

# A Highest Education in the Year 2049

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## *Predictive Paper*

### I. INTRODUCTION

In his 1962 paper “A Day in the Life of a Student in 2012,” Ponte describes the university of 2012 through the eyes of a student. Such a paper may be written to predict the future, to influence changes, or simply to highlight shortcomings and opportunities in the present. His motivation seems to be prediction, so it is best to view the paper in that light.

Ponte’s prophecy still has over a decade to play out. One vision not yet true, but likely, is the obsolescence of the lecture hall—his Professor Faraway gives recorded, masterful lectures that are broadcast to students, who gather in teams of 30 around a task master. Indeed, the lecture hall does seem antiquated today—it may be replaced by a “learning hall,” where faculty and students gather physically to engage in a discussion and projects, supplemented by a “multimedia textbook,” which students use to self study. One-way lectures can be satisfactorily replaced by store and playback, with a substantial improvement in productivity, but what cannot be readily displaced is an intellectual give-and-take discussion among faculty and students, accompanied by friendship and community building. Thus, Ponte’s task masters and closely knit group projects seem likely to arise together with multimedia study materials.

Ponte highlights the promising technologies of his day—for example, Faraway’s lecture is about cable matching—but naturally fails to anticipate some future challenges and advances. For example, it is hard to imagine a poorer user interface than Joe’s pushing “key 23” to bring up Faraway’s lecture. User interfaces simply were not an issue in 1962, in part because functionality was much simpler. It was not the technology, but the need, that could not be imagined. Others of Ponte’s predictions illustrate an over exuberance with the technologies of the day, including millimeter-wave transmission (which has been displaced by fiber optics, but which may make a comeback with

wireless) and moon rockets (which are unlikely to enter student projects).

It is said that imitation is the sincerest form of flattery. We now offer a new essay in the spirit of his. Our objective is not so much prediction, but rather to speak to our own era, using a speculative view of the future to point out today’s shortcomings and opportunities. Like Ponte, our essay reflects both our hopes and our fears for the future. Reflecting the greater pace of change today, this vision is a more radical departure than Ponte’s. Fifty years from now, this essay will probably be only mildly amusing, since the details of our prediction are unlikely to reflect reality. A more realistic goal is to influence the course of education today.

### II. UNIVERSITY WITHOUT GATES

Quins University was founded in 2024 through a merger of Berkeley, Leiden, Tsinghua, and Yale. Nobody knows for sure where the name “Quins” comes from, but it may be an acronym for “Quins University Is Not Stanford.” Quins was founded in response to a wildly successful “educational startup,” Gates University (GU), endowed by the estate of a wealthy businessman. GU remains today, in the year 2049, a principal rival.

The origin and success of these rival universities is due in no small part to the massive changes in the global society wrought by information technology. While industry had adapted through a process of “creative destruction” of existing companies and concurrent formation of new ones, educational institutions, being mired in tradition, had not been so quick to change. As a radical departure from tradition, GU had established a new and successful model—at least from some perspectives—and Quins was a competitive response.

Quins College is the heart of the university. Like GU, it is not geographically centralized, having instead a deeply global perspective. Quins’ slogan, “a university without Gates,” reflects its geographic unboundedness. (This slogan ignores the geocentricity of humanity, which has not yet transcended the solar system.) It maintains many geographic sites, including some that are small and remote. Its

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primary “place” is in cyberspace, a “college of bits.” To create the social structure of the highly successful residential colleges of Yale in cyberspace, it divides participants into distinct global villages. Villagers are admitted to a specific village and develop a camaraderie with fellow villagers that lasts a lifetime.

Village rivalries strengthen the institution—villages try to outdo one another with the best cyberpresence, the best virtual parties, and the best village cyberseminars. Intervillage sports take the form of violent virtual wars. Occasionally, the rivalries lead to pranks involving increasingly sophisticated computer viruses. More than once an entire village infrastructure has been temporarily brought down by a virus (such events are known as a “village crash”).

Even with high-definition, three-dimensional telepresence, a purely electronic village fails to completely address the human need for personal interaction and companionship. Consequently, each village is associated with a set of globally scattered geographic sites. These “F2F” sites have facilities for research, tutoring, group projects and team building, competitive sports, and community building parties. Villagers enjoy periodic in-residence sojourns at a local F2F site throughout a lifetime.

### III. THE CRISIS

GU and later Quins became successful on the heels of an expanding crisis, not just in education but in life. Several elements conspired to make obsolete the old paradigm. One was the loss of community and adverse psychological effects that came from rapid job and occupational changes and geographic mobility. Another was the expanding number of years in education, delaying family and “real life,” followed by a career marked by rapid obsolescence and declining employment prospects. This was brought about by the rapid expansion of human knowledge coupled to the notion that one “finishes” an education. The lengthening life expectancy and forced increase in the retirement age resulted in longer careers, accentuating these difficulties. By 2020, a typical person spent 30 years in “education,” 50 years in a “career,” followed by a 35-year “retirement.” The intensity as well as the length of the educational phase kept increasing, and became stressful and financially tenuous.

Today, GU, Quins, and a few other universities have abandoned this education-career-retirement life model in favor of a “life education” model.

### IV. THE LIFE EDUCATION MODEL

The life education model at Quins discards the notion that a certain body of knowledge defines an educated person. It also discards the antiquated idea of educating only the young. Since there is no such thing as an educated person—at least in a permanent sense—the concept of “graduation” has become obsolete.

Quins is the first university to have adopted the life education model. Its distinctive features are, first, an ex-

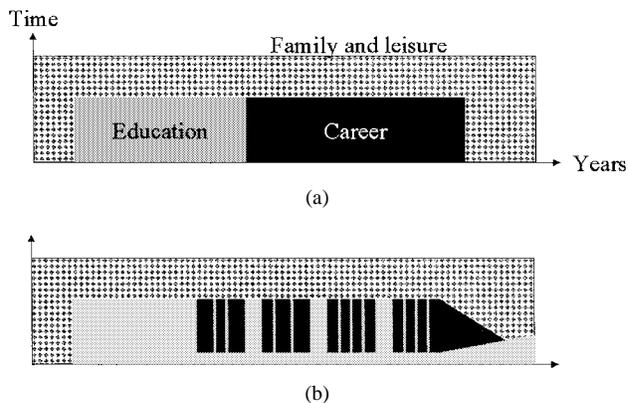


Fig. 1. The old and new views of education: (a) twentieth century model and (b) Quins’ life education model.

tension of education to an entire lifetime—extending even to quality-of-life enhancing activities in retirement—and second, a full integration of education and work. The early integration of work experience with education dramatically shortens the initial full-time college-level education to a mere two years. A continuing education process perpetuates educational experience throughout a lifetime, tracking the expanding knowledge base and changing life and career needs. The term “student” seems limiting in the context of a life education, which is why Quins has villagers (what chief executive officer wishes the appellation “student?”).

The life education model intersperses discrete intensive educational events with intermediate periods of continuing education, as pictured in Fig. 1. The intensive educational events are full-time periods of education in residence at a F2F site. The first such event is a two-year initial intensive grounding in the Quins College of Foundational Studies. Villagers are also expected to spend one month in residence every three years, with a one-year renewal educational period every ten years. Since a villager commits to a lifelong involvement with the university, it is a critical part of creating and renewing a sense of community among villagers, faculty, and administrators.

In the mid-twentieth century, it was the norm for workers to stay with the same company for an entire career, but that sense of belonging and community dissipated as workers increasingly moved from job to job. Fortunately, today this sense of professional community has been successfully renewed and replaced by a lifelong relationship to the Quins village, even as villagers move from job to job. One pragmatic motivation for the global reach of Quins’ F2F sites is that villagers can maintain and renew their community wherever they may live.

The in-residence program frees villagers from day-to-day job concerns and allows them to focus periodically on educational advancement. This has proven important for those renewal phases where villagers acquire an entirely new subject, as opposed to simply updating their knowledge of a familiar subject. Because different generations of villagers congregate together at F2F sites, a primary mode of education is different generations of villagers

learning from one another, as well as from the faculty. The faculty also learn from villagers, who bring real-world experience to these interactions. Even families are renewed; in many cases, multiple generations of a family are able to coordinate their in-residence programs at Quins.

Life education has revolutionized the workplace as well. Most employers have come to embrace it by redefining the very notion of career to include concurrent education. Laws and union agreements have institutionalized it in all but the most impoverished countries. Employers are required to allow time for renewal, and minimum “educational sabbaticals” are mandated. Many workers take longer in-residence sabbaticals between jobs to enhance long-term career prospects.

An exclusively online model of education proved unsatisfactory, but at Quins the education between in-residence periods relies entirely on the Net. Quins research has established the merits of a combination of in-residence and Net experiences. In-residence periods at an F2F site maintain a sense of community and provide a practical way to intensively attack new fields, while the Net provides a practical way to mix career and family obligations with education.

## V. THE EDUCATION BUSINESS

The gradual transition of education from the elite and noble to the practical and business that began in the late twentieth century has reached its pinnacle at GU. In some respects, the early results were not pretty, but a reasonable compromise has been struck at Quins that adequately sustains the institution and aligns the interests of villager and institution.

A life education at Quins represents a radical shift in the business model. A young person entering his or her life education today executes a life contract with Quins. (Quins’ reputation is so great that this represents no obstacle to obtaining extraordinary students.) Conditioned on satisfactory performance, the villager is guaranteed access to the Quins education for life. In return, tuition is tied directly to a percentage of a villager’s income (according to a graduated scale) to be paid annually with a three-year delay. The financial support of Quins is equitably spread across villagers. Payment is made by the party that directly benefits—the villager—and not by third parties like the state or parents. Education is free in the early years when the villager has fewer resources and never becomes burdensome. There being no tuition without an income from career, villagers can be admitted solely on the basis of academic merit. Reverse tuition (a stipend from Quins to the villager during the in-residence programs to offset lost salary) supports villagers’ life expenses during in-residence programs.

With this lifetime business model, Quins is motivated to invest in the long-term financial success of its villagers. Early critics predicted that it would adversely affect the quality of an education by encouraging a blatantly vocational approach, driving out humanistic and theoretical

topics. These fears were stoked by GU, which did in fact expunge much of the liberal tradition in favor of a blatant (albeit popular at the time) emphasis on the immediately practical.

Today, these fears seem quaint and unjustified, as it is recognized that a liberal education is an essential component of any career. Quins invested in considerable research aimed at establishing the factors contributing to their villagers’ long-term success, which is immediately tied to Quins’ long-term success. Many of the findings—surprising to the early administrators and to the critics—buttressed the importance of both a liberal education and competitive team sports (now mostly in the form of virtual wars). As a result, Quins has become more aggressive than most technically inclined institutions in imbuing villagers with a liberal education.

## VI. INTELLECTUAL LIFE

The intellectual life at Quins, aside from its protraction over a lifetime, is different in other ways, reflecting the realities in the growth and change in human knowledge. An epistemic change is the abandonment of the notion that any single human mind can bear any significant fraction of what is knowable, and that there is a static body of information that can be conveyed. Even the renaissance notion of an “educated person” has been discarded—there is no longer a canonical body of basic knowledge that defines this notion. This occurred first in the rejection of “the canon” in the liberal arts, but the crisis eventually came to revolutionize even engineering.

The cannon was first abandoned at GU, which shifted its research mission from knowledge acquisition to knowledge encapsulation and synthesis. Major research efforts became concerned as much with ways of organizing old knowledge as with the development of new knowledge. Digital libraries, information search agents, immersive exploratory environments, and visualization of information spaces matured.

These ideas are realized in software, which has become recognized as a medium for archiving and organizing knowledge, indeed, a primary mechanism for communicating with posterity. Software is a literature, no less significant than the printed word. In the twentieth century, by contrast, software had a very utilitarian role—its value lay entirely in its execution. Now, a work of software can be considered eloquent.

The innovative new curriculum at GU introduced software as literature. Courses include reading “the greats,” such as Brian Kernighan, Linus Torvalds, and Donald Knuth. There are also metalevel courses, such as one called “network ontology” and another called “software linguistics.” The former studies such thinkers as Heidegger and Searle, and considers questions about the extent to which the software reflects humanness. When does an avatar replace its author? Has the author been resurrected as avatar?

Software linguistics considers the vernacular expression of concepts in standard languages such as Java and SML. It

looks beyond the syntax and semantics of the languages to the extensive development of idioms, which have become so pervasive and complex that these languages have split into dialects that differ only idiomatically. It looks at the use of slang, in which “unapproved” features of the language are exploited in common usage and ultimately change the structure of the languages themselves. Even “bugs” (flaws in the implementations of the language that result in incorrect execution) contribute to its richness as literature.

Of course, the innovations at GU did not go unnoticed by the academic world. Soon, many top students worldwide were shunning the traditional universities and going to GU. The establishment of Quins, therefore, was a survival move, forced on the founding universities by their slumping rankings in World Report.

For years, Quins played catch up. It began to compete effectively with GU only after 2036, when Alonzo Iglesia published his famous Ph.D. thesis, “Cybernetic Hermeneutics.” A Department of Technological Hermeneutics was formed at Quins devoted to studying the study of technology, and Iglesia became its founding chairperson. Technology came to be viewed (in a complete reversal of the twentieth century canon) as the richest development yet in human culture. This cemented the merger of the humanities with technology and forever changed the ways of technical education.

GU and Quins now dominate the intellectual scene. They are neck-and-neck in both Turing and Pulitzer prizes. The premise of their research programs is significantly different from those sidelined traditional research institutions, which continue to garner most of the (now lackluster) Nobel prizes in the traditional sciences.

Both institutions have their intellectual roots in engineering and technology. In the nineteenth and twentieth centuries, technology was about coercing physical devices to do man’s bidding. Today it is about coercing abstract human constructions. Where the laws of physics used to define the constraints, now it is complexity, computability, and chaos, plus the all-too-human barriers of logical flaws, awkward languages, (in)human interfaces, regulatory artifacts, information overload, limited attention span, and limited domain knowledge.

Technology is the medium, not the message. Today, an engineer works with “materials” that are more cultural than physical. She works within an artificial universe of formal languages and (often bizarre and arbitrary) laws of interaction of components. Her artificial universe is created by a second cadre of engineers who invent its “laws of physics.” They, in turn, craft their artificial universe using as a medium another artificial universe. Eventually, these layers of abstraction rest on the concrete, and only there will we find engineers recognizable as such in the twentieth century. They work with the physical properties of the concrete, fashioning it into a foundation for the towers of abstraction. Much of this foundational research continues in traditional universities.

The “laws of physics” of these artificial universes, since they are often quirky and rarely self-consistent, are more

aptly called their “culture.” These laws have more in common with social protocols than with particle physics. Windows 2049, for example, is more like a cult than a physics.

The way teaching is done in the new universities reflects fundamental changes that have occurred in the ways that humans communicate. Immersive games, interactive art, and virtual spaces for congregation mean that technology has replaced broadcast with dialog, in contrast with the awkward unidirectional medium of the printing press. In print, there was no feedback from the reader to the writer, except by the awkward and sluggish mechanism of a published response. Technical dialogs of the twentieth century were mediated by print journals, which no longer survive.

Radio and television in the twentieth century followed the unidirectional metaphor of the printing press. Their pervasiveness resulted in a homogenization of culture that many historians believe made it possible for the global villages of Quins to get started. Although they were founded on the commonness of worldwide culture, they have evolved to develop their own unique and rich cultures. The replacement of broadcast technologies by the Net has reversed the homogenization of culture that made the Net possible in the first place. The global village is not just about interdependence, but also about mutual provenance.

For example, McLuhan Village—one of the more prestigious and selective villages in Quins—has a distinctly libertarian slant. It counts among its villagers several influential privacy rights scholars. Its researchers were instrumental in developing the encryption technology that we all depend on now to maintain our privacy despite the biometric identification used to close financial transactions. Without this technology, when we purchase dog food and present our retinal scan at checkout, Visa Global would infer and record that we own a dog and use that information for directed subliminal advertising. These same researchers have made private dialog on the Net commonplace, and thus are credited by some devotees with making dialog itself possible.

Whereas broadcast promotes homogeneity, dialog spawns individuality, expressiveness, and even eccentricity. The techno nerd of the twentieth century has become cool in the twenty-first century, the renderer of culture rather than its refugee.

## VII. THE KNOWLEDGE STRATA

The diffusion of humanities into technology, and vice versa, has led to a radical reorganization of intellectual disciplines. In the twentieth century, knowledge was partitioned into disciplines and subdisciplines and sub-subdisciplines in an increasingly desperate attempt to limit the scope of knowledge required of each individual, while allowing for a sophistication and depth within a limited domain. Each of these sub-subdisciplines took on a life of its own, consuming its adherents in intellectual challenges that were increasingly inward looking.

By the end of the twentieth century, it became evident that this approach was not preparing students effectively for commerce, government, and even academe. In engineering, for example, in a desperate attempt to prepare students for professional competence in a four-year undergraduate program, the technical content had been expanded, almost completely displacing the humanist and social traditions of a liberal education. The graduating engineers were ill prepared for critical evaluation of technology, collaboration, communication and selling of ideas, and design of large human-centered technological systems. Also, they were certainly unprepared to appreciate the impact of technology on society and the increasing influence of society on technology.

By the early twenty-first century, as technology invaded every societal endeavor, the ills of over specialization became persuasively evident. Humanists and scientists—both physical and social—were ill equipped to cope with the technology in their personal and professional lives, and in the systems being studied by their respective disciplines. They were especially unprepared to mold technology to best meet the needs of the society with which it was intertwined. The graduates of the best technical schools were even more poorly equipped to contribute, with their overly compartmentalized and insular view of technology for technology's sake. These graduates were unable to take a systems view—their education was focused on a single narrow technology—in which diverse technologies are integrated with human organizations.

Quins is a revolutionary response to this dilemma, one that has been emulated by others. The idea is not totally new, however, as it was presaged by changes in industrial organization in the late twentieth century. Of course, industry has different goals—for example, the continued nurturing of the classics or anthropology is not on their agenda—but industry faced some similar challenges in dealing with an expanding knowledge base. In particular, parallels can be drawn between industrial organization—the partitioning of commerce into individual competing and cooperating firms—and the organization of academe into disciplines. Industry, driven by economics rather than politics, made fairly rapid progress in adapting to new realities, driven by the need to form new organizational boundaries to reduce coordination and transaction costs. The result was a radical reorganization of industry in the late twentieth century that later influenced the academic organization of Quins.

Specifically, industry shifted from a “stovepipe” to an “integrated layer” model. This new layered model addressed two related challenges. First, successful products and services were increasingly flexible and adaptable. Second, products and services assumed the characteristics of systems—conglomerates of many different types of elements. For example, it is common for organizational processes of many types to integrate groups of people together with various technologies, each with specific functions, cooperating to achieve the overall goals. These pressures resulted in organizational processes that integrated tech-

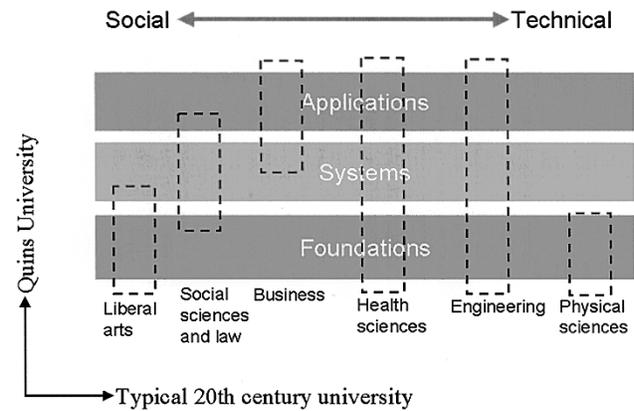


Fig. 2. The academic organization of Quins University into knowledge strata.

nologies and functions, rather than separating them by department or by company.

While the challenges faced in a university education are distinctive, they have some common elements with industry. In both, it is too limiting to address the various challenges from a narrow disciplinary perspective. The real issues, whether they be organizational, political, legal, or intellectual, require an approach that integrates many perspectives—social, economic, scientific, and technological.

The early vision of the new universities was to replace this narrow disciplinary model with a supradisciplinary model, illustrated in Fig. 2. The twentieth century approach divided into disciplines (like engineering, the social sciences, etc.), which largely independently defined their own axioms, the layer of abstraction above the axioms, the layer above that, and so on. This model promoted an endless growth of abstractions primarily of interest to those narrow disciplinarians, while underappreciating the rich interactions across traditional disciplines that characterizes the real world.

The knowledge taxonomy adopted by Quins is based on three primary strata, the top two built on the ones below.

- 1) The foundations stratum addresses the physical world and the human experience from an individual perspective and molds them into useful constructs (such as technologies, models, and analogies) to be built upon at higher strata.
- 2) The systems stratum deals with systems of all varieties (such as technological, biological, cosmological, social, or organizational). Grouping all types of systems in a common stratum reflects the reality that most systems (especially those most wide-scale and challenging) intermix technological and social elements in ways that cannot be separated. Today, “system construction” mixes social and technological elements in ways that maximize the strengths of each and maximize the effectiveness of their interaction. It further benefits from an understanding of natural systems, such as biological and cosmological, which has profoundly impacted our understanding of social and technological systems.

- 3) The applications stratum focuses on direct benefits and detriments to people and society.

Each stratum is further decomposed into academic departments that are a holdover from the disciplinary approach, although their composition and number have changed dramatically. For example, math, physics, literature, psychology, biology, and electronics reside primarily at the foundations stratum, while cybernetic and human sociology, law, cybereconomics, physiology, and computer systems live in the systems stratum. The applications stratum emphasizes direct connections to people and organizations, and includes departments of business, art, music, information management, and politics, among others.

Villagers are encouraged to gain a broad perspective across the range of disciplines, choosing one stratum for emphasis. Consonant with a life education, a villager's education initially focuses on the foundations stratum, and through a lifetime broadens and deepens knowledge of the other strata in accordance with changing career demands.

Within the Quins College of Foundational Studies, mathematicians, physicists, psychologists, biologists, and others provide the "conceptual fabric" that forms the basis of systems within the College of Systems Studies. Researchers and practitioners of both the foundations and systems strata do not think primarily in terms of "applications," as it is more effective to be built upon than to be applied (applications are exclusively the domain of the College of Applied Studies).

Software, for example, had been vaguely viewed by twentieth century theorists as applied mathematics. Today, it is viewed in terms of its decomposition into the knowledge strata. A twentieth century "computer science" discipline responsible for anything related to software (the disciplinary or stovepipe model) no longer exists. Indeed, the metamorphosis of computer science illustrates well how knowledge strata function in a villager's education at Quins today. Within the Quins College of Foundational Studies, all villagers study the axiomatic presumptions of Turing, Church, and Von Neumann, and appreciate a suite of formalisms that the systems stratum can build on. Modeling courses study how these formalisms can be used and adapted to defining languages, expressing concurrency, and understanding automata. Information psychology deals with the intricacies of human-mechanism collaboration. The biological view of cybernetics conveys the deep principles uncovered from the animal brain and genetics, and how they have profoundly influenced computer design in the twenty-first century. Cybernetic hermeneutics allows villagers to appreciate how everyone studies through a cultural anthropology of technologists.

Within the College of Systems Studies, villagers build on languages and concurrency models to appreciate distributed and networked systems, as well as how physiology, human sociology, and cosmology have profoundly influenced these technological systems. The human and cybernetic sociology courses inspire better methodologies for integrating technological, physiological, and social elements

in well-integrated sociotechnical systems. In these courses, villagers also learn how these systems define culture, and how culture in turn influences our conception of these systems. Cybereconomics is where villagers learn the theories underlying the systematic production, distribution, and consumption of cyberwealth.

The College of Applied Studies is where villagers study specific system applications to real-world contexts, such as, for example, knowledge and decision management in organizations (such as government, university, and business), and specific sociotechnical systems molded to applications like cybercommerce. These studies are typically reserved for later in a life education and are tailored to specific and changing career needs.

In summary, Quins has fomented a revolution in the view of academic disciplines, transforming them into coherent knowledge strata with a holistic and integrated perspective on the broad challenges addressed at each stratum.

## VIII. POSTSCRIPT

Looking back over the past century, there have been remarkable changes in education. As an archetype, engineering has been the most extreme in its transformation. A century ago, in 1949, the world was recovering from one hot war and entering a cold one. The vision of the future of science and engineering promulgated by Vannevar Bush and his colleagues during and following World War II was inspirational and influential. At the dawn of the "jet age," the "nuclear age," and the "space age," engineering education was revolutionized by the introduction of scientific rigor (although sometimes to the detriment of surrounding "real world" issues).

Fifty years ago, at "the dawn of the information age," engineering education had changed remarkably little in the 55 years since the war, except for a dramatic emphasis on both specialization and quantity at the expense of everything else. It was considered imperative to teach students everything about an untenably narrow spectrum of human knowledge, built on a shaky foundation of rapidly shifting technology fundamentals. While it had become evident to many that a new era was approaching, its characteristics were hazy. Lacking a vision, or even a consensus, the status quo dominated. This must be considered a low point for engineering education, rivaling the doldrums of the war when apprenticeship engineers were shoved aside by physicists in the most inventive aspects of the war effort.

The turnaround occurred in the postmodern enlightenment of the 2020's and 2030's. The cumbersome and shaky order was overthrown by a process of revolutionary change, culminating in new models—life education, knowledge strata, and humanist technology. Remarkable even in retrospect is how the old order was overthrown not by visionary educators or administrators, but in the pursuit of a more viable model for life—including education, work, career, and retirement. Even more extraordinary is how this metamorphosis has injected education and scholarship with new vitality and excitement. Today's educational model can truly be considered "a highest education."



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