2006-647: TEACHING TECHNOLOGICAL LITERACY AS A QUEST, OR "SEARCHING FOR SELF IN THE ENGINEERING COSMOS"

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Teaching Technological Literacy as a Quest,
Or "Search for Self in the Engineering Cosmos"

Abstract

At an April 2004 NSF-NAE faculty workshop on teaching Technological Literacy at the undergraduate level, it became obvious that:

There was no consensus definition of "technological literacy," and
There was no consensus format among the twelve presenters of technological literacy courses.

Why would twelve different faculty develop "technological literacy" courses absent any common, simple definition ? The premise of this paper is that the voluntary creation and teaching of such a course represents, broadly speaking, a kind of academic quest, wherein the protagonist sets out on a large voyage to explore the history and modernity of his/her discipline, and more deeply, his or her own place in the engineering cosmos, by the learning which comes through the development of such a multi-dimensional course. This hypothesis is illustrated using the author's experiences, and examples drawn from the 2004 NAE-NSF workshop.

Introduction

At a recent engineering workshop for Technology Literacy, sponsored by NSF and held at the NAE [1], the faculty presenters consisted of a few forty-somethings and an easy majority of engineering elders. Why would an "old guard" be the dominant course inventors for this topic, when new engineering courses are typically initiated by younger faculty ? Why would accomplished senior researchers and a former dean and department heads teach a course characteristically populated by undergraduates outside their departments and college? And why did no consensus technology literacy emerge at this workshop, when undergraduate engineering courses are famous for their uniformity within the US, due largely to common utilization of a few widely accepted texts in each discipline?

Reflection on the individual presenters showed that their academic journeys were logically similar in origin, but not in structure. The dominant majority were simply teaching the understanding of technology, or colloquially "How Stuff Works ," from the point of view of their individual disciplines, as illustrated in Table 1 [2]

TABLE 1 Technology Literacy Courses Titles and Instructors [2]

Course title	Instructor
Designing People	James Baish, Bucknell University

Converging Technologies .... Robert Balmer, Union College
How Things Work, Physics 105 and 106 .... Louis Bloomfield, University of Virginia
Technology and Human Values .... Stephen H. Cutcliffe, Lehigh University
Science at Work: Technology in the Modern World ...... Kate Disney, Mission College
Fuel Cell Systems... Camille George, University of St. Thomas
The Hidden World of Engineering................. William Hammack, University of Illinois
Science and Technology of Everyday Life .... John Krupczak, Hope College.
The Digital Information Age..Roman Kuc, Yale University
The Engines of Our Ingenuity.......................... John H. Lienhard, University of Houston
Engineering in the Modern World ...... Michael Littman and David Billington, Princeton
Electrical Machines and Information Technology Systems ..... Deborah Mechtel, USNA
Technological Literacy: How Things Work……..David Ollis, North Carolina State Univ.
Technology 21... Albert J. Rosa, University of Denver
Electrical Signals and Systems............................... Albert J. Rosa, University of Denver
Innovation, Invention, and Technology ....Tarek Shraibati, CSU-Northridge.
Introduction to Computer-Aided Graphics Tools ....Tarek Shraibati, CSU-Northridge
Technology and the Human Built World ....Krishna Vedula, UMass.-Lowell
Engineering for Non-Engineers………..……………Larry Whitman, Wichita State Univ.

For example, Lou Bloomfield (physicist) presented the “Physics of Everyday Life”, Roman Kuc (electrical engineer) explained computers and computing, and David Billington (civil engineer) and Michael Littman (mechanical engineer) discussed the relevance of buildings, bridges, railroads, and ships to Western civilization, the US in particular. This chemical engineer author, an academic researcher in photochemistry using light-activated semiconductors, described his technology literacy lab containing more than a dozen modern devices, many of which were light-activated or otherwise involve light in their functions: bar code scanner, compact disc (CD) and digital video disc (DVD), reader-“burners”, facsimile (FAX) machines and scanners, optical fibers in medicine and communications, photochemical water purification, and film and digital cameras. Why such diversity of disciplinary training (physics, aeronautical, electrical, mechanical, industrial and chemical engineering), what consensus background, if any, would provide credible training for Tech Lit instructors ?

Said differently, these faculty were interpreting their own engineering discipline to a wider, non-technical audience. The message at first appears to be professional: each instructor was simply playing his/her area of research and professional expertise into explanation of a particular portion of technology, an area in which some level of instructional comfort was needed and obtained. However, even within local comfort zones, the course were remarkably varied: some with lab, some without, most but not all with lecture demonstrations, some co-taught, most not, credits ranging from 1 to 4 units. Again, the problem with such structural variability, what common ground exists? With such individual structures, how could a consensus format be found, and eventually utilized to recruit more US engineering faculty in technology literacy instruction ? What arguments could be found to induce an increased engineering faculty interest in helping to make the US population, beginning with undergraduate students, more technologically literate, as urged by the National Academy of Engineering [3], and sponsored by the National Science Foundation ?

Consensus in motivation: Seeking self through the adventure of teaching

Why would twelve different faculty develop “”technological literacy” courses absent any common, simple definition ? The premise of this paper is that the voluntary creation and teaching of such a course represents, broadly speaking, an academic quest, wherein the protagonist sets out on a large voyage to explore the history and modernity of his/her discipline, and more deeply, his or her own place in the engineering cosmos, by the learning which comes through the development and teaching of such a multi-dimensional course.

Let us imagine each presentation example to be a particular story genre: an adventure. Analysis of this genre summons the talents of literature faculty. Here we draw upon English professor Thomas Foster and his intriguing book How to Read Literature Like a Professor[4], and its more enticing subtitle “ A Lively and Entertaining Guide to Reading Between the Lines.” His opening salvo, “Every trip is a quest”, argues that each adventure story posses five characteristics:

A quester
A place to go
A state reason to go there
Challenges and trials en route, and
A real reason to go there.

In the context of teaching technological literacy, the quester is the instructor who sets out to construct and teach such a course, the place to go (physically) is the lecture hall and laboratory and (intellectually) the literature on technology in all aspects. The stated reason to go there is to address students’ need for knowledge about “How Stuff Works” in their material world. The challenges and trials en route include gathering materials and devices, fighting and surmounting faculty and administrative hurdles, persisting despite lack of collegial support, developing a new course absent a consensus format or materials, and frequently, teaching the course as an instructional overload [2].

Foster argues that the protagonist’s real reason to ”go there’ is never the stated reason. Rather, the real reason for a quest is always “self-knowledge.” In this paper the author explores his experiences in starting and teaching a “Tech Lit “ course, and finds indeed that his “real reason” is more compelling than my stated reasons. Drawing on examples of other presenters from the 2004 NSF/NAE faculty workshop, this finding is generalized to a substantial number of the presenters. The utility of this result is that the quest for self-knowledge among engineering educators may provide a common motivation for teaching technology literacy. If so, it provides a clue for recruiting new candidates to join the enthusiastic, but thin, ranks of current technological literacy instructors.

Reconstructing this quester's voyage: beginnings

My voyage began early, and is ending with the recently created Tech Lit course as the 'dessert" in a long buffet line of learning opportunities. The initial leg of this engineering adventure was the personal growth through summer jobs (Table 2) to learn firsthand, if haphazardly, "How Stuff Worked

Table 2 One engineer's summer education

Summer Activity	Age	Location
Felling trees, cutting wood	8-10	Home
Pouring concrete	10-12	Home
Building a garage	13	Home
Picking fruit	14-15	Community
Repairing roads	5-16	Community
Baking	16	Bakery
Drawing blueprints	17	Navy
Manufacturing composite pipe	18-19	Industry
Chemistry lab analysis	20	Campus
Manufacturing soap/detergents	21	Industry
Testing refinery pilot units	22	Industry

The first experiences were taught by my father, and led to understanding how a house worked. I moved into comprehension of the local rural community via opportunities to pick summer fruit and trim orchards, and to repair road potholes, drill a water well, and lay water pipe. A summer month with a high school classmate in a local bakery educated my sweet tooth on the "construction" of cakes, pies, and even bear claws and donuts. The bakery failure immediately after our departure was my introduction to the consequences of poor management practices.

The transition from high school generalist to specialist engineer came next. A post-high school technical stint of tracing drawings for the Navy was followed by a first factory job as a summer substitute in lines for manufacture of asbestos-cement composite water pipe. My first disciplinary experience was as a chemistry research assistant, measuring radionuclide levels in sewage across the nation, a simple means of tracking radiation fallout from Pacific nuclear tests in vogue at the time. The oldest chemical factories were gravity fed, as illustrated by a post-graduation summer manufacturing soaps: the raw coconut hulls were unloaded from ship up to the top floor, descending one floor in each operation of formulation, blending, packaging, and shipping. An MS degree was followed by an industry year operating small scale refinery processes, and learning computer programming.

Along the undergraduate way I certainly took and survived many classes, though in retrospect I probably regarded most more as obstacles rather than enlightenments on my path to engineering. My deepest learning and sense of confidence for "how stuff works" arose largely from the easily remembered summer activities vs. the now very hazy course topics of academia. "Hands-on" was clearly the best path for this prospective engineer, a lesson I returned to practice decades later through the creation of a campus device dissection laboratory to allow others to understand "HowStuffWorks."

Reconstructing this quester's voyage: middle and ending

Graduate study began the formation of this chemical engineering scholar, and research opportunities led from catalysis for oil refining and chemical synthesis (graduate life) to biocatalysis and the emerging field of genetic engineering, (assistant professor period) and finally to the fascinating if very narrow and newly created domain of photocatalysis: the use of light-activated semiconductor oxides (TiO_2, ZnO) for air and water remediation, and for self-cleaning surfaces. The narrower the field, the greater the scholarly impact: this author's research reputation is based largely upon a small set of papers in the photocatalysis domain.

Accumulating by age 50 an appreciable research success through increasing narrowness, albeit a productive one labeled scholarship, in the early 1990s my path began broadening. My research group focus had been narrow, as befits most PhD groups. To better prepare my graduate students for the broader world which might have no interest in the as yet uncommercialized photocatalysis area, I created a graduate Photochemical Engineering course, and explored the broader topical range of photography and xerography, of microlithography in microelectronics and microfabrication, of light-based water purification, and photovoltaic energy conversion and storage, and of environmental photochemistry including smog formation and ozone hole creation.

With such broadened graduate training, this breadth was next propagated into undergraduate instruction, becoming yet more general through creation of a device lab for entering engineering students. The range of devices originally encompassed light-driven contraptions (bar code reader, CD and DVD players and "burners", FAX and scanner machines, black and white photocopiers and film, digital cameras, optical fibers in medicine and communication, and water treatment), and presently is yet broader through incorporation of music (electric and acoustic guitars, electric piano), power (electric drills, internal combustion engine) and transportation and biomechanics (bicycle). My initial lab was utilized as a first year engineering course, conceived to introduce new students to the devices which engineers have created, and thus to define engineering early as an activity dominated by device design, fabrication, and repair, rather than by math , chemistry, and physics[5].

Having now incorporated devices from a range of engineering disciplines, a next broadening arose through collaboration with the English department to create a first year course in reading and writing about technology, engineers and scientists, and history. The joint offering of device lab with the English instructor's writing course allowed a yet wider conceptualization of engineering through reading and writing of the past via biography and history, and touching the present and imagining the future through the device lab packed with illustrations of the day, immediately familiar. The broader readings for students allowed broader readings for this instructor, of course. At first, these included forays into biographies of standard characters: Galileo, Newton, Babbage and Edison, and into the twentieth century with Jack Kilby, Gordon Moore, Steve Jobs, etc. Movement from these external actors to the author's internals began with the lovely book, Catching the Light [6], the intertwined history of the external light of the world and the internal light of the spirit.

This course pairing worked nicely, as both the English instructor and I sifted and sorted through the myriad possible sources for readings, and eventually created a 600 book lab library on biography of engineers and scientists, inventors and technical entrepreneurs, and history of technology and technology companies [7,8]. The library assembly itself has been a multi-year, continuing activity, involving visiting new and used bookstores in whatever cities my research and teaching conferences were held, as well as sites of family vacations and visits. My slow growth in outlining the scope of technology and science showed signs of maturity when more and more of the same titles were recognized in successive stores as old friends themselves.

Table 3 A chemical research thread: converging then diverging

SUBJECT	AGE	TREND
Chemical catalysis	25-28	NARROWING
Biocatalysis	29-45	NARROWING
Photocatalysis	35-55	NARROWING
Photochemical Eng. Grad Course	50-present	BROADENING
Device first year laboratory	52-60	BROADENING
Tech. Lit laboratory	61-present	BROADENING
Context: historical evolution of device		
Content: 'How Stuff Works"		
Contraption: take apart and assemble		
Case: book analysis (biography)		
Cross-College Collaborations		BROADENING
Devices + Spanish , Design		
and Tech Education	63-present	

The opportunity to teach "Tech lit" and its cast of actors to non-technical students invited thinking about how to best connect such students to the electro-mechanical-optical devices of the lab. Clearly, the need to place these devices in the world of these non-engineering students from various other colleges, meant to create not only content, but context, both historical and personal. The history arose naturally because it allows viewing engineering activity as addressing continuing needs of society in communication, transportation, business and recreation. The personal context connects easily, since the current student generation is probably more surrounded and immersed in technology than any predecessor.

This need for connection, or bridging, using context is not new, of course. Florman's first book, Engineering and the Liberal Arts, argues for the bridge analogy to create specific linkages to arts[9]. Thus, history of technology is a bridge to history, ethics a bridge to philosophy, and sound a bridge to music. The intrigue and pleasure of exploring a "liberal education" I opportunistically pursued with the arrival of the ABET EC 200 criteria, which attempt to spell out not only the technical but the interpersonal and personal attributes of a modern engineer. A survey program organized in the ASEE Liberal Education division led to the co-editing of Liberal Education for 21st Century Engineering [8] with humanities faculty from other institutions, and thereby an accidental introduction to cross-college collaboration, the topic of a subsequent grant.

My technology literacy course itself has been a journey, first of "Trials and Tribulations" [11], then of multiple device and presentation avenues, illustrated by the subtitle "Context, Content, Contraption, and Case" [12]. My particular voyage was foreseen by Ashby [13], who wrote "The path to culture should be through a man's specialism, not by by-passing it … The sine qua non for a man who desires to be cultured is a deep and enduring enthusiasm to do one thing excellently".

In the end, the path has led from a narrow scholarly focus on exernal objects, to an appreciation of engineering, and of my own activity as an engineer, in larger social and educational contexts. While informing students has been pleasurable, doubtless the most informed was this instructor, who now sees his discipline in historical context, and more importantly, according to Foster, through a deepening self-knowledge about my place in the research and education engineering cosmos.

This satisfying, if ethereal, sense of personal substance is deeply rewarding. I have sensed similar feelings among my instructional peers in this area more than those in most engineering courses, probably for two reasons: First, the inherent breadth of the material invites broad reflection, personally satisfying but not professionally promoted by the various external structures (departments, colleges, professional societies, colleagues). Second, the age of the instructor fascinates. Young faculty are not typically present in this activity, for evident reasons: they are starting their research careers and both their research and teaching must be easily judged and rewarded by their engineering colleagues, almost none of whom teach technology literacy. Second, the outlook of the younger instructor is in an earlier, outbound phase of exploration and conquest of research (the stated reason, according to Foster), whereas the senior faculty are more likely to have completed sufficient "stated reason" voyages to reflect more openly and personally on what such academic quests actually produce, including self-knowledge.

Other senior viewpoints

For other senior examples of the instructor as quester for self-knowledge as well as teacher for students, we consider workshop participants John Lienhard, David Billington, and Robert Balmer.

John Lienhard's opening Preface to his Inventing Modern indicates the challenge of representing technology, even after achieving National Academy status in his domain:

> "It would seem only reasonable that, to tell the story of technology, one must first learn something about that great sprawling enterprise. In my case, I worked for a half-century as an engineer and that was after spending a childhood building model airplanes and homemade replicas of all the dazzling new twentieth-century machines. Then I read a whole library-full of books about technology."

The immense satisfaction arising from such a course creation and installation is informally evident from the workshop conversations. The effort has been for most, one of the most personal voyages or adventures. There being no consensus for technological literacy definition, a complete freedom of subject formulation is available. Comfort arises from staying appropriately close to home. The relatedness of the Tech Lit course foci to the disciplinary foci of the instructors is evident in Table 1. This coming together of both reflection and disciplinary comfort leads to a deeply satisfying 'flow," as Csikszentmihalyi [14] would have it, in which the instructor is able at last to explain the origins, meanings, and importance of his discipline, and thus to some extent, himself, in the engineering cosmos.

David Billington is a civil engineer, a member of that profession which historically has done most to explain its designs not only to the corporate administration, but routinely to local , regional, and national public boards and licensing bodies. Here the need for explanation at multiple levels of technical detail, and to hearers of varied backgrounds is most extreme. It is unsurprising that the depth of self-perception of authors in this discipline exceeds that of most others. Billington, in The Innovators, argues that

> "engineering history (is) an interplay of three perspectives: what great engineers actually did, the political and economic conditions within which they worked, and the influence that the designers and their works had on the nation. This three-sided view implies technical discussion, historical context, and cultural impact. We shall discover that the essence of engineering lies not just in natural science, as is usually thought, but also in social science and the humanities"

These are the words of an engineer who has increased his self knowledge, presumably from an early outlook that engineering is derived exclusively from science ("as usually thought"), to the self-knowledge that his discipline, and he himself, act in a theater involving the triumvirate of disciplines: science, social science, and humanities.

Similarly, Lienhard reflects the eventual self-knowledge realized by his generation when he writes

> "We were a people buoyed by our new ability and strength. Not until we had twice watched all our new technology feeding the monster of war did the worm of doubt finally eat into the heart of that childlike assurance."[18]

The implied transition from possessing "childlike assurance" to being possessed by "the worm of doubt" reflects the new self-knowledge, his generations return to

> "where we started
> And know the place for the first time."

Robert Balmer, a former Dean of Engineering at Union College, happened upon his search by yet a different path,

> "For me the insight occurred 20 years ago when I was involved in a new Culture and Technological Studies program at UW-Milwaukee. A history professor (Ray Merritt) received a 5-year grant from HEW to start the program. It included engineering and liberal arts faculty and a multitude of team taught courses. I team-taught with several historians and a philosopher during the life of the program (it quickly died when the funding ran out since the administration was not interested in providing continuing support).
>
> "The program attracted a lot of students and created some important bonds between the engineering and liberal arts faculty involved. In my case it completely changed my life and my way of teaching. For one thing, by co-teaching courses with liberal arts faculty I learned how to face and lecture interactively with a class instead of just talking to the blackboard (a big step for an engineer). Ever since this experience I have used material culture artifacts in the classroom to stimulate interest and discussion about whatever engineering subject I'm teaching. I also published the first engineering thermodynamics textbook that humanized the subject by including interesting personal material about the developers (Kelvin, Watt, Joule, etc,) and the impact of thermodynamic technology on society. Unfortunately my experience and revelations did not rub off onto any other engineering faculty and in the end I was a lone wolf."

The terminal aspect of his early experiences with teaching of technology in the broad context embraced by technological literacy is not uncommon. Sympathy with Don Quixote arises often for faculty seeking to reform their own kind !

Viewpoint from Younger Faculty

Younger participants in the faculty workshop on technological literacy evidenced a distinctly different, and more formal set of motivations for undertaking their individual approaches to technological literacy. John Krupczak, associate professor but seasoned deliverer of courses in this vein comments:

> "If I try to null out all of the various campus and departmental forces that were at work to examine my own motivations, I might suggest that I was driven by personal interest or curiosity to understand the subject matter. I saw teaching the class as an opportunity to pull together many things that interested me under the one umbrella of a technological literacy course.
>
> "I would agree with your idea that understanding how these technical pieces fit together in a larger human-created technical world has been a motivating factor. I think that teaching and working with the material has given me much more insight about the significance (or lack thereof) of my own engineering specialty. It would have been helpful to have had some of this big picture understanding a little earlier on."

The desire to "pull together many things" is achievable within a technological literacy course, which thus serves to catalyze realization of this quest.

Camille George, the youngest presenter at the NSF workshop, offers a distinctly more feminine viewpoint than the previous examples:

> "I am involved in technology literacy for various reasons.
>
> "It is wonderful way to break down the fear of technology, especially for females who for one reason or another believe "it is not understandable". I love to see the "yes, I can do this" and the "oh- so that is what is going on" reactions. I guess I enjoy seeing people become empowered with knowledge, and enjoy engineering.
>
> "I passionately believe that we must do everything we can towards having a truly sustainable future. Our technology is currently unsustainable. The more people I can get thinking about the challenges of the 21st century, the better. If I can inspire even one person per class…then I have accomplished a small step towards sustainability.

> "I love sharing thermodynamics with non-majors. (even at dinner parties) Who could not love the study of energy and energy transformations- we all use energy every day- all day. I guess I really do believe in engineering for benefit rather than engineering for profit. I want to see a better world. I believe technology touches humanity in a fundamental way. It changes our world- let us make sure it really is for the better…
>
> "I want business majors, political science majors, and even theologians to think about technology and society. It cannot just be put in the "engineering building" or some distant part of campus…it matters to everyone, it matters to our economy, it matters in our politics, and it matters from the perspective of human justice."

Searching for other teachers; The messenger is the message

As the achievement is satisfying, and to a great extent, a summary of the individual's life journey, and as this satisfaction appears to be independent of discipline, we may ask the now obvious question : "How many others are out there, eager to 'tell their story' but as yet uninvolved in the presentation of technological literacy?" The impersonality of most engineering courses is absent in much of these renderings, because the instructor is immersed in his or her world of technology, rather than someone else's. Thus, not only the student and but also the instructor are engaged in the adventure, outwardly of exploration of the external world, but inwardly, of searching for self-knowledge, i. e., of "themselves in the cosmos of engineering."

In retrospect, we must also ask how the instructor's final circumstances relate to the origin of this trip. In my device lab case, providing stories of inventors and inventions (context), of diagrams to explain how it works (content), of a lab to allow self-exploration (contraption) , and of stories of adventuresome engineers and companies (cases) is a professionalized version of my own technical education, received largely from my father and my community (Table 2). I see my point of origin again, from a new light. Or, in Elliot,'s words [15:]

> "We shall not cease from exploration
> And the end of all our exploring
> Will be to arrive where we started
> And know the place for the first time

If the premise is correct that many of the "Tech Lit" instructors are both representing their disciplines to students, and seeking self in the engineering cosmos, then two things naturally follow:

1. Their diversity of disciplines works against development of a consensus version of Technological Literacy, although one could imagine a collection of versions as constituting an encyclopedia of "Tech Lit" possibilities, and

2. If there is a consensus to be found, it lies in the instructor's motivation of "seeking self" (the real reason for the teaching adventure) for undertaking the adventure of teaching technology literacy, which represents, perhaps, the greatest opportunity for academic failure, as well as success.

Engineering is now an established academic discipline. With development of a depth of reflection long established in other , more classical fields, it may be reaching the next stage in maturation. The majority of engineering practitioners are currently those who are old enough to sense that many of the perceived technical problems of today will likely not be solved within their lifetime, or more narrowly, within their academic careers, and are objective enough to see, to accept, and even to teach the increasingly obvious.

To see the individuality of the inhabitants of the "tech lit" frame of mind, we need only note the diversity and disciplinary focus of authors of recent engineering reflections:

Billington(civil):	The Tower and the Bridge[16]
Florman(civil):	Engineering and the Liberal Arts[9]
Lewis(mechanical):	Masterworks of Technology[17]
Lienhard (aeronautical)	Inventing Modern: Growing up with X-rays, Skyscrapers, and Tailfins[18]
Petroski(civil):	Builders of Dreams[19]

Each of these authors frames the texts in multiple dimensions, not simply that of technical explication.

The interweaving of the activities of a technological world with the personal search for self is exemplified also in the cover blurb of E. E. Lewis' Masterworks of Technology: The Story of Creative Engineering, Architecture, and Design. Here the publisher indicates that

> "Melding his own personal experience –-from visiting the cathedral in Chartres, France, to flying aboard a Boeing 777—with vivid historical vignettes, the author skillfully demonstrates the importance of the craft tradition, scientific method, production organization, economics, and more to the creation of modern technology."[17]

Through "melding personal experiences" with "vivid historical vignettes", the author locates himself in the broader engineering cosmos.

Florman trained himself in a bi-disciplinary manner at the outset, with undergraduate engineering and master's level English degrees. His first book, Engineering and the Liberal Arts, attempted to teach others what he learned in his formal education "adventure" of civil engineering (BS) and English literature (MS), claiming that "Only liberally educated engineers can bring the profession the esteem it craves and, in so may important ways. deserves". Florman's succeeding contributions of The Existential Pleasures of Engineering marries philosophy to technologists, his Civilized

Engineer updates the criteria of the good citizen, to that of the "good" engineer, and his Introspective Engineer relates the power of critical thought to the achievement of personal and profession good.. Finally, his contributions Blaming Technology: The Irrational Searching for Scapegoats and his fictional The Aftermath attempt to extinguish, or at least reduce, the "worm of doubt." This body of writing certainly has brought "the profession the esteem it craves."

In closing, one path to technology literacy for instructors appears through reading the lessons from these great writers, who represent in some sense the collective conscience of engineering. To read their writings brings self-knowledge to the engineer reader, thus aiding the "search for self in the engineering cosmos."

If all teachers of technological literacy were motivated by their own searching, then the search for a consensus version of technological literacy should probably be abandoned. The inherently disciplinary nature of the published authors above indicates that waiting for a universal product written by an engineering polymath will likely disappoint, like waiting for Kafka's Godot. Rather, we will be better served by utilization of the "texts" now available with their particular foci. So said, we return one last time to the published authors participating in the 2005 workshop, all of whom are technology literacy faculty, and note their range of disciplinary backgrounds:

Billington (civil)
Bloomfield(physics)
Kuc (electrical)
Lienhard (aeronautical)

As most teaching is evolutionary, any new technology literacy aspirant might be well served by creating a "first pass" TLC using the disciplinarily friendly versions above (Table 3)., then broadening the offering over time. One critique of the 2005 Technological Literacy workshop was that perhaps the area had been defined "too narrowly." The range of workshop presentations, and the range of prospective texts for such a course, would appear to echo this sentiment. Moreover, by avoiding subject matter consensus, and leaving the textbook menu open to a wide variety of tastes, the likelihood that each prospective Tech Lit instructor will find a local "engineering" cosmos within which s/he can discern self is enhanced considerably.

With one potential instructional pool for new "Tech Lit" courses identified here by stage of self-inquiry, rather than by discipline, there remains the challenges of how to identify, contact and recruit such promising candidates to the cause of representing engineering, technology, and self.

An alternate approach could be to recruit those engineering faculty already engaged in broad representation of technology to undergraduate engineering students. This groups would logically include capstone design instructors, first year engineering teachers, and faculty involved with various “device dissection “ laboratories. This latter topic is discussed elsewhere in this ASEE 2006 meeting. [20]

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