Philosophical Foundations for Systemic Mentoring at the Timbuktu Academy

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Introduction

Established in 1990, the Timbuktu Academy[1] is a research-based systemic mentoring program at Southern University and A&M College in Baton Rouge (SUBR), Louisiana. It is named after the former University of Timbuktu, a bastion of scholarship in the middle of the second millennium. The city of Timbuktu, in Mali, West Africa, is located on the left bank of the majestic Niger River. SUBR is similarly located on the left bank of the mighty Mississippi River.

We define mentoring[2] as the dynamic sum of a host of processes and activities through which the young generation is prepared to take its responsibilities in enabling the continual betterment of life. The somewhat amorphous nature of these activities stems from inherent differences between the sets of mentoring activities at home; in precollege school, college, or graduate school; or in public or private organizations. In all cases, however, mentoring entails communicating substantively, supporting significantly, and challenging appropriately. To be systemic, mentoring has not only to be comprehensive; it must also be woven through the core activities, values, and reward systems of an organization or academic department.

Philosophical Foundations of Systemic Mentoring

The ubiquitous need for mentoring is established diagrammatically in the first document at the Web site noted in the box below. An itemized, retrospective review of the career path of the most successful individual, from the precollege

days to professional life, shows the critical role played by mentors in various stages of the continual growth of that individual. *We have not yet found an exception to this pattern!* In particular, the more complex the tasks to be performed, the more critical is the role of mentoring. Learning or doing research in science, technology, engineering, or mathematics (STEM) is an extremely complex process. Hence, the need for mentoring in STEM disciplines, from precollege to graduate school and beyond, is significant, but it has only started to get the attention it needs.

Mentoring a youngster to be a religious leader or a research scientist, if done properly, should be guided by a quasi-exhaustive inventory of critical knowledge and skills that underpin success in these professions. Consequently, the principles enunciated below are to guide the systemic mentoring of a precollege, college, or graduate student in any of the STEM disciplines. Their sum constitutes the paradigm of the Timbuktu Academy for its precollege and college mentoring processes and activities, the aim of which is to produce competitive scientists, engineers, and mathematicians. The principles are based in part on the fact that there is no substitute for mastery of the applicable language, mathematics, science, and engineering subject contents and skills. In a way that complements teaching, mentoring therefore serves to ensure the mastery of these contents and skills while also demonstrating attendant skills that are germane to success in the STEM careers. Succinctly, the following principles constitute the essence of our philosophy of mentoring.

Timbuktu Academy at a Glance

The first document at the Timbuktu Academy Web site provides a comprehensive description of the academy's goals and objectives, the design principles that constitute its paradigm, its component programs, a 10-step guide to systemic mentoring activities, and its results to date. This document provides sufficient details to enable an adaptive replication of the academy at home, at school, in college, in research laboratories, or in public or private organizations.

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Languages are the vehicles of thought.

This tautology holds for thinking in mathematics, physics, engineering, materials science, or in any other discipline of study. Consequently, our programs and activities pay continual attention to the development and enhancement of *English* and communication skills, from the elementary- grade level to graduate school and beyond.

Mathematics is the language of STEM disciplines.

In fact, anecdotal evidence exists, in many countries, to indicate that the dearth of majors in STEM fields at the college level can be traced to the inadequate exposure of precollege students to the proper sequence of mathematics courses.[3] We therefore place a great emphasis on the enhancement of the mathematics proficiencies of scholars at the academy. For precollege students, this emphasis is

credited with over 80% of participants enrolling in college STEM curricula. For undergraduate STEM students, it has enabled successful graduate pursuits, up to the doctorate.

Recognize and respect the hierarchical or taxonomic structure of knowledge in most STEM disciplines.
Specifically, some arithmetic and algebra are needed to excel in calculus, the same way that some basic vocabulary and grammatical rules are necessary to compose meaningful prose. This obvious principle, it turns out, is very often the one violated by students and many programs purporting to prepare them for STEM careers. Namely, a rigorous and professional approach is needed to determine the proper sequence in which STEM knowledge and expertise should be built, depending on the selected field. Many college students and their advisers still continue to deal with this issue in an anecdotal fashion, with dire and often unavoidable consequences. Advisers, we presume, are the ones in a position to know that extreme difficulties in some STEM courses, for a student devoting adequate time to the learning tasks, are often due to an inadequate background and not a lack of intrinsic "smartness."

Before the advent of the printing press and the subsequent growth of formal schooling, academic and nonacademic training mostly occurred in apprenticeship contexts, i.e., mentoring. A general review of sociocultural conditioning, including the acquisition of value systems, suffices to make the point. Our fourth design principle is therefore:

Recognize that mentoring is the coupling between teaching and learning, on the one hand, and between research and education, on the other.
Even in a private corporation, mentoring seems to be the mechanism by which competitiveness is preserved from one generation to the next.

The law of human performance[4] is our extension of the power law of human performance[5-6] or of practice.
The power law of performance or of practice (PLP) is perhaps the most stable of the laws in cognitive science. It states that the time (T) it takes an individual to perform a given task decreases as the number of times (N) the individual practices the task increases. In mathematical terminology, the power law[5] is:

$T = A + B (N + E)^{-p}$ or $T = A + B/(N + E)^{p}$

where A, B, E and p are constants that vary with the task at hand and with the individual performing the task. The constant A represents a physiological limit. The constants B and E partly denote prior experiences before the beginning of the practice sessions, and p is the learning rate. In essence, PLP states that practice renders perfect. This law applies to the performance of sensory-motor (or athletic), creative (or artistic), and cognitive (or intellectual) tasks. The shorter the time taken to perform the task--completely and correctly--the higher the level of proficiency. Hence, as the number of practices increases, so does the proficiency of the individual.

- The law of performance does not need to be explained to anyone in the realm of sport or the arts. Athletic and artistic champions, irrespective of

1. The Timbuktu Academy (http://www.phys.subr.edu/timbuktu.htm), 2001. The very first document at this site provides extensive details on the paradigm and results of the Timbuktu Academy.
2. D. Bagayoko, R. L. Ford, E. L. Kelley, Fundamentals of Mentoring and Networking, in *Scholarly Guideposts for Junior Faculty* (Quality Education for Minority Network, Washington, D.C., USA, 1999).
3. Global Education Database and online resource: United Nations Educational, Scientific, and Cultural Organization (UNESCO) and the U.S. Agency for International Development (U.S.-AID): http://www.usaid.gov/educ_training/ged.html or http://qesdb.cdie.org/ged/index.html
4. D. Bagayoko and E. L. Kelley, The Dynamics of Student Retention: A Review and a Prescription, *Education* **115** (1), 31-39 (1994).
5. A. Newel, and P. S. Rosenbloom, Mechanisms of Skill Acquisition and the Law of Practice, in *Cognitive Skills and Their Acquisition*, J. R. Anderson, Ed. (Erlbaum, Hillsdale, New Jersey, 1981).
6. K. R. Boof, L. Kaufman, J. P. Thomas, *Handbook of Perception and Human Performance, Vol. II, Cognitive Processes and Performance* (John Wiley and Sons, New York, New York, 1986), pp. 28-71.

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