EDUCATIONAL TECHNOLOGY:
Yesterday, Today and Tomorrow

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In a time of resource constraints, better, more efficient and more cost-effective methods of training and education must be found. This article was originally a paper presented to the Army Extension Training Conference sponsored by the US Army Training Support Center in May 1986. The author presents his views on how to get better returns for the money.

IN 1973, Isaac Asimov, the famous futurist and science fiction writer, attended a conference on educational technology. Television (TV) cassettes were then considered the wave of the future. A number of papers were presented by educators enthralled with the possibilities of storing an extensive trove of information, readily retrievable by a student. The TV cassette, it was held, constituted the beginning of a new era in entertainment and could open new vistas in teaching. When some mishap befell one of the scheduled speakers, Asimov was unexpectedly asked to speak. In an impromptu talk, he invoked his experience in imagining the future and invited his audience to accompany him on an intellectual foray into what was to come.

He began by describing the size, bulk and expense of the apparatus that decodes the analogue signals recorded magnetically on the cassette tape, controls the flickering beam which stimulated the face of the bulky picture tube and evokes synchronous sound from the audio amplifier and speaker system. Obviously, he predicted, the relentless drive of technology, aided and abetted by international economic competition, would assure that this auxiliary equipment became progressively smaller, lighter, more mobile and more responsive to its users' habits and needs. Eventually, he opined, the auxiliary equipment would be eliminated and combined with the recording medium, the cassette itself.

Asimov then turned to the considerable energy requirements for a 1973 TV cassette system. That 1973 audience was keenly attuned to the implications of the United States' dependence upon foreign-supplied fossil fuels. Accordingly, he predicted that our engineers would systematically reduce the energy requirements for the system to the point that its energy requirements would be negligible.

Hence, he prophesied, we can look forward to a small, light, self-sufficient, imminently portable information source. While it would consume energy and materials in its manufacture, its cunning design would all but eliminate a need for a power supply. Moreover, he thought it would be possible to design the cassette so that system/learner transactions could be completely private, with no possibility of infringing upon the activities of others. Since it could function anywhere, it would take learning to wherever the student desired—into the field, into bed or into other environments which, in no way, resembled a classroom. Individual instruction on job sites would become a distinct possibility.

But, Asimov said, these were by no means the limits of the marvels yet to come. He believed it would be possible for the cassette to be activated by brain waves, eliminating the need for switches, knobs or other mechanical controls. In effect, the cassette would be started at a glance and stopped whenever the eye or attention was averted. Further, he opined, there was no reason why such a cassette could not be programed to provide for random access to any of its frames. Conceivably, some sort of index system would be keyed to the learning experience so that very elegant mapping by educational technologists would be feasible and the learning paced to the absorptive capacity of the student.

How many years would it take to develop such a learning system? How long would technology take, assuming continued strong stimulus from commercial competition, to evolve this self-contained, energy-independent, mobile, perfectly private, mentally controlled cassette? Asimov's answer was "sooner than we think." His estimate was *minus 500 years*.

Asimov was describing, of course, a printed book. He timed its development from Johannes Gutenberg of Mainz who invented movable type in the middle of the 15th century. Asimov went on to extol the advantages of the printed page as a medium for teaching. He felt it was superior, for most educational purposes, to other forms of recording. With a book, the reader's imagination was relatively free to embellish the printed word.

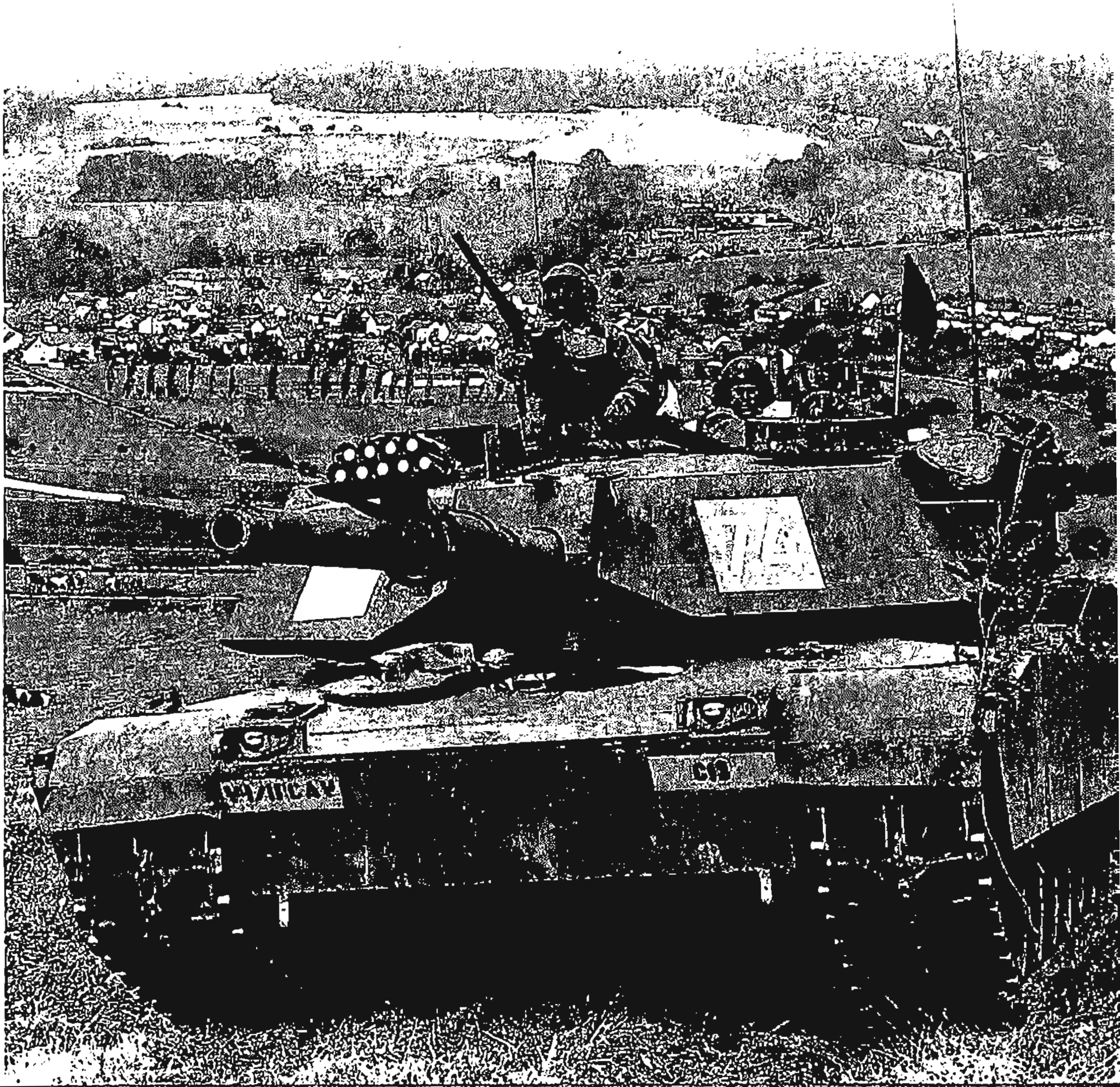
Asimov did not argue that books could or should replace TV and related forms of audio-visual communication. He described reading as an activity confined to a shrinking minority, a form of communication that had been confined to societies' elites for all but a fraction of recorded history. He went on to predict that the same elites—which he thought were less than 1 percent of the world's population—would remain wedded to the printed word.

But, of course, the US Army's problem lies with the 99 percent—with the nonelite, to use Asimov's construct. It is abundantly clear today that neither traditional schoolhouses nor other paper-based instructional systems will enable the Army to transcend the difficulties it faces. These difficulties include advanced technology and relatively illiterate users and maintainers, constrained budgets and ever more competition among readiness, sustainability, modernization and force structure.

From the perspective of educational technology, the Army's challenges are more numerous and demanding than those of the other services. It is, therefore, understandable that the Army has led the way with the Electronic Information Delivery System (EIDS) which is now, according to the Defense Visual Information Standardization Committee, the Department of Defense videodisc standard.*

As I see it, EIDS is the culmination of a search which began at Fort Monroe, Virginia, in 1974. It was then, as I recall, that I first showed a videodisc at the US Army Train-

*Note, however, that the Army has lagged behind the Navy and the Air Force in serious efforts to upgrade unit (shipboard and squadron) training for individuals. For instance, the US Air Force Science and Technology Program now includes an advanced on-the-job training system, predicated on the fact that 70 percent of technical training requirements that support unit missions are met through on-the-job training and affect more than 90 percent of Air Force enlisted personnel.



. . . in US Army, Europe, traditional training methods relying on maneuvers in the countryside and live fire at major training areas are under severe attack from politically potent environmentalists. . . . I have long doubted that firing live ammunition at two-dimensional, pop-up or moving targets continues to make much sense in an era in which most direct-fire weapons are equipped with infrared sighting devices and many have laser range finders and on-board fire control computers. . . . robotic, freely maneuverable, three-dimensional targets are available and . . . such targets can be realistically engaged with lasers with almost no loss of realism. . . .

ing and Doctrine Command (TRADOC) Commanders' Conference. I talked about the prospective convergence of lowered costs for storing information and for processing it interactively with students. But, just as it took TRADOC 12 years to develop and field the Multiple Integrated Laser Engagement System *(MILES)*, it took us the same period to bring EIDS to fielding. Yet, *MILES* is by no means all that needs to be done with collective training. And even the most enthusiastic supporter of EIDS will understand that it can offer no more than partial answers to the tough questions facing those who design and direct the Army's individual training.

Let me enumerate the more important of the pending questions on individual and collective training. I believe it is imperative that any group concerned with the future of educational technology needs to understand them. They have not changed much over the past 13 years. There are at least three fundamental questions:

- How can the Army balance readiness in its units with individual training and education in TRADOC institutions?
- How can the Army optimize its investments in training for readiness to afford the continuing modernization of its materiel and force structure?
- How can the Army define tasks and conditions and establish standards of performance both horizontally and vertically throughout its ranks?

In the larger sense, these are all strategic problems of educational technology. The choices today's leaders make will govern the future of Army training.

Concerning the perennial tension between institutional and unit training, our Army—one of the more robustly conservative institutions within US society—cherishes its heritage of mobilization in time of crisis. But that past is no sure guide for the future. Events in the modern world will probably not as readily delineate peace from war or allow the nation time to redirect its social energy from peaceful to martial purposes. For the foreseeable future, the Congress and the US electorate are going to have to continue large expenditures to maintain, and periodically to update, a large standing force capable of deterring war by being demonstrably ready to fight.

But the Army's extensive TRADOC system of schools has been built around our mobilization heritage, designed largely to advance the training or education of individuals and, thereby, to increase their potential for larger responsibilities. But an officer or noncommissioned officer in school is not available to a unit. I believe it is true that many of the changes in TRADOC schools over the past two decades have involved hard choices between manning the force or providing better leaders for tomorrow.

But I argue now, as I have over the years, that educational technologists could free the US Army chief of staff from having to regard such choices as either-or. They can enable him to select from alternatives, making it possible to train or educate, evaluate and credit as well in units as is now possible in schools. Hence, I see a requirement for overarching training management which can assess need and accomplishment. It must deliver training or education to most of the Army's individual leaders who, most of the time, serve in operations vice school assignments. In the long run, nothing less will work.

Concerning the tension between readiness and modernization, I have already described how institutional training subtracts from readiness by diverting critical manpower from units into an expensive training base. There are extensive annual outlays imputed to unit training, including training ammunition, field exercises and the related consumption of spare parts and automative fuels. Training costs have been rising over

With the Defense Advanced Research Projects Agency's (DARPA's) *SIMNET* project now under way at Fort Knox, Kentucky, it is possible to contemplate force-on-force engagements without even having to position elements of a task force on the same continent. . . . I could conceive of an integrated program of individual and collective training in units resting on EIDS, ITMS, *SIMNET* and NTC-like field exercises for battalions. These could be coupled at higher echelons with battle simulations and corps-level instrumented tactical exercises without troops (TEWTs) which permit evaluated, opposed maneuvers over actual terrain in real time.

recent years. For an Army with a fixed end strength which must plan for a fixed budget (or even a reduced budget) in the years ahead, either the Army must find more cost-effective ways to train or forgo some of its planned materiel modernization or part of its structural upgrades, or both.

At the same time, in US Army, Europe, traditional training methods relying on maneuvers in the countryside and live fire at major training areas are under severe attack from politically potent environmentalists. Again, I suspect that educational technologists could supply remedies, but I am not sure they have been brought to bear.

I have long doubted that firing live ammunition at two-dimensional, pop-up or moving targets continues to make much sense in an era in which most direct-fire weapons are equipped with infrared sighting devices and many have laser range finders and on-board fire control computers. I know that robotic, freely maneuverable, three-dimensional targets are available and that such targets can be realistically engaged with lasers with almost no loss of realism unless one insists on the environmentally objectionable concussion.

With the Defense Advanced Research Projects Agency's (DARPA's) *SIMNET* project now under way at Fort Knox, Kentucky, it is possible to contemplate force-on-force engagements without even having to position elements of a task force on the same continent. However, I detect disconnects between such obviously related projects as EIDS, the Integrated Training Management System (ITMS) being fielded at Fort Lewis, Washington, the upcoming effort to automate the Army Training and Evaluation Program (ARTEP) and *SIMNET*, the upgrades contemplated for the National Training Center (NTC), the new Joint Readiness Training Center, DARPA's AirLand Battle Management project and the Army Research Institute's several undertakings directed at training and evaluating senior leaders or their staffs.

Were I one of the Army's leaders, I would be looking with urgency for a way to pull all that disparate, largely research-oriented effort together and to focus it on the larger question. I could conceive of an integrated program of individual and collective training in units resting on EIDS, ITMS, *SIMNET* and NTC-like field exercises for battalions. These could be coupled at higher echelons with battle simulations and corps-level instrumented tactical exercises without troops (TEWTs) which permit evaluated, opposed maneuvers over actual terrain in real time. Whether my vision is true or not, somehow the Army—and the Air Force—must find a better way to train for the AirLand Battle without sacrificing needed improvements.in its equipment and structure.

Concerning standards of performance, I am aware that the vice chief of staff of the Army has asked perceptive questions as to whether the Army has adequately defined training missions horizontally across the combat, combat support and combat service support units of the force, and vertically from the theater echelon downward to the lowest functioning units and detachments. As far as I know, his questions have never been answered.

From my own experience, I know we have focused our attention, appropriately enough, upon the combat arms and those arms and services directly involved in aiding the former to control land and people. Moreover, the Army has a propensity to drill repeatedly in the performances of units at battalion or lower level and labors under strong budgetary disincentives for exercises involving brigades, divisions or larger formations. These budget limitations are not all bad, for I share the heresy of General Arthur S. "Ace" Collins Jr. who wrote in his book *Common Sense Training: A Working Philos-*

ophy for Leaders concerning conventional field training exercises (FTXs):

The benefits from a field-training exercise extend to units two levels below the highest headquarters participating. In a company-level exercise, the platoons, squads, tank crews, and gun sections derive the most benefit; a battalion exercise benefits the company and platoon level; a brigade exercise benefits the battalion and company; and so on. If this is a sound rule of thumb, and if the training of individuals and small units is the real key of successful training, then field exercises above battalion do not add much to the quality of training. The larger-unit exercises consume time and resources that could better be used to improve individual and small-unit training, the foundations of unit readiness. Battalion-level exercises should not be held too often; once a year is enough. . . . Some will disagree thoroughly with this outlook on large-unit training, but there are good historical precedents to argue persuasively that full-scale division and brigade-level FTXs are not essential to achieving a fully trained status. For World War II, the Japanese trained a formidable fighting force with no exercises above battalion level. The training of the Wehrmacht *emphasized small-unit training and was done for the most part near home* kasernes. . . .

While I am sure that we should not wholly accept the Japanese or Germans as models—after all, they lost the war—I do agree that, if resources and time are scarce, giving priority to field exercises at lower echelons makes eminent common sense. But the usual FTX will hardly do the job today at any echelon. The Army has a doctrinal imperative for the proficient exercise of command at higher echelons, derivative of the speed and reach of modern weaponry and of the ever-increasing interdependence of the Army and the Air Force. A maladroit corps staff can obviate very high proficiency among the corps' battalions.

AirLand Battle will be only rhetoric unless there is genuine integration of air and ground operations at the corps level. Training for such integration now relies on simulations driven by computers, using models which are simply not credible to many generals as a measure of how the joint forces might perform under the time-distance stresses of actual operations. I am convinced that the Army must now find a new format for training for AirLand Battle—one which would permit, as I have indicated, an opposed TEWT for a corps and its air support against a Soviet-type field army and its air. If the Army can do so, it will be able to validate, or to make more credible, its computer models. More importantly, it will be able to find ways to train and evaluate its corps commanders and their staffs to realistically high standards, better assuring the president and the Congress that our forces are indeed ready to discharge their wartime responsibilities.

But to find, the Army must search.

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