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Generation Beta: Do Cyborg Students Write Electronic Philosophy?*

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The Polytechnic University, New York, USA, operates at the forefront of digital education, with online delivery of administrative, teaching and reference services. Every student at the University is required to use a laptop computer conforming to standard specifications, which include a wireless modem. In the environment of a wireless campus, *smart* classrooms and technical support services, the laptop-, calculator- and mobile phone-enhanced student is a fundamentally new creature, with new capacities and needs to which curricula and teaching practices are only beginning to adapt. Just as the replacement of slide rules by portable electronic calculators around 30 years ago fundamentally altered the shape and scope of undergraduate education in mathematics, the introduction of laptop computers with Internet connections is precipitating an analogous but more profound transformation of the shape and scope of students' experience of the humanities, and of the development of their ability to understand, develop and articulate complex concepts through the effective use of the tools at their disposal. It must be acknowledged that the cost of installing and maintaining all these new amenities has been enormous. Oddly, it seems that the humanities may have a crucial role to play in making the sacrifice, inconvenience and expense worthwhile, particularly for science and engineering students. A more active adaptation of the technologies to the real needs and goals of universities and their faculty and students is now in order. In this article, the author seeks to describe the process of a second phase of electronic augmentation of academic life in which we move beyond a crude adaptation to electronic tools and networks in the classroom, laboratory and office. Up to this point, that adaptation has been on the order of an *ad hoc coping* with very rapid change. If the technological enhancements of education are to be anything but a fantastically expensive distraction, this making-do must end. As academics, we are useless if we cannot achieve and communicate the ability to exapt, rather than adapt.

TERMINOLOGY

Exaptation: this term dates back to the debates about Darwin's *Origin of Species*. Exaptation is what happens when an adaptive mechanism or feature (such as feathers) evolves for one purpose (such as heat regulation) and then turns out to be helpful for some other adaptive function (such as flight). The term is also used occasionally to describe a process of ultra-adaptation, where an organism changes not so much because it must to survive, but because it can afford to, and therefore evolves beyond the satisfaction of competitive or environmental requirements.

The Bachelor of Science is *not* a professional degree, but rather an academic one whose mandate is the laying of a foundation for further study, and ultimately research and teaching [1]. Notwithstanding the fact that Bachelor of Science programmes are currently offered in everything from technical writing to management, the intent of the design of the Bachelor of Science is to provide a well-rounded education. Its most basic qualification is that half of the work undertaken towards it must be in the liberal arts and

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sciences, not including study in the particular specialty. Insofar as the corresponding requirements for the BEng and BFA are one-quarter, it could be argued that the Bachelor of Science degree is, in fact, the best balanced undergraduate education, offering a broad blend of liberal arts, sciences and mathematics, and thereby the general foundation for sound analytical and synthetic thinking as it may apply to work and participation in the political process. Indeed, the classical liberal arts may well be better reflected in the range and proportion of the Bachelor of Science degree than in current interpretations of a Bachelor of Arts, which would have been thought severely deficient in mathematics and science by most of the philosophers now ensconced in the canon.

Professional: the use of this term in post-secondary education is utterly confusing. By and large, students seem to interpret *professional* as a euphemism for *get you a job*, or *corporate*. In general, even graduate students often fail to appreciate the significance of the authority to accreditation, regulation, and censure by one's colleagues and peers. The analogy to citizenship is critical and the prerogative-responsibility balance it implies is fundamental.

Technology: at some point, this word became a euphemism for engineering in general, but also for a range of blue-collar occupations involving the use of electronic equipment. Small wonder, then, that it is hard to get American teenagers interested.

Liberal Arts: this term is considered to relate to grammar, logic, rhetoric, arithmetic, music, geometry, astronomy, etc.

BARBARIC ACADEME

> *Le bon sens est la chose du monde la mieux partagée; car chacun pense en être si bien pourvu, que ceux même qui sont les plus difficiles à contenter en toute autre chose n'ont point coutume d'en désirer plus qu'ils en ont* [2] [*Good sense is, of all things in the world, the best apportioned; for each thinks himself so well provided with it, that even those who are most difficult to satisfy in any other regard are not in the habit of desiring more of it than they have*] (trans. by the author).

Generation Beta, the term coined in the title of this article, is actually a euphemism for a radically disrupted academic culture. Generation Beta does not describe the students, but rather the faculty, curriculum, facilities and academic practices to which those students are subjected every day. Although Huxley refers to a Beta class of workers in *Brave New World*, this was not the intended reference. Rather, *Generation Beta* alludes to the practice of releasing software to the public on the understanding that it is at a semi-final state of completion, documentation and debugging. That is the current state of electronically *augmented* post-secondary education.

The biggest disruption has not been one of technology, but scale. As universities have multiplied, and their client populations have been dramatically expanded and redefined since WWII, the most fundamental strength of academic culture has *un-happened*, ie its stability. Sons and daughters of mechanics and nurses did not simply move up into the social and political elites as they signed up for college in the 1960s; they also became a very large population of test subjects. In the process, universities digested many of the disciplines from which their new populations came: fine and applied arts, applied science and so on. The extreme form of this proliferation is higher education as a mass consumer commodity, which is precisely the contrary of the academy's historical mandate. In particular, the idea of *distance learning* should be considered with extreme sensitivity to its omission of the most basic process of university education: its function in assimilating a person to a subculture through regular personal contact and a shared transnational identification with peers and an established canon. A profession is, first of all, a community with a social contract and specific norms, not all of which are *technical*. Economies of scale simply do *not* apply to higher learning, which still is undertaken by individuals idiosyncratically using the same tools they have worked with since the inception of oral culture. The point here is not that distance learning or Bachelor of Science programmes are in themselves pernicious, but that the continuity of academic culture, which has been its stock in trade for over 2,000 years, has been abrogated and/or mutated at a rate well beyond its norms that are its lifeblood.

Some of those mutations have been for the good, but have been bartered for at great cost and risk: the academic world is now effectively *primitive*. Any academic over 40 (ie almost *all* of the non-adjunct faculty) is, by definition, being called upon to teach in ways in that they did not learn themselves. This ought to be the real definition of *primitive culture*.

The effective shattering of the attention of faculty in service of temperamental infrastructure, constantly changing procedures, unreliable equipment, and teaching and tutoring budgets substantially displaced by Information Technology, which aptly abbreviated to *IT*. The same faculty members who used to argue vehemently about foreign policy now pleasantly kibbitz about the

arcana of retrieving student transcripts from *Peoplesoft*, or how to get *Blackboard* to cough up an electronic version of the grade roster that still has to be printed out on paper in duplicate.

If Moore's Law holds up much longer, department heads will soon be expected to provide clerical and administrative services 24/7, as well as respond to student queries about their desire for a better grade for less work, etc, because there will be no layer of regular junior faculty between the department head, and an underclass of *permadjuncts* will be teaching online from garrets in Bangalore and Bozeman.

Are we cursed with a cruel parody of interesting times, where what is least interesting about the work is now so demanding that just keeping up has become the game, or the profession? Are we in a period of adaptation? Or worse?

The author was exchanging pleasantries with a member of the board of trustees of a small private school at its annual Christmas party. His name was Joseph and he was an accountant. He was a little tipsy and very concerned about the near-term difficulties of Western civilisation, but foresaw in the not-too-distant future a period of *incredible productivity*, whose delights lit him up with joy. Joseph, clearly, was not making any distinction between productivity and prosperity. This fundamental error, if typical of university trustees, might explain much that has been taken as a purposefully cynical degradation of educational institutions by their boards. It is not that trustees are evil; they just need a little more philosophy in their curriculum.

Is historical perspective obsolete in applied science? The cliché that change is now the only constant would seem to devalue the traditional strengths and mandate of universities across the board: a global network of structurally and culturally conservative organisations, subject to the overlapping regulatory authorities of government, clergy, commerce and a very elaborate international system of peer review, with a likewise standardised system of the conservation of documents to which all subsequent documents must refer … in other words, the most stable (ie least dynamic) system imaginable. What could academia be good for, in a rush to change more and faster every day? This conundrum is more of a problem in some disciplines, such as engineering and the fine arts, where generations of professors turn over much more slowly than generations of technology or practice. It is less of an issue for philosophers and historians, on the other hand, perhaps because they have less trouble distinguishing between general time-insensitive abstractions like productivity and prosperity.

The Polytechnic University, Brooklyn is one of many polytechnic institutes in North America to have converted to a university. Whether this trend was driven primarily by concerns of marketing, diversification or the relative status of diplomas and degrees, it has provided an opportunity for engineering and science to avail themselves of the traditions of the other professions, whose privilege of self-regulation is predicated on something far more important in the long run than status: the *cultural technology* to self-govern. This *software*, traditionally reserved for the upper levels of society, is nothing more or less than the *liberal arts*, loosely translatable as the *skills of the free*. As in the past, of course, this actually conceals a less benign concept of personal power, namely that the liberal arts have traditionally associated with social groups empowered to make decisions not only for themselves, but for the rest of us. Democracies, whether Periclean or Jeffersonian, have yet to achieve – or even aim for – universality.

At a time when technological change is transforming economies, societies and physical conditions in an accelerating regime of perpetual revolution, the engineering professions are arguably more than simply free to direct themselves; they are now a para-government whose every deliberation and product amounts to a determination of the conditions under which humanity will operate henceforth. Now that dozens of enterprises, institutes and governments undertake initiatives whose potential consequences are in the same league as the Manhattan Project *as a matter of course*, the social need for the directors and researchers to be competent governors of technology (rather than soldiers in its advancing army or agents of its inevitability) is absolutely paramount.

Adaptation to the level of sheer power now wielded by engineers is as simple and urgent as the need for anyone to be at least as wise as they are powerful. In effect, engineering has accumulated creative and destructive power to the point where the provision of technologies of wisdom to engineers directly, as well as to those who traditionally have directed their efforts, is a matter of life and death on a new scale, conventionally associated with the Divine.

The maturation of engineering disciplines into true professions is gathering momentum – at least at the level of goals and policies. Paradoxically, undergraduate engineering curricula may be choking on the sheer technical complexity they have built up in the last few decades, leaving less and less room to meet their own self-created challenges, particularly the non-technical ones. As computer-aided design tools have broadened their scope and increased their sophistication, the learning curves they enforce have expanded and multiplied, while adding to the cognitive load of everything from

introductory physics to drawing to course registration, effectively compounding the difficulty of coping with historical curricula in the undergraduate years, precisely at a time when it is vitally important that they develop *big picture* skills like the ability to distinguish between deductive and inductive reasoning.

If the effective emphasis of undergraduate engineering education shifts back to skills and/or ability to adapt to future change under the sheer weight of technical over-elaboration, *technology* becomes not just an end in itself, but a kind of divine agent. Sooner or later, this will imply a shift to the concept of engineers as servants of their own tools. The thing to remember is that these tools were designed, some of them in good faith, with a view to *augmenting* (rather than displacing) intellectual capacity and creative work [3].

WIRED CLASSROOMS AND HUMAN SACRIFICE

> *A fairly complete handbook for studying the extensions of man could be made up from selections from Shakespeare. Some might quibble about whether or not he was referring to* [*PowerPoint*] *in these familiar lines from Romeo and Juliet:*
>
> > *But soft! what light through yonder window breaks?*
> > *It speaks, and yet says nothing* [4].

The Human Cost, aka *Dogmentation*

Compounding the disruptive effects of the explosion of the academies (and subsequent politics of scarcity as demand fluctuates) has been a mind-boggling increase in the administrative and operating expense overhead of teaching the humanities (another syndrome to which academic culture and institutions are very poorly adapted or adaptable). In the last 10 years, we suddenly started to mimic the costs of technical departments, minus their use-value: no heavy equipment is being replaced or brought up to date in electronic form, no drudgery is being eliminated (quite the contrary). Indeed, we may have done worse than mimic, we may have led the charge in undermining both engineering and the liberal arts by a primitive (or just dumb) failure to apply our skills to our needs, and to those of our students. A computer is *not* a normal piece of capital equipment that depreciates over decades. The *design life* of a desktop computer is about four years, and that of a laptop in the hands of a young adult considerably less. And yet these items are purchased at a price to which people had become accustomed by the acquisition of materials and equipment designed to last decades and centuries. It gets worse! The rooms in which the computers are housed are then *locked*, and all but those students enrolled in that class are excluded, which in a small school like the Polytechnic University, is often one or two sections a term. When parents and prospective students come, we display with pride the spectacle of their predecessors' tuition fees burning.

Every *Smart Room* costs as much to install and maintain as how many instructors?

The laptop programme started at a flat $4K per student, adding up to $125 per course on personal equipment/software, or more simply: for every course offered to 20 students, $2,500 are being spent on having the laptops in the room. If their only use is word processing and students are being asked – or ordered – to buy books and calculators as well, then we have actually set them back quite a bit.

In more urgent terms, the laptops have displaced a meaningful percentage of a full-time faculty position. In particular, they have replaced a particularly large percentage of a junior faculty position. As the academic sector has been *rationalised* by administrations, the middle tier of junior, tenure-track faculty has been replaced with an underclass of career adjuncts, supplementing two classes here with three there. These people do not generally undertake committee work or develop new programmes or bring their native acquaintance with the so-called wired campus to bear on curriculum development or pedagogy, which fall in more and more concentrated form to the dwindling ranks of the senior full-time faculty.

Bear in mind also that the presence of laptops brings the entertainment industry into the classroom. From the podium, a student playing Donkey Kong looks just like one looking up the Thirty Years' War to get context for the discussion of Descartes' life and times. One does *not* want to think about what one likes from where they sit. In other words, the cost and nuisance of computerisation have been amplified and the benefits mostly systematically avoided up to this point.

The Human Benefit, aka *Neuromance*

What might the students be getting from all this upheaval and sacrifice? There is an accepted wisdom that well-implemented, wired pedagogy can offer benefits to particular kinds of students in particular situations: near-sighted students can follow notes/diagrams; students can look up terms they do not know, and avoid falling behind; shy and foreign students can participate more actively through chat/forum media

than traditional class discussion; and participation can be tracked.

The likelihood that any particular student is using their laptop in class to follow, or follow up on, the subject at hand is probably close to nil, but probably not any closer to nil than previously. Note-passing, doodling, love-letter-writing, etc, may be *augmented*, but they were certainly not created by the wireless classroom.

If possible, one should set up *back-channelling* – this is a feature of certain kinds of conferences. The author first came across it recently at Drupal Camp, a two-day un-convention of Drupal developers that was hosted at the Polytechnic University under the aegis of the Integrated Digital Media Institute [5]. An online forum, moderated by one of the organisers, was running as the speaker gave his/her presentation. This provided for attention span issues, but also a running FAQ for background information and/or whether a question might be of interest to the whole group as part of the proceedings, or was already fully addressed in the support literature or elsewhere online. The screen is bigger and more legible than the blackboard, the laptops can and *will* carry a back-channel of chatter between the students. Use it, or lose to it. This practice requires the presence and full engagement of a teaching assistant; if that person was turfed in order to get the students wired access to them, then one is not alone.

Instantaneous and pervasive access to primary texts is provided as a matter of course by the Internet in the form of funded initiatives at every scale. One should remember that hypertext was invented by Tim Berners-Lee expressly to serve two augmentation functions: first, to enable instant exchange of academic papers; second, to provide instant access to the whole text of works cited through the hyperlink. In some cases, the Web version of a work of philosophy is more useful than a paper book because it provides efficient access to internal information. For instance, in the case of Descartes' *Meditations*, every few paragraphs the original Latin, the contemporary French translation and an English translation are cross-linked [6].

The two reservations to bear in mind are as follows:

1. This hyper-access stops abruptly at around 1920 due to copyright issues. The fact that this is so should qualify not only enthusiasm for Web resources in undergraduate education, but also for copyright law. Who is available? Locke, no sweat; Camus, no way;
2. There is, therefore, a very significant convenience gap between access to primary and secondary texts, whose effects should not be underestimated as students move up from the freshman level;
3. The third of two reservations is listed nonsensically because it is common, but false to the point of being actively pernicious: the objection that the Internet provides easy access to materials that have not benefited from the salutary effects of peer review and the rough justice of the economics of publishing. Why is this herring so red?

The Birds and Bees of Online Research

The third reservation of the above two is predicated on a typically unstated idea that the editorial and curatorial professions surrounding academic publishing and library collections could somehow substitute for, or lead to, the development of the kind of mature critical and ethical understanding on which the legitimacy of all professions is founded. *Mein Kampf* is, after all, a fixture of public and academic libraries, and for (regrettably) good reasons.

Providing sound critical *technology* for students, and requiring of them that they understand and evaluate any source, whether or not it has been approved by an authority, is the first and only absolute responsibility of an educator. This is true for engineering and science now just as much as it was for the liberal arts as they were propounded by Aristotle to Alexander the Great. As the power of people to act is increased by their social or technical capital, the value of their wisdom increases for everyone else.

Again, there is the question of the *de facto* investment: we have given up an awful lot of human capital to the care and feeding of online and onsite electronic academic resources. Ultimately, all of that cost must be understood to have been borne by the students through the displacement of other services. At the same time, we have worked hard to preserve old norms, mostly through limiting or forbidding the full use of the new tools.

The convenience gap between a Google-type Web search, a library database search and physical library search is *huge*. However, it is less useful to favour, or veto, or give up on any one of these than it is to treat them as distinct to be checked and graded for relevance and quality as appropriate. This is fiddly handwork, but crucial to the curriculum, because it will be crucial to students after they graduate.

REVIEWING THE CANON

It is important to first consider the dual meaning of the term *augmentation*:

- To supplement;
- To expand.

Doug Engelbart coined the phrase *augmenting human intellect* in his 1968 *Mother of All Demos* at the Fall Joint Computer Conference in San Francisco, USA, where teleconferencing, hypermedia and the mouse were demonstrated together for the first time [7]. The augmentation that Engelbart had in mind was more than an acceleration and more than an increase in the productivity of design or production teams. Rather than a new set of tools, he envisioned a *bootstrapping* that was an amalgam of societal/cultural and technical progress, a general increase in human development.

In particular, Engelbart hoped to establish as a norm the possibility of structuring arguments in more complex ways than the single linear exposition. Networks of linked statements could be associated in ways more accurately reflecting their causal relations. Ironically, this particular competence requires no technology more complex than the same paper and pencil used to jot notes on a napkin; it is a simple matter of creating diagrams rather than texts. Doubly ironically, the integration of chart- and diagram-making tools is one of the most obviously underutilised tool sets available to owners of personal computers and the one with the most potential in terms of augmenting the analytical and synthetic powers of the average student. Triply ironically, a judicious selection from the canon of philosophy would serve just as well in helping to develop students' abilities to imagine (or visualise) complex causal relationships, while providing some useful historical and ethical context for their education in science and technology.

A diagram of Plato's allegory of the cave, or a map of his *Republic*, or of Thomas Moore's *Utopia*, are all examples of descriptions of visual analogies for abstract expositions, an ancestral and still effective form of what contemporary thinkers might call *models*. Some of the models are developed as descriptions of visualisations, others by the judicious use or adaptation of forms of writing that lend themselves to particular theses. Thus, Plato's favoured genre of dramatic dialogue, besides inviting the reader to imagine the physiognomies and temperaments of particular characters, lends itself better than other forms to the sceptical anti-conclusions of Socrates, his main character. In fact, Plato was far from alone in the freedom with which he adopted forms other than the formal philosophical treatise to develop and communicate his ideas. One of the traditional purposes in teaching philosophy, in fact, has been the implicit teaching of a wide variety of test forms, whose various structural characteristics provide formats suitable for the development of highly complex (often non-linear) analyses and syntheses.

This might seem mind-boggling or just plain incomprehensible to anyone not acquainted with Spinoza's *Ethics*. Spinoza wrote his *Ethics* in the form of a mathematical treatise, rather than a summa, philosophical treatise or essay for good reasons: first, to make the point that the divinity and universe he described were as precisely and intricately inter-determined (the author's neologism) as numbers, but also because the form leant itself to just the kind of hyper-textual construction, exposition, and reading we now think of as *networked*. This is a highly developed instance of the non-linear exposition that Engelbart was still envisioning as potential in 1968, notwithstanding Spinoza's full realisation of it in 1673 or so.

Spinoza is an unusual case, of course, and generally regarded as too esoteric for non-specialists. In fact, the mathematical terms and methods he used may well provide a certain ease of access to students who have identified with math and science, and against the humanities, up to the point of entering college.

Likewise, Descartes is a reassuringly familiar name to engineering students through their experience of Cartesian coordinates. This simple connection, in combination with his authority in the history of the scientific method, can open up a lot of doors at once.

It should be emphasised that the particular combination of Descartes and Spinoza was introduced in the second term of a freshman course in *writing for the humanities*, which is more generally interpreted at Brooklyn Polytechnic as an English composition class. The Descartes/Spinoza sequence was part of a syllabus starting with the trial of Socrates, and including Locke's second treatise on civil government, and Albert Camus' editorial in Combat about the bombing of Hiroshima.

The course was designed and introduced at two levels, as follows:

- Thematically, a sampling of philosophers in controversy;
- Technically, as an introduction to the complex relationship between *reason* and *rhetoric*.

As budding engineers and scientists, the students enrolled in this course might have been expected to identify very strongly with their disciplines as *rational*. Enriching their understanding of reason, as well as their competence as rhetoricians, through a thorough consideration of the methods and the ideas of historical philosophers amounts to teaching English composition indirectly, but at a high level.

Interestingly, the conceptual complexities of continental rationalism were less of a problem for students than Locke's 17th Century English, whose archaic grammar and usage were a real stumbling block for non-native speakers or, more particularly, even for native speakers from non-literary backgrounds. The point at which it becomes clear that making sense of individual sentences is a big part of the work, then all pretence of post-secondary education must be abandoned.

On the other hand, there is, in the philosophical canon, a largely untapped resource for comparing different combination of writing format and ideas: Plato's use of dramatic dialogue for the presentation of theses and their refutation, Descartes' use of autobiography to introduce his rationalism, Spinoza as a *hacker* using the mathematical treatise form to articulate a coherent complex and stable system of logical relationships between philosophical terms, etc. In other words, the ready availability of many original texts makes it convenient to comparatively introduce philosophers in terms of their conceptual/discursive methods and uses of form, as well as their *talking points*.

It should be noted that the shape of the canon itself has changed, at least as far as relative availability is concerned. Occasionally, students are distracted from the proper use of their laptops as vehicles for mass entertainment. In these admittedly rare transgressions, they can find at *no additional cost* a wide selection of sources and resources, many in fact identical to the standard printed texts sold in university bookstores. The ease of acquisition of public-domain texts in philosophy and literature is a fulfilment of the promise of the Internet, as envisioned by the most idealistic of its early proponents.

A proviso: this easy and free (once the machine and Internet service have been paid for) access is not uniform. Few texts published after 1920 by non-Marxists are freely available. Therefore, the *freely available* canon is a partial and distorted subset of the broader range still kept in paper form in most university libraries. The relative *inconvenience* of going all the way over there and actually lifting books from shelves represents a further distortion in practice.

Therefore, it is important to stipulate that the Web is not a proper substitute at this point for conventional books in the formation of specialists in philosophy, but that the range of available materials is adequate for the provision of key elements of philosophical thought and tradition insofar as it can and must inform the education of people as powerful as engineers have become.

The key factor is the necessity of understanding that the wireless classrooms and laptop computers have been paid for with the money that used to go into books and teaching assistants, and that we therefore have no legitimate objection to the students' reluctance to pay for *content*. At some level, they understand better than we of Generation Beta do that they have already paid, and that any expectation on our part that they should also cover the cost of the conventional materials amounts to double-billing.

In the case of primary texts written prior to 1920, this expectation must be particularly galling to any undergraduate with enough sense to have any business in a university – we cannot even muster the specious pretence advanced by other more familiar publishing industries about giving the artist his/her due. It is obvious enough that Spinoza is not getting royalties and that every cent of the price of the book is, therefore, going to paper and intermediaries.

Beyond the clear and enforced underutilisation of the wireless university's ability to deliver course materials, there is the perhaps more fundamental and obscene failure to make full use of its utility as a tool for composition and, therefore, for the construction of complex thought. It is not reasonable to expect undergraduates in any field to so thoroughly understand the various genres in which they think and communicate that they can readily mix and match and switch between modes effectively. On the other hand, they can use their computers to greatly accelerate the development of their skills in structuring writing – and therefore thought – through two basic modes, specifically:

- Text, ie rhetoric (see next section);
- The visual organisation of concepts, ie charting text structure (see subsequent section).

Rehabilitating Rhetoric

Rhetoric is, in contemporary usage, pejorative in the same way as *politics* has become so (how bad a sign is this in a democracy?). In its derogatory use, rhetoric is conventionally the opposite of reason, a kind of ahistorical version of sophistry.

On the other hand, there is the author's father: a research chemist, looking back on a 40-year career, estimated that he had spent 70% of his time reading and writing reports. If one adds to that the time spent in meetings, his day was perhaps not so different from that of an English professor. Insofar as much of his writing was addressed to non-engineers (management and technical staff) and the things he wrote about had implications, including the viability of the company, workers' safety and the price-quality balance of a range of products being manufactured in large quantities, the

author's father had a special obligation to write and speak clearly and succinctly. In effect, most of his job was understanding and explaining, and indeed persuading his colleagues and superiors to carry out certain activities in ways that seemed obvious to him only because he had spent so much time researching the problem (and as much as he could get away with actually running experiments and tests). If he could not communicate his findings succinctly, clearly and persuasively, then his job was not being achieved. In other words, the author's father – the chemist – was in the rational-empirical business a little of the time, and the rhetoric business a lot of the time.

More importantly, the process of organising the individual bits of information he had gathered into groups and these groups into a coherent structure was both a process of explaining to others and of understanding in the first place. In practice, there is no point at which reason stops and rhetoric starts – even in engineering.

Whether the task at hand is to understand a complex situation or to explain one, there may be no worse preparation than the five-paragraph essay form. In fact, writing structure is a crucial but weak point in American freshman literacy. It is the primary tool of complex thought construction and exchange. An adequate repertoire of essay and, therefore, conceptual structures may indeed be the most glaring deficiency in the education of engineers and scientists, both for reading and writing. Traditional formats, eg thesis-antithesis-synthesis, or compare-and-contrast, are poorly understood, let alone practised.

Before considering the possibilities proposed by Engelbart in 1962, a partial inventory of ubiquitous (but poorly used) tools is in order, as follows:

- Templates: Consider offering blank structures as templates and articulate a typology of structures and formats;
- Full use of current word processing capabilities: The *outline view* feature of Microsoft *Word* is a particularly powerful aid in organising texts. It turns any heading into a button, which opens and collapses the contents of that section instantly. Having seen what the Polytechnic University's Humanities and Social Sciences Department's catalogue information looks like in outline view, the author can affirm from experience that this feature is a real eye-opener;
- Tables of Contents and site maps: This form is well understood by undergraduates as the essence of organising information. Understanding the relationship between the branching hierarchy of the contents, as well as the linear causal chain or dramatic arc of a text read from beginning to end, is the level at which current students should be able to process and create new writing and complex thought;
- Hypertext: As students become more proficient in imagining, they will find that even some of the more sophisticated paper-writing techniques do not render certain kinds of causal relationships well. The use of hyperlinks within a text may actually be an effective writing device in certain situations, particularly with regard to text-hacking, aka *augmented plagiarism*.

VISUAL ORGANISATION OF CONCEPTS

Approximately 20 years ago, it took the author about six months to become comfortable with computers as tools for writing. The essence of the transition had to do with the very different style in which the indispensable phase of re-arranging simple concepts and statements into coherent groups, and those groups into robust chains, had to be accomplished. The mechanical process of cutting and pasting was, of course, much neater and faster, but the process of organising the groups and subgroups was rather more difficult, as it involved either printing things out and chopping them up by hand, prior to the laborious process of manually emulating the edits after they had been made manually, or the more difficult work of so thoroughly memorising and imagining the structure of an essay in its entirety, that the word processing could be undertaken all at once as a kind of stenographic record of an arduous internalisation. The author had no idea at the time that there was a fashion for *outline editors* in progress expressly designed to enable one to build and juggle those groups and subgroups as they were formed. This article was written entirely in *outline view* in Microsoft *Word*, whose ability to expand and collapse headings and subheadings with a mouse click effectively makes the work of moving between the levels of paragraph, subsection and section as automatic and effortless as it should be if one hopes to educate engineers (or philosophers) who are to navigate between levels effectively, and especially to compose thoughts and texts as a fully plastic medium. The easier it is to switch to viewing the higher-level structure of a text, the more often people will undertake it. The more often people carry this out, the less they will forget where they are in a causal or conceptual chain.

Rendering an argument or analysis as a flowchart can reveal all kinds of interesting things about how different pieces of the text can – or should be – related to one another. Some traditional essay structures, such

as a classical argument or compare-and-contrast, make a rather obvious translation to the visual. On the other hand, distinctions between a thesis-antithesis-synthesis format designed to justify a middle way between or beyond opposite views of a question and more subtle structures, such as thesis-antithesis-refutation of antithesis, can best be explained and taught through the liberal use of diagrams. Software that can link diagrams to substantial chunks of reasoning and references becomes a valuable tool in the construction of complex configurations of thought. At the point at which a student makes effective use of such means, they achieve an augmentation beyond the power of the syllogism, and beyond the range of a panoply of standardised structures or writing, which is in itself an augmentation of reason.

Visual reasoning is actually a propensity of a percentage of the general population, which happens to include a lot of engineers. There are alternatives, such as a strict adherence to conventions or procedures. Such adherence is less a matter of learning than it is of mimicry. In its extreme form, such imitativeness reduces to plagiarism.

MAKING PLAGIARISM WORK

Plagiarism may be the single worst-used tool in pedagogy. The prevalence of a degenerate form of this useful practice is at least, in part, a side-effect of the mass production of curricula, materials and teaching, just as much as it is of student immorality or the conveniences of online paper-selling.

The most important precedent for plagiarism is its ancestor, tradition. How much of the *Odyssey* Homer had heard, and how much of it he composed as *original* material, is an appropriately trivial matter. In any case, it is in the public domain for the time being.

In contemporary practice, it is important to bear in mind that sampling, remixing and remaking are considered legitimate, desirable and normal cultural practices, as they were for Mozart, Mahler and even Disney. It is time to at least consider the possibility that we should use the Internet more the way that calculators are utilised in class and examination rooms: as a resource that *will* be freely available in the workplace and home indefinitely, a baseline amenity and resource which should allow us to *move up the value chain* as teachers and students, to concentrate on the higher-level issues made available by the hyper-acceleration of browsing and cross-referencing.

Sampling and mixing techniques are actually more consistent with the average learning process than *originality*. Why not, at least once, try to carry this out with essay-writing? There is so much writing effectively embedded in every computer with an Internet connection (this now includes smart phones, portable game consoles and certain airplane armrests) that it is almost crazy that more is not obtained from it as spare parts. There are, of course, limits to the use that can be made of these techniques outside of the fair-use haven of the university, but for freshmen, the author have devised the following eye-opening composition assignment: the cut-and-paste paper.

The assignment is simple enough. Set a topic and then instruct the students to lift every single word from the Internet. All the borrowed pieces must be hyperlinked to their source online, and no gaps may be filled in with the student's own words. In other words, the assignment is not writing, but editing. The standards of grammar, logic and structure were to be as for the previous assignment, but on a different topic.

The first time the author set this assignment, there was tremendous glee in the classroom. Never having tried it, and having been enjoined to avoid it on the grounds that it was cheating, the students assumed wrongly that it would be much easier than writing their own. A week later, they understood much better that making sense of available bits of text in the service of a specific argument is serious business.

This exercise is a very useful introduction to the significance and challenge of editing, as opposed to writing. Insofar as most of what students read in print has been produced by the author in collaboration with an editor, and that the process of professional writing is itself a *cheat* by the standards imposed in the classroom, it might make some sense to at least let them experience the writing process as a composite of writing and editing, the latter of which is as demanding as it is crucial.

A more advanced level of the assignment would call for using only texts published free of copyright restrictions. This includes public domain, but also work published under one or another forms of public license or copyleft.

In this regard, the reader should refer to Isodore Ducasse, aka Comte de Lautréamont, inventor of shareware and arguably of the conceptual kernel of the open-source movement, through his familiarity to university students in the 1960s:

> *Le plagiat est nécessaire. Le progrès l'implique. Il serre de près la phrase d'un auteur, se sert de ses expressions, efface une idée fausse, la remplace par l'idée juste. Une maxime, pour être bien faite, ne demande pas à être corrigée. Elle demande à être développée (Poésies 1870)* [8].

The more developed form of this idea is the principle of *hacking*, as put forward by McKenzie Wark in his *Hacker Manifesto* of 2004 [9]. There, he applies the specific idea of the computer hacker, who modifies existing programs to suit his own ends, to a more general concept of the intellectual class as idea-hackers. Asking students to *hack* the texts they read, to select elements from disparate sources and assemble them into new conceptual, dramatic and logical structures, is what we most fundamentally are mandated to carry out. Why, then, forbid exactly this practice in the classroom and essay? It should also be noted that the *Hacker Manifesto* was written according to what is becoming a standard method in some disciplines: Wark posted chapters on the Nettime listserv over the course of a year or so with an RFC (request for comment), and made substantial modifications to the work on the basis of comments by his peers. Is the text still original? Indeed, is McKenzie Wark still its author?

The more general question of collaborative writing projects is, at least potentially, ripe for expansion, again as appropriate preparation for professional life. Word processing applications now support version tracking, commenting and so forth. For almost every writing assignment handed in the last few years, an opportunity has been missed to set the work as a baseline for a thorough commenting project and another for an editing assignment. These kinds of approaches to research and writing have traditionally been anathema or novelty items in composition classes, and yet part and parcel of the writing process in work groups, peer-review journals and commercial publishing. For future engineers and scientists in particular, it would be a shame to fuss over the formatting of footnotes at the expense of preparing students adequately for the methods and practices that lead to quality writing and research in their chosen profession.

The text-hacking exercise mentioned above was handed in shortly before the coordinator of Freshman English, in the course of his regular duties, asked all the instructors to submit papers from each class through *Turnitin*. The author complied. Shortly thereafter, said coordinator contacted the author in great alarm with the news that the author's student had handed in a paper that was 96% plagiarised. The author responded that he would indeed censure the student for cheating on account of the 4% he had slipped in to save time searching for something appropriate online.

CONCLUSIONS

When was the last time an educator or his/her school took the time to *assess* the costs and benefits of the various technological novelties and revolutions that universities have been foisting on their students and faculty over the last dozen years? Are they the same in every case, or is there actually a special new mandate for the humanities in schools of engineering to teach the difference between the three aspects of technology with a capital T: Tool, Toy and Treadmill?

As educators, we must face the fact that we are teaching material we know, but not within the cognitive or practical habits with which we learned to learn it ourselves. If, as the author hopes, those teaching philosophy to the next generation of scientists and engineers were educated in schools and therefore subcultures specialised in their field, they face the special challenge of teaching students who had self-selected *away* from those subcultures, and whose pedagogical needs (and whose idea of what is easy and what is hard) are, therefore, fundamentally different at the outset.

While it is probably true that computers have generated more harm than good to liberal arts education in the near term, it is also true that the skills and standards traditionally carried by them are at a premium in conditions where the very medium of the university (not to mention of the workplace, society and planet Earth) is in a state of flux. It is also true that while the promise of the mass production of higher education has been, and continues to be, an obscenity, educators and students do have new tools ready to provide at least the rudiments of the functionality of such non-primitive technologies as the conversation, seminar, letter, footnote and the good long walk.

The myth that engineering students are less inclined, or less able, than other groups of undergraduates with regard to the consideration of philosophical questions is pernicious. As things now stand, engineers have as great a need for such education as any professionals and human society has at least as great a need for engineers who are prepared to address qualitative and ethical dimensions of new technologies and new applications at ever larger scales and ever shorter intervals. In fact, engineering students have a much easier time with certain segments of the philosophical canon than their counterparts in the liberal arts and, indeed, those parts of the canon for which they have the most direct use in work and life.

Cyborg students are powerful, but a priori primitive beings: they are the first to be born into their condition. For us, Generation Beta, to be anything but archaic to them as teachers and role models, we must be prepared to not only adapt to the costs and inconvenience of the disruption of intellectual life by its inundation with novel tools and practices, but, indeed, to utilise electronic devices to the full extent of their

useful potential in the formulation and exchange of new forms of wisdom.

We must be prepared to exapt [10].

REFERENCES

1. Chapter I of Title 8 of the Official Compilation of Codes, Rules and Regulations of the State of New York, Section 3.47. Requirements for Earned Degrees, http://www.highered.nysed.gov/ocue/chapter_i_of_title_8_of_the_offi.htm
2. Descartes, R., Discours de la Méthode (1637), http://www.cvm.qc.ca/encephi/contenu/textes/discmet1.htm
3. Engelbart, D.C., Augmenting Human Intellect: a Conceptual Framework. AFOSR-3233 Summary Report, SRI Project No. 3578, October (1962), http://www.bootstrap.org/augdocs/friedewald030402/augmentinghumanintellect/ahi62index.html
4. McLuhan, M., *Understanding Media: the Extensions of Man*. 9 [*PowerPoint* was substituted for TV].
5. Drupal, an open-source content management application with an ancillary course-management program called *Moodle*, www.drupal.org
6. Manley, D.B. and Taylor, C.S. (Eds), Descartes' Meditations: a Trilingual HTML Edition, http://www.wright.edu/cola/descartes/
7. Engelbart, D.C. and English, W.K., A research center for augmenting human intellect. *Proc. AFIPS Fall Joint Computer Conf.*, San Francisco, USA, 395-410 (1968).
8. Ducasse, I. (Comte de Lautréamont), Poesies II (1870), http://www.anthologie.free.fr/anthologie/lautreamont/poesie02.htm
9. Wark, M., *A Hacker Manifesto*. Cambridge: Harvard University Press (2004).
10. Gould, S.J. and Vrba, E., Exaptation - a missing term in the science of form. *Paleobiology*, 8, 4-15 (1982).

BIOGRAPHY

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