the environment leading to more changes in the system’s structure) and vice versa (Morgan, 1986: 137). Since the “kick” in the environment is unpredictable, the changes associated with it in the agent can be experienced as random, yet containing the possibility of morphing the agent’s structure from static equilibrium to a state of chaos and disorder with the potential for self-organizing into innovative new structures and practices (Prigogine, 1996: 32-34).

Hence, out of seeming “chaos” new structures can emerge that are sustainable since they are a better fit with the changing conditions in the environment. Any particular state of equilibrium or stability are not permanent but continue to shift as new unexpected perturbations in the environment creates new *dis-shuffling* of the structural order moves it toward phase shifts that produce a new equilibrium (Strogatz, 2001: 81). Because of this dynamic association between the agent and the environment, the

structure will always be able to reorganize itself and produce something new that can thrive more effectively under new conditions (Waldrop, 1992: 217-237).

However, for this dynamic to work, the agent must be autonomous and must be interconnected with other agents within a network of association that is flexible, is more unrestricted, and possesses a greater resiliency in the face of change (Gilbert, 2008: 21). This means the entire network of connected agents and environments form a *complex adaptive system* with a capacity for ongoing adaption to environmental changes (Miller and Page, 2007: 237). If the system is not operating in such a complex and adaptive manner, it will either die completely or result in an unwanted worse state of affairs (Holland, 1998: 112-113). Figure 3 demonstrates such a dynamic. It illustrates the interconnectedness of a complex system that morphs from one stage to another, transforming within each stage into different evolutionary phases that is self-organized and adaptive to changes in the environment. These phases are also circular, moving in a constant state of change from equilibrium to disequilibrium to equilibrium to disequilibrium and so forth. The primary phases of these self-organizing stages start at random from awareness of the environmental changes as a Stage One, morphing to an analysis of the system's structure in Stage Two, leading to the transformation of the system in Stage Three. This is in order to correspond with changes in the environment, and then progressing to sustainability of the complex system for a limited period of equilibrium until another kick in the environment forces a new set of changes, leading the complex system once again to go through the same self-organizing dynamic of awareness, analysis, transformation and sustainability.

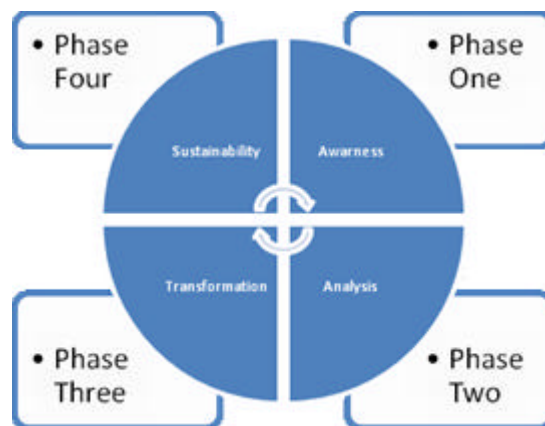


Figure 3: Complex Adaptive System

Funding public education is better thought of as a complex adaptive system along the lines of scenario described above. In order for public education to live within a continually changing environment, it must act (and be funded) as a dynamically adapting system. This complex system is composed of many interacting and autonomous agents residing in the federal government, the states, as

well as the local school districts. Each agent is associated with the other as partners. In such a scheme, no single agent is posited as in a position of control or centralized decision-making. Instead, the autonomy and network nature of the associations among the agents make possible a continuing transformation of internal structures meshing more suitably with changes in the external structures making up the environment. The complex network is characterized as:

1. Transparent in its operation to those both within and outside observing it;
2. Operating out of mutual causality and influence;
3. Focusing on the present moment where adaptability proceeds and accordingly realizing that long term predictions and planning may drastically alter in the “fog” of battle;
4. Pattern seeking by way of creative disequilibrium and disorganization that enables an ongoing shifting into new structures;
5. Paradoxically preparing for unexpected consequences and uncertain outcomes;
6. Evolving by benefiting from the “butterfly effect”;
7. Self-transcending in the sense of emerging out of the interactions of autonomous agents (Goldstein, 2007).

## **Conclusion**

Newton’s laws of physics and the subsequent linear interpretation of the world that came out of it were obviously a tremendous step in progress for human knowledge that unveiled new frontiers and understanding of the world around us, even enabling humans to land on the moon. The Newtonian understanding went way beyond physics as such shaping the other natural and social sciences. It was the accomplishments of that world-view which led to the undergirding of much of modern decision-making processes, analytical thinking and interpretations of the world (Kauffman, 1993). However, new discoveries in sciences and mathematics have revealed an entire new world understood much better through the constructs of complexity that strict linear analysis is incapable of producing (Kiel, 1999:69). The new findings transcend a narrow focus on linear rationality, singular cause and effect, certainty, predictability, hierarchy, formal organization, centralization and control, even inertia in the face of change (Wheatley, 2006: 26).

In public policy and administration the new science of complexity offers new solutions that the old Newtonian science is incapable of entertaining (Morcol and Dennard, 1999: 245). However, this frontier is so new and despite its already proven success in so many arenas of application, it has not yet been widely accepted or practiced. Nevertheless, now seems to be an opportune moment to relook at the problems within our current political and administrative structures and come up with new solutions.

The fact is that the world is not linear (Strogatz, 1994: 9). We cannot predict the future, and we live in a constant state of uncertainty (Prigogine, 1996: 29). Building our public education system and its funding solely on an unwarranted belief in predictable, long-term planning is futile at best, and potentially catastrophic. Instead, we have to treat each unit within the public education system as an autonomous agent. These agents exert influence on other agents and the system as a whole. With such an

understanding, long-term budgeting must be welded to flexible and short-term budgeting that can adjust according to the unpredictable changes in the environment.

Autonomous agents in interaction with each other have the potential for generating funding in ways that have not previously even been imagined. Moreover, because these agents are embedded in a larger network of connections, they can rely on each other and the system of the whole in a manner not thought possible before. Collectively all agents work together in order to operate as one while maneuvering and making decisions as autonomous units. Surplus revenue in a particular unit that is not used due to larger revenue can be allocated to future growth of that particular agent or to support other agents that lack funding. And this process of allocating resources is one that is constantly evolving and adapting to new fiscal constraints and resources.

Policies such as NCLB will have to be modified so that funding will no longer be linearly linked to shallow measures of performance as a precondition. Competition for limited funding can be replaced collaborative problem-solving for sake of promoting one another based on mutual causality. The federal government of course needs to act as a supporting agent in such a network of association in order to facilitate the growth of other agents such as the states and the school districts. Just as local school districts can generate their funding locally through property tax and other sources of revenue, the federal and state governments, understood as hierarchically arranged agents themselves can supplement by providing additional funding based on need. This is a network emerging complex system that can produce synergies capable of adapting rapidly to changes in the environment. Indeed, the current world-wide economic crisis can be seen as a test site for a new complex system understanding of the funding of education.

This brings us to the issue of accountability. Since funding will no longer be tied to performance, other measures for accountability must be enacted in order to assure each agent's autonomous growth that is part of the system's overall synergy. In order to establish such accountability for individual autonomous agents, the system itself will be accountable. This means that measures for growth in educational performance have to meet medium parameters established by the system as a whole and within the collaborative efforts of its individual autonomous agents. This medium is not measured by the current day standards of testing as set by NCLB. Rather it is left for the individual autonomous agents within the system to decide. The associations within the network will be coordinated towards pushing the internal dynamics to achieve meeting that parameter or excel beyond it. Agents that are incapable of meeting the medium parameter will be assessed by the system as a whole in order to uncover the causes for their shortcomings and help them overcome their difficulties. This is how complexity answers the problems of funding public education.



## About the Author

Alexander Dawoody is assistant professor of public administration at Marywood University. He received his Ph.D. in Public Affairs and Administration from Western Michigan University. He also holds four master degrees in Philosophy, Health Administration, Public Administration and Education that he received from Western Michigan University, Suffolk University and Cambridge College, respectively. Dr. Dawoody is the author of several books and journal articles on complexity and public policy and has presented numerous research articles on this topic at various professional conferences. He can be reached at [aldawoody@aol.com](mailto:aldawoody@aol.com).

## References

- Gilbert, N. 2008. *Agent-Based Model*. Los Angeles: Sage.
- Goldstein, J. 1994. *The Unshackled Organization*. Portland, Oregon: Productivity Press.
- Goldstein, J. 2007. "A new model for emergence and its leadership implications." In J. K. Hazy, J. Goldstein and B. B. Lichtenstein, Eds., *Complex Systems Leadership Theory*. Mansfield, MA: ISCE Publishing Company, pp. 61-92.
- Holland, J.H. 1998. *Emergence from Chaos to Order*. Cambridge, MA: Presus Book.
- Kauffman, S. A. 1993. *The Origin of Order*. NY: Oxford University Press.
- Kiel, D. 1999. "The science of complexity and public administration." In g. Morcol and L. Dennard. Eds., *New Sciences for Public Administration and Policy*. Burke, VA: Chatelaine Press, pp. 63-80.
- Lindblom, C. 1959. "The science of muddling-through." *Public Administration Review*, 19(1):79-88.
- Miller, J. and S. Page. 2007. *Complex Adaptive Systems*. Princeton: Princeton University Press.
- Morcol, G. and L. Dennard. 1999. *New Sciences for Public Administration and Policy*. Burke, VA: Chatelaine Press.
- Morgan, G. 1986. *Images of Organization*. Beverly Hills, CA: Sage Publications.
- Prigogine, I. 1996. *The End of Certainty*. NY: The Free Press.
- Seib, G. 2008. "Pump prices hurt Americans not just in pocketbook." *The Wall Street Journal*. Available at <http://blogs.wsj.com/politicalperceptions/category/gerald-f-seib/> [Retrieved on July 9, 2008].
- Strogatz, S. 2001. *How Order Emerge from Chaos in SYNC*. NY: THEIA.
- Strogatz, S. 1994. *Nonlinear Dynamics and Chaos*. Cambridge, MA: Westview.
- Waldrop, M. 1992. *Complexity: The Emerging Science at the Edge of Order and Chaos*. NY: Touchstone Books.
- Wildavsky, A. 1980. "The self-evaluating organization." In D. Nachmias, Ed., *The Practice of Policy Evaluation*. NY: St. Martin Press, pp. 441-460.