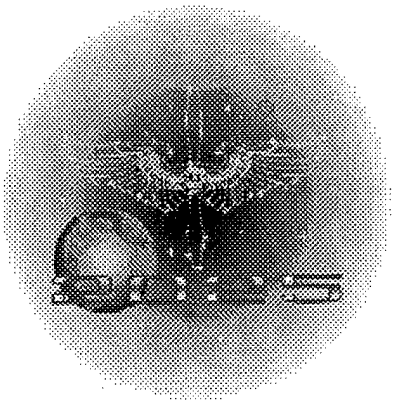
Brilliant Warrior:
Information Technology Integration in Education and Training



A Research Paper
Presented To

Air Force ***2025***

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2025 is a study designed to comply with a directive from the chief of staff of the Air Force to examine the concepts, capabilities, and technologies the United States will require to remain the dominant air and space force in the future. Presented on 17 June 1996, this report was produced in the Department of Defense school environment of academic freedom and in the interest of advancing concepts related to national defense. The views expressed in this report are those of the authors and do not reflect the official policy or position of the United States Air Force, Department of Defense, or the United States government.

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Executive Summary

The Air and Space Force (ASF) of 2025 will be a smaller and far more technical force than even today's Air Force. It will be a matured third wave information age force, incorporating new technologies, new operational concepts, new tactics, and new organizational structures. The advanced weapons of 2025 will require brilliant soldiers, sailors, marines, and airmen. The military of the future will need warriors who are not only comfortable with high-technology equipment but can also deal with diverse people and cultures, tolerate ambiguity, take initiative, ask questions, and even question authority.[1] As a result, the ASF of 2025 will increase its emphasis on education and training to give its warriors the best possible learning opportunities in an effort to make them as productive as possible quickly and economically.

To achieve these goals, the ASF will develop an integrated adaptive learning environment (ALE) centered on four overlapping areas which impact education and training. These areas include the people involved in the learning process along with their changing roles and responsibilities; the evolving goals and objectives of education and training programs; the new skills, knowledge, and competencies required in the information age; and rapidly emerging information systems technologies such as high-capacity global networks, digital knowledge-bases, advanced software, and virtual reality systems.

Education and training in the information age will rely only partly on the application of advanced technologies; the human element will remain the most critical element to

successful information technology integration and exploitation. By 2025, we will see the advent of an educational revolution in military affairs (RMA), reflecting the paradigm shift from "providing instruction" to "producing learning." Included in the RMA will be incorporation of other fundamental changes in the academic culture, curriculum, and teaching methods.[2]

The integration of technology for ASF education and training will be the key to developing "brilliant warriors." If successful, technology integration will provide the best education and training possible for ASF personnel, units, and others. It will employ a variety of delivery media to allow learners around the world to engage in education and training activities tailored to their individual needs on demand. It will exploit computer technology to create ultrarealistic simulations that enhance training. It will make vast amounts of information through global networks and digitized libraries available to speed and improve critical decision making. Ultimately, it will harness the tremendous technical power of the information age to educate and train brilliant warriors who are better prepared to fight and win the conflicts of the future.

Notes

1. Alvin and Heidi Toffler, *War and Anti-War* (New York: Warner Books, Inc., 1993), 85.

2. Donald A. Norman, "Designing the Future," *Scientific American*, September 1995, 160.

Chapter 1

Introduction

> *Computing is not about computers any more. It is about living. . . . We have seen computers move out of giant air-conditioned rooms into closets, then onto desks, and now into our laps and pockets. But this is not the end.*
>
> –Nicholas Negroponte, *Being Digital*

In 1996, we celebrated the 50th birthday of the first electronic computer. Since then computers have progressed rapidly, and recently our lives have been flooded with advances in information technology. Nicholas Negroponte, professor of media technology at MIT, highlights several examples of this phenomenon:

> Thirty five percent of American families and 50 percent of American teenagers have a personal computer at home; 30 million people are estimated to be on the Internet; 65 percent of new computers sold worldwide in 1994 were for the home; and 90 percent of those to be sold this year [1995] are expected to have modems or CD-ROM drives. These numbers do not even include the 50 microprocessors in the average 1995 automobile, or the microprocessors in your toaster, thermostat, answering machine, CD player, and greeting cards.[1]

Experts project that these explosive trends in information systems technology will continue. Advances in the next 30 years through both public and private research, development, and production efforts should result in a matured high-capacity global information infrastructure (GII) by 2025. This GII will give virtually everyone

everywhere the possibility to connect to other people, digital libraries, and massive interconnected knowledge bases around the world.

Today, the Air Force is experiencing its own explosion in the use of state-of-the-art information systems. Desktop and laptop computers are proliferating through even more and more offices. Our bases are rapidly expanding their network infrastructures and connecting people into the Internet. We are implementing highly integrated, automated command and control and support systems.

In 2025, the ASF will have to continue to exploit advances in technology to maintain its edge as the world's preeminent air and space power. Undoubtedly it will continue to use hi-tech applications across the force, but as the information age matures, one area will become even more important than before. That area is education and training.

As information becomes the capital commodity of the future,[2] we must ensure our people have the most current information possible about a wealth of topics. As futurists Alvin and Heidi Toffler note, information age "militaries place a massive emphasis on training and education at every level. . . . As in business, learning, de-learning, and re-learning has become a continuous process in every occupational category in the military. Training organizations are rising in the power-pecking order within the various military services. In all branches advanced technologies are being developed to speed learning."[3]

But technology is only one dimension critical to the success of information age education and training. To be effective and efficient in 2025, we must properly integrate technology into our education and training systems to keep us in front of the pack.

This paper examines four critical integration areas which we must consider as we migrate our current education and training systems into an effective ALE of 2025. Those

are (1) the purpose of education and training; (2) the required skills, knowledge, and competencies; (3) the people involved in the learning process; and (4) the technical capabilities and systems used to support it. As figure 1 depicts, integration is the central point at which these elements come together to form a whole. In addition, we will briefly discuss the process we recommend to properly integrate technology in the next 30 years.

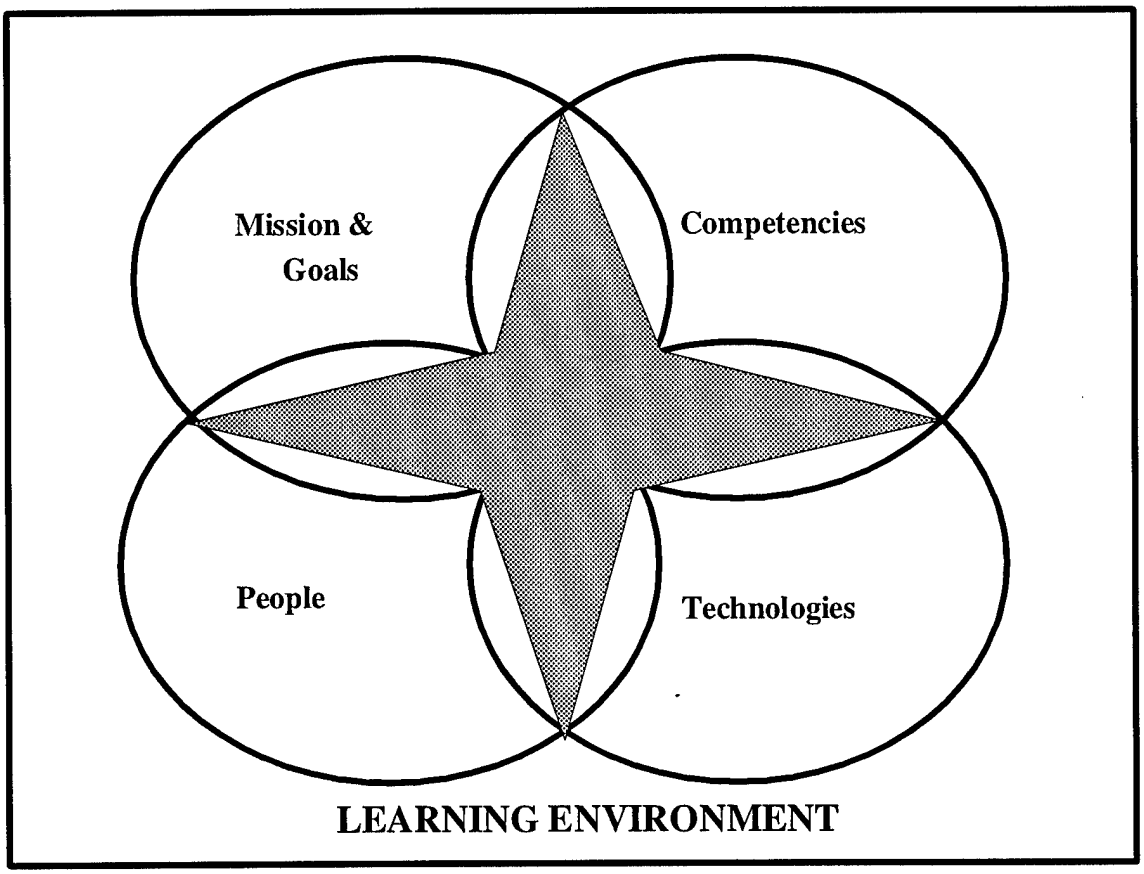

Figure 1-1. The Adaptive Learning Environment Model

Our thesis is that a change to any one element of the learning environment will impact other elements forcing them to adapt in some way. The net result of all the changes can be a dramatically different learning environment. The process of managing these changes in order to produce the desired ALE is a function of integration.

To analyze the ALE model we first identify the missions and goals of education and training for the ASF of 2025. Next, we address the shifting focus of education and training in the information age and the implications of that shift for the people involved. We then look at expected changes in curricula based on new skills, knowledge, and competencies required in the hi-tech world of 2025. We then discuss future information systems technologies which will impact the ALE and some of the key issues involved in integrating these technologies. Finally, we present a process and some caveats we believe will be useful in helping implement a mature ALE by 2025.

Before we begin these discussions, however, we must identify the key assumptions which shape our concept of the future. These assumptions provide the backdrop from which our discussions proceed. They are as follows:

1. The ASF of 2025 will continue to value, support, and invest in the education and training of its members.
2. The proliferation of global information networks and technologies will be driven by the commercial sector. As the costs of these systems (hardware and software) decrease, they will become both available and affordable for use by the ASF.
3. Information and time will be key commodities of the future for all organizations. Technologies that enhance access to current and accurate information and save time for the user will be incorporated into the learning environment.
4. Technology integration will result in the development of content-independent learning systems that can be accessed by learners in various locations—either at home, at the workplace, or in the field—to satisfy a variety of education and training requirements, thus creating new learning environments.
5. The new learning environments will require new information service infrastructures, protocols and procedures, and support professionals possessing new expertise and skills.

Notes

1. Nicholas Negroponte, *Being Digital* (New York: Vantage Books, 1995), 5.
2. John L. Peterson, *The Road to 2015: Profiles of the Future* (Corte Madera, Calif.: Waite Group Press, 1994), 70.
3. Alvin and Heidi Toffler, *War and Anti-War* (New York: Warner Books, 1993), 172.

Chapter 2

Mission and Goals

If we should have to fight, we should do so from the neck up, instead of from the neck down.

—Jimmy Doolittle

The overall mission of education and training in the Air Force is to leverage the most powerful factor in the warfighting equation—human potential.[1] As we move into the twenty-first century and the information age, it will continue to be people who must fight and win our nation's wars, and the military must continue to prepare its warriors to accomplish this awesome task. The growing possibility of engagement in nontraditional military missions emphasizes the need for a competently trained and thoroughly educated force prepared to meet a variety of future challenges. It is for this purpose that the ASF of 2025 will continue to value, support, and invest in the education and training of its members.

While military training and education both aim at achieving success in warfare—regardless of the nature or type of conflict—they each have a separate and distinct focus. Training is the process of teaching others specific skills to be performed under defined conditions.[2] It focuses on the psychomotor domain of learning and on performing

specified tasks in specified ways to a predetermined level or standard. Military training, for example, creates competence in using machines and equipment in the appropriate ways; it ensures that people can operate and maintain military systems used to fight wars. Education, on the other hand, focuses on the intellectual or cognitive domain of learning. It is the process of preparing others to solve problems and deal with situations not yet known or defined.[3] It is about learning how to learn and discovering what we do not know so that we may survive in the future. Military education focuses on the art of war and on developing insights and intellectual constructs that ensure we fight our wars smartly; it enables the warrior to envision future threats, engage in creative ways to resolve conflict, select the right tools and methods, and achieve the desired effect.[4]

Although the mission of education and training will remain essentially the same in 2025, new goals will likely evolve as a result of our growing dependence on information. The much-lauded coming of the information age or information revolution brings with it certain assumptions about the future that will impact the learning environment.[5] For example, the growth of information systems technologies will continue to increase the amount of available information and the speed at which it can be transferred. The continued globalization of society, substantial economic growth of multinational organizations, emergence of the knowledge worker,[6] increasing rates of technological advancements, and reliance on space-based assets and global networks are results of the information age. These trends are so significant that information is now considered a center of gravity for the military.[7] And developing "brilliant warriors" capable of success in the information age is becoming a function of education and training.

What are the desired characteristics of the brilliant warrior that can be translated into goals for education and for training? Foremost, brilliant warriors are professionals committed to ASF mission and values. In addition, they are expert in joint, combined, and coalition operations.[8] They are empowered individuals capable of creative problem solving both independently and in collaboration with others; they are able to apply theoretical and analytical knowledge. They have achieved mastery levels of performance and competence within a specialized career field; however, brilliant warriors also embrace change, can rapidly adapt to it, and are willing to take risks. Moreover, they are eager to discover new tools and develop innovative solutions for the problems they face. Finally, these professionals have a good deal of formal education and have acquired a habit of continuous learning.[9] These desired characteristics, when transformed into goals for learning, become the measures of success for education and training in the future. In other words, content and subject areas, learning theories and methodologies, and technologies that enhance the development of these characteristics in our brilliant warriors will be the elements integrated into the ALE of 2025.

Today, our military training institutions appear to be better prepared for their role in the future than are our educational institutions.[10] Military training has remained relevant and repeatedly re-engineered itself to take advantage of new theories of learning and advances in information technology. Our training processes are poised for the future. They are experiential and frequently conducted in realistic contexts using either simulations or real equipment and work-site facilities.[11] There is growing concern, however, that the theory of learning reflected in our current educational programs no longer reflects the needs and practices of our changing environment. Military educational

institutions have been slower to adapt to new insights about how people prefer to learn, slower to incorporate information technology, and reluctant to venture outside their hallowed walls.[12]

However, as we move to the future our brilliant warriors must increasingly merge knowledge and skill to quickly resolve the problems they face; the traditional lines which distinguish education from training will blur. As a result, we must shift our historic focus from separate education and training programs to develop content-independent learning systems and information networks to support them. In the next section we will explore this shift in emphasis and its implications for the people involved in the ALE of 2025.

Notes

1. Lt Gen Jay W. Kelley, "Brilliant Warrior" (Unpublished paper, Maxwell AFB, Ala.: Air University, 1996), 1.

2. Lt Gen Charles G. Boyd, briefing to Gen Merrill A. McPeak, CSAF, during the Education and Training Review conducted at the Air Force Wargaming Center, Air University, January 1992. This definition was later expanded upon by Dr John A. Kline, Air University Provost.

3. Dr John A. Kline, "Education and Training Today: Some Differences," *Air University Review 36*, no. 2 (January-February 1985): 94–95.

4. Kelley, 2.

5. Lt Col Alfred M. Coffman, Jr., "Strategic Environmental Assessment for Modernization Planning," Report of the Strategic Planning Division, Directorate of Plans, Headquarters United States Air Force, 6 June 1994.

6. Peter F. Drucker, "The Age of Social Transformation," *Atlantic Monthly* 274, no. 5 (November 1994): 53–80. The term *knowledge worker* refers to the dominant working class of the information age. They replace the industrial workers who were predominant in the industrial age.

7. Coffman, 2.

8. Kelley, 5–6.

9. Drucker, 62.

10. This view is shared by members of the Air University staff and is reflected in General Kelley's article.

11. Kelley, 1.

12. Ibid.

Chapter 3

Roles and Responsibilities

> *There is an often-expressed fear that technology will replace teachers. I can say emphatically and unequivocally, IT WON'T. The information highway won't replace or devalue any of the human educational talent needed for the challenges ahead: committed teachers . . . and, of course, diligent students. However, technology will be pivotal in the future role of teachers.*
>
> —Bill Gates, *The Road Ahead*

An article by Robert B. Barr and John Tagg, "From Teaching to Learning,"[1] offers an excellent exploration of education and training paradigms and the impact that changes will have on people interacting in the system. According to these authors, the old—or current paradigm—looks to the institution to provide instruction while the new paradigm expects the institution to produce learning. The shift then is from the instruction paradigm to the learning paradigm, and it requires both a new type of learner and a new type of teacher.

The instruction paradigm takes the means or method—called "instruction" or "teaching"—and makes it the primary purpose of education and training institutions. "To say that the purpose of colleges is to provide instruction is like saying that General Motor's business is to operate assembly lines or that the purpose of medical care is to fill

hospital beds."[2] This assumption illustrates the point that the focus should not be on instruction but rather on producing learning with every brilliant warrior. While it may take decades to understand all the future implications of the paradigm shift from providing instruction to producing learning, one goal is evident now. The learning paradigm opens up the truly inspiring goal that each new class of brilliant warriors will learn and know more than the previous class. "In other words, the learning paradigm envisions the institution itself as a learner—over time, it continuously learns how to produce more learning with each graduating class, each entering student."[3] This concept of the learning organization is truly revolutionary and futuristic. The learning organization and the impact of the new paradigm on the structure of institutions are addressed in more detail later in this paper.

The plan for realizing this paradigm shift by 2025 begins with the understanding of continuing and lifelong learning and the impact of this concept on the individual.[4] Here individuals engage in learning as a lifelong process; adults as well as children participate. Regarding our ASF of 2025, the fact that our brilliant warriors of the future are adults is significant. Educational research has shown that adults are not simply "grown up children."[5] Traditional methods of pedagogy, the art and science of teaching children, is in many ways different from andragogy, the art and science of teaching adults. Consequently, we must understand andragogy and incorporate its principles into our learning processes if we are to be successful.

Malcolm S. Knowles has given us four assumptions of andragogy.[6] They describe the characteristics of adult learners that have implications for how we should structure the ALE within the ASF. First, adults both desire and enact tendency toward self-

directedness as they mature, though they may be dependent in certain situations. Second, their experiences are a rich resource for learning, and they learn more effectively through experiential techniques of education such as discussion or problem solving. Third, adults are aware of specific learning needs generated by real-life tasks or problems; and adult education programs, therefore, should be organized around "life application" categories and sequenced according to learners' readiness to learn. And finally, adults are competency-based learners in that they wish to apply newly acquired skills or knowledge to their immediate circumstances and are, therefore, performance-centered in their orientation toward learning. These characteristics help to describe the brilliant warrior and serve as yardsticks for measuring success in the future. In other words, instruction is more likely to be successful in the future if it is responsive to adult needs. Instead of teaching students specific answers to a set curriculum, instruction should help students learn how to ask questions and pursue their own answers.[7] It also should be adaptive to individual goals and learning styles, build on an individual's prior knowledge, be experiential and realistic, and be applicable to the workplace.

As our perception of the learner's role changes from a passive model to an active empowered model, we must also consider the changing roles and responsibilities of instructors in the ALE (fig. 3-1). In recent years the terms *facilitator* and *resource person* have developed more favor than "teacher" when discussing adult learning environments. Knowles specified new roles and responsibilities for facilitators that differ from traditional teacher roles—mainly that facilitators do not direct; rather they assist adults to attain a state of self-actualization or to become fully functioning persons. Likewise, resource persons do not direct. They assist adults in locating individuals and

material resources to complete learning efforts that the learners, themselves, have defined.[8] These ideas of Knowles imply that the instructors of 2025 will rarely direct learning. Obviously, some instructor-directed learning will be necessary, given the critical need for uniformity in some aspects of the military.[9] However, as noted above, self-directedness and effective decision-making ability will be characteristics of our future brilliant warriors, and the ALE will offer them the ability to exercise significant self-direction over learning. Moreover, instructors of the future will adapt their role to create the options and opportunities brilliant warriors will need to make good learning choices.

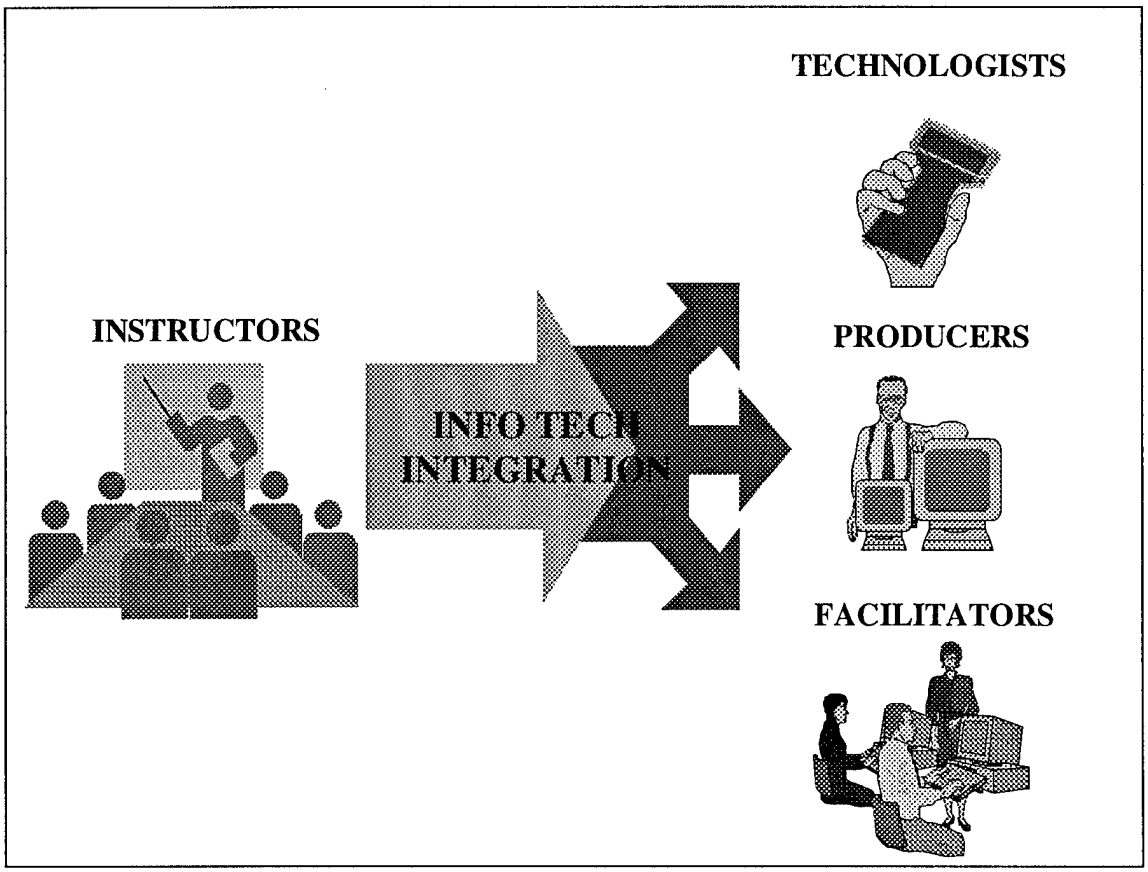

Figure 3-1. New Roles for Instructors

Knowles also lists some facilitator traits for andragogy that will become important for future instructors to possess.[10] Faculty must begin to acquire these traits in order for the paradigm shift from teacher to facilitator to occur within the learning environment. First, faculty must establish a physical and psychological climate conducive to learning by creating "a climate of humanness" that encompasses mutual respect among all participants, collaborative modes of learning, and an atmosphere of mutual trust. In addition, faculty must involve learners in mutual planning of methods and curricular directions to the extent possible and involve participants in diagnosing their own learning needs. They must encourage learners to formulate their own learning objectives when appropriate, and encourage learners to identify resources and to devise strategies for using such resources to accomplish these objectives. Then, acting as facilitators, they must help learners to carry out their learning plans and, finally, they must involve learners in evaluating learning, principally through the use of qualitative evaluative modes. These traits of the facilitator will be important for success in the traditional classroom setting as well as in the new global networked environment. They will become criteria by which we judge instructors and instructional systems in the future.

It is clear that these basic fundamental elements of andragogy are the building blocks for the paradigm shift in the roles and responsibilities of instructors, but other skills will be required of the instructor of 2025. Both educators and trainers must better understand the learning process, human motivation, alternative learning strategies, and evaluation techniques. They must understand and implement learning opportunities that enable the achievement of objectives, are situated in a real-world task or simulations, actively engage the learner, accommodate new ideas into prior knowledge, allow learners to

collaborate with others in a conversational, dialogical process, and allow for ample articulation and reflection on the part of the learner.[11] Put another way, instructors must be able to teach knowing-in-action—knowing how to do something as opposed to knowing about something; to stimulate reflection-in-action—the ability to restructure an action based on feedback; and to supervise action research—research based on the practitioner's application and generation of knowledge in the form of prototypes or models that can be carried over to new practice situations.[12] For example, the development of learning software—the practitioner's application of knowledge—will be a valued form of academic research for ASF educators and trainers in 2025.

In addition, instructors must leverage information technologies to enhance the learning environment and must be proficient users of classroom technologies and distance learning media. While the availability of smart software, authoring systems, curriculum development models, and media selection aids will enable instructors to manage the instructional systems design (ISD) process,[13] the aids alone will not be enough. Instructors will need to work with production programmers, information technologists, information "gatekeepers," and other support professionals (discussed in greater detail in the technology assimilation section of this paper) in order to use multimedia technologies and multimode processes in the future. As virtual reality increasingly is used to simulate warfighting environments and techniques, instructors must understand how to "mix Disneyland, Hollywood, and the Silicon Valley," orchestrate video cameras, and stage-manage special effects.[14] Also, instructors must interact with contractors in the private sector responsible for developing software applications, and they must understand the acquisition process.

To use information technology properly, instructors of 2025 must understand how it supports the learner. David H. Jonassen, professor of Instructional Systems at Penn State University, describes the proper roles of learning technologies necessary if learners are to acquire the survival skills needed for the twenty-first century. Not only must instructors use information technologies as delivery vehicles and controllers of instruction, they should ensure these technologies become facilitators of thinking and knowledge construction in their own right.[15] Instructors must continuously employ the traditional functions of information technology as tools used for accessing information, for representing ideas and communicating with others, and for generating products. And they must begin to see technology as an intellectual partner or mind tool for knowledge construction[16] and as context[17].

As a mind tool, according to Jonassen, technology must be used for articulating what learners know; for reflecting on what they have learned and how they came to know it; for supporting the internal negotiation of meaning; for constructing personal representations of meaning; and for supporting mindful thinking. Accordingly, instructors must use technology to augment rather than automate human intellect and interaction and to amplify intellectual processes.[18] As context, Jonassen explains that technology must be used for simulating meaningful real-world problems and situations; for representing beliefs, perspectives, arguments, and stories; for defining a controllable problem space for student thinking; and for supporting discourse among a knowledge-building community of learners. Instructors in the future must make certain that technology engages the learner in knowledge construction, not reproduction; conversation, not reception; articulation, not repetition; collaboration, not competition; and reflection, not prescription.[19]

To be successful in the future, our instructors must merge the skills of the human factors engineer, the cognitive psychologist, the information systems technologist, the subject-matter expert, the instructional systems designer, the curriculum developer, the Hollywood director, the mentor and teacher, and the learning resource person. Continuous professional development and increasingly sophisticated curriculum development tools will be the means for learning facilitators to adapt to these changing roles and responsibilities. The ASF of 2025 will embrace structures and vehicles that build professionalism among its instructors, create a supportive working environment, and provide incentives for innovation.[20] In the future, educators and trainers will become active consumers and producers of knowledge and research in order to create a culture of ongoing learning that questions the traditional paradigm.[21]

In addition to changing roles and responsibilities of the people involved with the ALE of 2025, the information age will also challenge the ASF's brilliant warriors to master new subject areas beyond the typical skills and knowledge emphasized in today's education and training programs. These new subject areas are the topic of our next section.

Notes

1. Robert B. Barr and John Tagg, "From Teaching to Learning," *Change*, November-December 1995, 13.

2. Ibid.

3. Ibid., 14

4. This notion of lifelong learning originated with the development of continuing higher education or CHE.

5. Lynn B. Burnham, "Teacher Traits That Facilitate Adult Learning," *Education Digest*, March 1983, 32–35.

6. Malcolm S. Knowles, *The Modern Practice of Adult Education: From Pedagogy to Andragogy* (New York: Cambridge Books, 1980), 43-44.

7. Roger C. Schank and Chip Cleary, *Engines for Education* (Hillsdale, N.J.: Lawrence Erlbaum Associates, 1995), 13.

8. Knowles, 44.

9. Stephen Kenney, "Professional Military Education and the Emerging Revolution in Military Affairs" (Unpublished paper of the Science Applications International Corporation), 8.

10. Malcolm S. Knowles and associates, *Andragogy in Action: Applying Modern Principles of Adult Learning* (San Francisco: Jossey-Bass, 1984), 14–18.

11. David H. Jonassen, "Supporting Communities of Learners with Technology: A Vision for Integrating Technology with Learning in Schools," *Educational Technology*, July-August 1995, 60–63. Jonassen discusses the seven qualities of learning as active, collaborative, conversational, reflective, contextualized, intentional, and constructive.

12. Donald A. Schon. "Knowing in Action, The New Scholarship Requires a New Epistemology," *Change*, November-December 1995, 27–34.

13. AFM 1 36-2234, *Instructional Systems Development,* 1 November 1993.

14. James Der Derian, "Cyber-Deterrence," *Wired,* September 1994, 158.

15. D. H. Jonassen, J. P. Campbell, and M. E. Davidson, "Learning with Media: Restructuring the Debate," *Educational Technology Research and Development* 42, no. 2 (1993): 31–39.

16. Jonassen, 62.

17. Ibid.

18. Linda M. Harasim, *Online Education Perspectives on a New Environment* (New York: Praeger Publishers, 1990), 40.

19. Jonassen, 62.

20. Al Luke, chair, United States Department of Defense Distance Learning Workshop, Report of Special Interest Groups, Conference held at National Defense University, 23–24 March 1994. Participants discussed the need for professional development and organizational incentives in order to stimulate distance learning productivity.

21. Judy Swanson, "Systematic Reform in the Professionalism of Educators," *Phi Delta Kappan*, September 1995, 36–39. Includes a discussion of selected universities engaged in systematic reform.

Chapter 4

Skills, Knowledge, and Competencies

War is a human endeavor, fought by men and women of courage. The machines, the technology, help; but it is the individual's skill and courage that make the crucial difference.

—Gen Gordon R. Sullivan, *Army Focus*

The ASF of 2025 will incorporate new learning theories into both formal and informal education and training programs—many of which will be customized to accommodate individual learning styles and delivered to the learner at various locations; at home, at the work site, or in the field. Inherent in the approach to learning is the presumption that brilliant warriors will work in new information age organizations as both independent learners and team problem solvers. Not only will the brilliant warriors learn in a greater variety of ways and environments, they will possess certain skills, knowledge, and cognitive processes in order to be comfortable and productive in the information organization. In addition, they must learn new competencies and master new content areas in order for the ASF to meet its goals for education and training.

Several cognitive skills—mental abilities—will be required for both independent and collaborative learning to occur in the era of electronic connectivity and the information age. Brilliant warriors in 2025 must be masters of cyberspace, able to manipulate

networks and hi-tech systems with ease. In addition, they will have to deal with unlimited amounts of information as they communicate and collaborate with others across the global information infrastructure (GII). As a result, brilliant warriors must understand cyber systems and the principles of connectivity. They must also be able to organize, analyze, and synthesize information and recognize the patterns and structures of connections to others. Moreover, they must appreciate and relate to diversity—our potential connections to others. And they must understand and facilitate communications verbally, spatially, and mathematically—the tools to make connections possible.[1] These requirements imply that the military curricula of the future "must cover a range of academic disciplines that includes basic and engineering sciences as well as humanities and the social sciences."[2]

Future brilliant warriors will combine these cyberspace information skills with required problem-solving cognitive skills such as the ability to apply multiple solutions to a wide-range of problems and analyze detailed feedback; the ability to determine conditions of applicability and nonapplicability based on alternate approaches to each problem; techniques for developing and evaluating alternative courses of action (COAs), and techniques for testing hypotheses. Also the brilliant warrior must develop mental models and communicate the content of those models, including assumptions, and utilize tools and procedures that enhance the retention of information.[3] Based on these requirements we can expect to see more interactive learning, virtual reality simulations, artificial intelligence, smart software, and more theoretical models to evaluate in the future. By 2025, these required skills and processes will be developed and enhanced by

technology-mediated instruction simulators, and smart computers using either education or training scenarios.

In addition to acquiring the above information and problem-solving skills, brilliant warriors will be required to master new metacognitive skills to succeed in the information age. These include such network-related areas as digital literacy, the ability to quickly focus attention on and shift from various visual and auditory stimuli, verbal and nonverbal communications skills for electronic conferencing, dictating skills for voice activated systems, typing (in order to operate left-over equipment using keyboards as input devices), digital graphics development, and netiquette—the etiquette of network conferencing and social interaction.[4] Moreover, brilliant warriors of 2025 will have to master coping and stress reduction skills to keep their cool in the face of information overload. Since the information age will also impact the civilian arena, we anticipate that the public schools of 2025, or their equivalent, will require mastery of these metacognitive skills before our brilliant warriors enter the ASF. If not, however, the organization will use informal means to instill them.

Two other goals of the ASF of 2025, mentioned earlier, will find an enhanced place in the formal curriculum of the future. These are core values and creative thinking. One can expect to see increased emphasis in the curriculum on leadership and ethical behavior, a deeper study of American political and economic systems, more options to study logic, rhetoric, and critical thinking, and improved opportunities for innovation, experimentation, research, and evaluation.[5] Additionally, more emphasis will be placed on the affective learning domain, values clarification, appreciation for right conduct, and professional standards of behavior.

In the future, as is generally the case now, there will be a division of individual learning objectives into four broad categories or competencies—core competencies, functional competencies, assignment specific competencies, and support programs.[6] Although these categories will continue to have broad application in the future, their specific objectives will change based on the changing needs of the ASF. For instance, there will be new core competencies required of brilliant warriors in addition to some of the old ones. Core competencies refer to requirements that are central to professions as a whole and are required for all members of the profession. For example, there are core competencies for all professional military personnel, all acquisition professionals, or all avionics specialists. Mastery of core competencies might be required for entry into a profession, such as areas taught in precommissioning programs or for promotion. The ASF of 2025 will be increasingly concerned with core competencies, and documentation of their mastery will become critical. New core competencies for the future might be developed for content areas such as space and space travel, information warfare, operations other than war, joint and coalition warfare, and the revolution in military affairs.[7]

Functional competencies are career-field specific. Again, some careers will cease to be important in the future as others come into existence or gain in importance. In an effort to ensure competency in the information age, the ASF will increase emphasis on information engineering, human factors engineering, artificial intelligence, and software engineering. Entirely new careers might be uninhabited combat air vehicle (UCAV) operator, information systems technologist, sublethal weapons expert, psychoinformation warrior, and offensive space warrior.[8] In order to be functionally competent, the brilliant

warrior must possess a variety of specified knowledge and skills that are career related. This category is expected to grow in the future as more specialization will be required of personnel.[9]

Assignment specific competencies refer to the knowledge and skills required to do a particular job or to perform a job-specific task. These competencies will depend on the nature and scope of the job and will be taught at the point in time when they are needed. For example, a pilot who becomes a joint campaign planner will be taught—through a computerized individual learning module—how to properly format and develop required joint documents after assignment to the new job where that competency is required. In other words, teaching a skill will occur at the point when it is needed and learning is relevant. Just-in-time education and training, made possible by the widespread availability of expert systems, will be the preferred method to assure assignment specific competencies are met.

Special and support programs are those that are available in the private sector, other government agencies, or civilian academic institutions. These programs will become more important in the future. The brilliant warrior of 2025 must possess advanced academic degrees and professional certifications in order to function as a knowledge worker in the information age.[10] The ASF will use the GII and distributed learning environments to facilitate new collaborative arrangements, consortia, and contract options with numerous agencies, businesses, and institutions around the world to support its brilliant warriors. Even if the traditional role of public institutions of higher education declines,[11] other options will become available through the private sector or through

cooperative worldwide arrangements with business and industry having similar education and training requirements.

As we know more about adult learning and the way individuals interact and synthesize this knowledge with what we know about the mission, goals, and competencies of ASF education and training, we begin to envision the learning environment of the future. Incorporate all this with what we know about the enhanced capabilities of technologies, and we have all the pieces of the puzzle. The next section identifies information technologies that have promise for future education and training and discusses how the ASF of 2025 might use them.

Notes

1. Ralph Brauer, "The Internet as School, Or Welcome to Our MUD Room," *Technos* 4, no. 3 (Fall 1995): 14–21.

2. Lt Gen Ervin J. Rokke, "Military Education for the New Age," *Joint Forces Quarterly,* Autumn 1995, 22.

3. Donald A. Smith, Paul J. Sticha, and John E. Morrison, "Soldier as Adaptive Problem Solver" (Paper presented to Roundtable Conference on Military Training and the Potential Revolution in Military Affairs, Fort Monroe, Va., 13–14 December 1995): 6.

4. The term is attributed to Linda M. Harasim, 1991, in Defense Research Studies 5, "Conferencing Issues and Decisions," *Learning without Boundaries* (New York: Plenum Press, 1994), 18.

5. Lt Gen Jay W. Kelley, "Brilliant Warrior" (Unpublished paper, Maxwell AFB, Ala.; Air University, 1996), 13–14.

6. James S. McMichael, director, Acquisition, Training and Career Development Policy, The Pentagon, memorandum to John A. Kline, Air University, subject: white paper, The Acquisition Education and Training Program, 15 October 1993.

7. Paul J. Berenson, "Revolution in Military Affairs, Some Implications for 21st Century Army" (Paper distributed to Air War College 2025 participants by the Scientific Advisor to Commanding General, US Army Training and Doctrine Command, 12 May 1994).

8. These technical capabilities, not careers, are referred to by the Air Force Scientific Advisory Board in its report, *New World Vistas; Air and Space Power for the 21st Century: Summary Volume* (1995).

9. Peter F. Drucker, "The Age of Social Transformation," *Atlantic Monthly* 274, no. 5 (November 1994): 68. Although forecasters predict the need for broadly educated personnel, this will not preclude the need for career specialists. Cross-training in two or

more related career fields may be required as the total number of personnel declines. Drucker predicts the need for a highly specialized workforce in the future. Also, the Scientific Advisory Board, *New World Vistas,* discusses the need for highly trained technical personnel.

10. Drucker claims that formal education will be even more important in the future than it is now.

11. Lewis J. Perelman, *School's Out: A Radical New Formula for the Revitalization of America's Educational System* (New York: Avon Books, 1992), 50. Perelman claims that the "social institution commonly thought of as education will be obsolete and ultimately extinct as the dinosaurs."

Chapter 5

Enabling Technologies

> *We are quickly moving toward the time when anyone can get any kind of information to almost anyone else, anytime. We are also increasingly moving information instead of people. And we're essentially doing it instantly.*
>
> —John L. Peterson, *The Road to 2015*

Experts generally agree that by the year 2025 we will have an information infrastructure available which will provide almost everyone global, high-capacity connectivity at a cost comparable to today's telephone and Internet charges.[1] At the end of this powerful infrastructure, we will have low-cost personal information devices (PIDs) which will give us integrated voice, video, and data capability in a package smaller than today's notebook computers.[2] Moreover, these PIDs will have computing power and speed virtually equivalent to the human brain[3] and will have access to massive knowledge bases around the world. All these capabilities combined have the potential to significantly alter the way people learn in the ASF. Shortly we will examine the specific technologies which promise the capabilities we have described. First, however, let us imagine the learning available to us in a world of micro-supercomputers and worldwide connectivity.

First, we'll look at a young laser radar technician in the field in 2025. Engineers have just developed a new modification to the system he's responsible to operate and maintain. Instead of sending him back to Keesler Air Force Base for supplemental training, the engineers work with educational experts to develop a virtual training module for this modification. Immediately before they upgrade the radar system, they electronically transmit this training module to all the field units and technicians affected by this change. Then our technician, using his PID hooked to virtual reality viewers and gloves, will work through this multimedia training module. The module gives him all the information he needs about the upgrade along with a simulation which allows him to practice new operational and maintenance procedures until he has achieved mastery. In addition, the training module will be able to answer questions the technicians have about the new procedures, and for any questions that stump the training module, the technicians will have immediate access to system experts either through E-mail or a video phone call. In this case system experts and educational specialists can provide just-in-time, system wide training without the expense of temporary duty trips or full-time classroom instructors.

Next, we'll look at a young major enrolled in joint professional military education (PME). Her seminar mates are scattered across the country, and several times each week they converge in a video teleconference to discuss PME topics with their faculty leader. All their lesson materials come to them through electronic media. A typical leadership lesson, for example, would have extracts of classic leadership texts for them to read along with clips from classic films on that leadership topic and lectures from leadership experts and senior military/civilian leaders for them to watch. When they "meet" to discuss this lesson, their faculty leader has instant access to any of this material, all of it digitized, to

emphasize key points and clarify any confusion. Then after the lesson, the leader can electronically administer a test to see how well the students have mastered the material. With instantaneous feedback, the leader can quickly correct any problem areas revealed through the test. For research, these PME students have at their immediate disposal a wide-range of government, university, and commercial knowledge bases available through their PID and the electronic network; they are not limited to the base library. They can research their paper, write it, and submit it electronically without ever having to leave their base. And if they have any questions, they will have quick access to their seminar mates and their faculty leader. In this scenario, the virtual seminar offers many of the benefits of the current residential program. An effective distance learning program such as this could significantly reduce the need for an in-residence version of PME.

Finally, let's examine two pilots from separate units who are training to fly a mission together. They each connect their PID to one of their unit's personal simulator kits and then hookup to each other via the multilevel secure network. Their simulation program is downloaded and synchronized so they can simulate flying their unmanned aerial vehicle (UAV) training mission together at their respective home bases. In addition, the simulation program has been automatically updated in a matter of minutes with the latest real-time intelligence, reconnaissance, weather, and mission planning information. As a result, these pilots can fly this simulated training flight under conditions as close as possible to their upcoming mission. During the simulation, the fidelity of the virtual reality program allows the pilots to experience the sortie as a real two-ship UAV formation. Each action by one pilot immediately registers a realistic change in the second pilot's simulated environment. At the end of the training flight, the pilots have actually

experienced flying together in conditions virtually identical to those they will face in their actual mission.

These scenarios are typical of the types of training and education we conduct in the armed forces today and will likely need past 2025. Common to them is the fact that by 2025 our brilliant warriors will be able to conduct most of their learning without having to undergo expensive temporary duty trips. Multipurpose PIDs and miniaturized virtual reality systems will obviate the need for expensive stand-alone simulators at each operational location. The GII will instantly connect learners with the people and information they need no matter where they are.

With that backdrop, we will now discuss the kinds of information systems technologies that promise us such immense capabilities by 2025. We'll group these technologies according to the three general types of functions that they will serve in the ASF's ALE. Categories include delivery systems which allow the learner to access information, simulations, teleconferences, or other learning products; development systems which allow education/training technologists,[4] facilitators, supervisors and others the capability to develop effective learning programs and services; and tracking systems which allow commanders, individual learners, supervisors, and personnel specialists to manage learning requirements and progress.

Delivery Systems

Advances in information systems are occurring at such a rapid rate that we see a new generation of technology every 18 to 24 months. With this rapid advancement, even major progress becomes evolutionary instead of revolutionary. In our 2025 project,

we've been told to think in terms of double leap advances. In the information systems arena, however, it's probably more appropriate to think in terms of quick "hops" instead of "leaps." If we conservatively project current advances over the next 30 years, we should progress at least 15 hops in information systems technology beyond where we are today. Experts generally agree that the seeds of 15-hop progress are strongly rooted in today's emerging technologies. Advanced networking technologies such as matured fiber optic links,[5] and new/improved high-capacity commercial satellite constellations (including geostationary and low-earth-orbit systems)[6] with laser links[7] will give almost everyone the possibility for low-cost access to the worldwide high-capacity information infrastructure—the GII. Moreover, new data/video compression techniques[8] will allow us to transmit huge amounts of information across this infrastructure with amazing efficiency. In just the last five years, we've been able to reduce the bandwidth required for high-quality video from around 45 million bits per second to just 1.2 million bits per second.[9] In 30 years, further advances in compression and bandwidth capabilities will allow us to deliver enormous amounts of information through the GII very quickly, cheaply, and reliably.

At the end of this massive GII will be incredibly powerful end-user devices and embedded microprocessors which will enable both individuals and groups of learners to access the capabilities of the adaptive learning environment (ALE). Nanotechnology[10] and microelectromechanics[11] promise us high-speed, multipurpose PIDs which will cost about the same as current desktop computers and have a computing capability roughly equivalent to the human brain! In addition, these PIDs will come in small packages—small enough to hold in a hand or wear on the arm (fig 5-1).[12] They will also have

wireless connections to other user devices such as wall-mounted high-definition video screens, speakers, and virtual reality simulation devices. In addition to supercomputing PIDs, peripheral devices and other objects (e.g., doors, furniture, appliances, etc.) will also be widely computerized with powerful imbedded microprocessors which will be able to interact with the PIDs to enhance network information.[13] Explosions in virtual reality hardware/firmware,[14] TV technology, and other similar devices are already giving us a preview of the incredible hi-tech possibilities which will be an everyday reality by 2025.

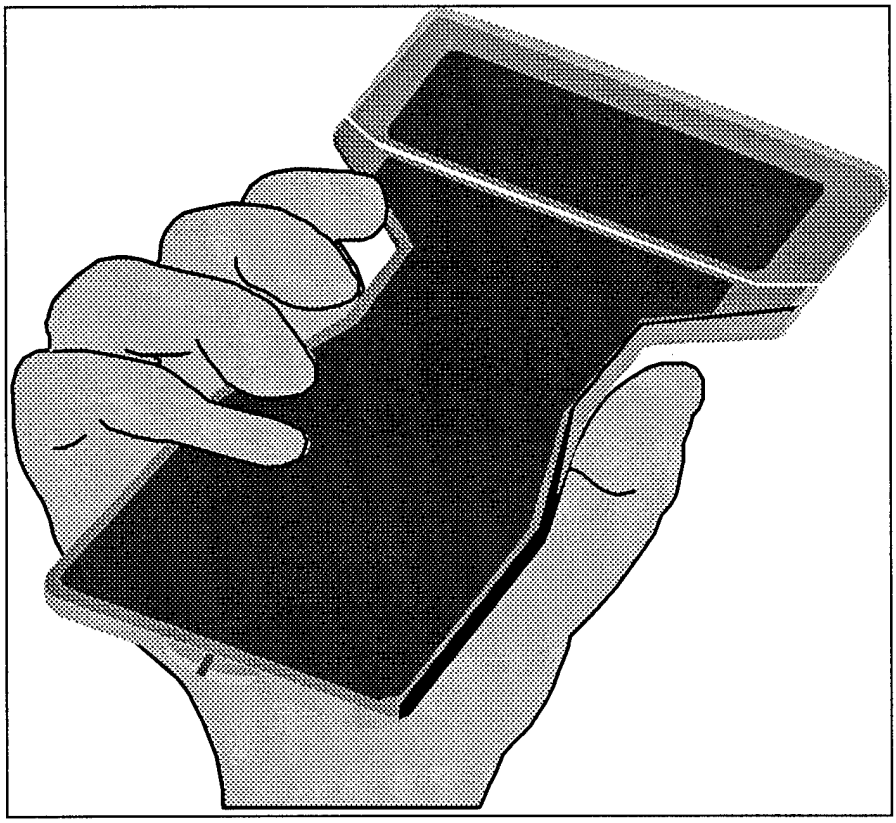

Figure 5-1. Personal Information Device

Development Systems

Obviously sophisticated software will be an integral part of the delivery systems available by 2025. Moreover, software will play a critical role in the development systems used to produce ALE materials in 2025. Advances in fuzzy logic/neural networks[15] will give us smart software systems which will allow PIDs to serve as automated assistants for humans. These will help education/training technologists to design better software systems and provide high-fidelity simulations tailored for a wide variety of education and training scenarios.[16] In addition, similar software will help keep track of learners' needs and preferences. These information age assistants, which Nicholas Negroponte calls "digital butlers"[17] will then be able to search various sources across the GII to compile the right information in the right format for the learner on demand.

In other areas, voice recognition systems, automated language translators, and similar software systems[18] will allow people of different countries to communicate with ease and without the use of a keyboard. This will greatly enhance the quality and ease of combined training with one or multiple allies. In addition, multilevel security (MLS) software systems coupled with low-cost personal identification systems (e.g., fingerprint, retinal scan, deoxyribonucleic acid [DNA] identification devices, etc.) will provide the security necessary to allow learners to use the ALE and GII with confidence.[19]

Other related technical advances will enhance software development to spur very efficient and effective ALE methods and materials. Advances in visualization technology will enhance the three-dimensional aspect of virtual reality simulations and other educational presentations.[20] Developments in what Lewis J. Perelman calls "brain

technology"[21] will not only help software developers, both human and automated, to build better educational systems but also will allow enhanced learning to take place from the inside out. For example, advances in cognitive science, human factors engineering and biochemical technology are already spawning promising developments in "new computer technology that mixes organic and inorganic elements,"[22] more effective human-machine interfaces, the inclusion of emotional elements in simulation models, and brain-enhancing chemicals. By 2025 these developments, combined with access to numerous knowledge bases available worldwide, should allow the ASF to acquire and/or develop a wide-range of ALE products and services designed to improve the thinking and learning skills of our brilliant warriors. These will range from simple education/training presentations to extremely challenging, high-fidelity simulations, all tailored to each learner's, or unit's, need deliverable anywhere on demand.

Tracking Systems

Despite enormous advancements in the GII and systems development capabilities, the ASF of 2025 will still need to know the status of its members' training and education. Fortunately the advances noted above in both delivery and development systems will enhance the ASF's efforts in this area, too. Advances in cognitive science, smart software, and human factors engineering will give us sophisticated aptitude, achievement, and preference evaluation tools. These will allow the ASF to accurately select and channel its brilliant warriors into career areas best matched to both them and organizational needs. These advanced evaluation tools will then help ASF personnel experts establish learning goals for each new brilliant warrior. From this point, the ALE

will automatically update individual records once a member has accomplished a learning task. This information will be stored in integrated corporate knowledge bases accessible to authorized members.

Because multiple options and parallel scenarios will exist, the ASF will embrace a flexible ALE management structure consisting of on-line enrollment and tracking systems that interface with personnel records and readiness information. The system will enable any student or training manager from any location to access data through a PID on the student's career path, individualized learning plan, and corresponding educational/training requirements. The student or trainer will be able to see which core competencies and proficiencies have been mastered to date, levels of readiness, and remaining deficiencies. The database will display available learning options, time frames for completion, and other pertinent information. Individuals will be able to select the appropriate programs, courses, and formats—whether resident or distance learning, individualized or supervised, at home, on-the-job, or in the school house, etc., and instantaneously enroll. Upon enrollment, the system will trigger the appropriate response—whether to process temporary duty instructions, or to activate instructional delivery in the appropriate distance learning format to the individual or training supervisor, at the appropriate place and time. As individual brilliant warriors successfully complete their learning objectives, the tracking system will automatically update the appropriate records.

Virtually all of the information technologies described above are already emerging from the hi-tech laboratory into the marketplace. We don't know exactly what products will emerge, because specific predictions in this dynamic arena are difficult. As Joel Swerdlow notes, "To know where information technologies are taking us is impossible.

The law of unintended consequences governs all technical revolutions."[23] Regardless of the exact nature of future systems and devices, by 2025 our brilliant warriors everywhere should be harvesting the mature fruits of the continued explosion in hi-tech capabilities. However, these technologies present us with not only tremendous opportunities but also with some daunting challenges which the ASF must overcome to create a well-integrated ALE in 2025. The next section discusses these challenges.

Notes

1. John L. Peterson, *The Road to 2015: Profiles of the Future* (Madera, Calif.: Waite Group Press, 1994), 30.

2. Ibid., 59–60.

3. Lewis J. Perelman, *School's Out: A Radical New Formula for the Revitalization of America's Educational System* (New York: Avon Books, 1992), 29-31.

4. USAF Scientific Advisory Board, *New World Vistas: Air and Space Power for the 21st Century* (unpublished draft, the human systems and biotechnology volume, 15 December 1995), 18.

5. Jack M. Sipress, "Undersea Communications Technology," *AT&T Technical Journal,* January-February 1995, 4–7. Undersea advances are also discussed in the following: "Undersea Cable Upgrades Proven Feasible," *AT&T Technical Journal,* January-February 1995, 2–3; and Peterson, 35–36.

6. Peterson, 190–91.

7. USAF Scientific Advisory Board, *New World Vistas: Air and Space Power for the 21st Century,* summary volume (Washington, D.C.: USAF Scientific Advisory Board, 15 December 1995), 20.

8. Otis Port, "Sifting through Data with a Neural Net," *Business Week,* 30 October 1995, 70.

9. Nicholas Negroponte, *Being Digital* (New York: Vantage Books, 1995), 17.

10. Ed Regis, "It's a Small, Small World," *Reason,* December 1995, 28–34. Additional aspects of nanotechnology are discussed in "Artisans of the Tiny," *The Economist,* 30 September 1995, 97–98; and "Quantum Caverns: A Thousand Points of Light," *AT&T Technical Journal,* January-February 1995, 3.

11. Richard Lipkin, "Teeny-weeny Transistors," *Science News,* 6 May 1995, 287.

12. Perelman, 36.

13. Ibid., 27–28.

14. Jane Ellen Stevens, "The Growing Reality of Virtual Reality," *BioScience,* July-August 1995, 435–39. Additional information on the rapidly expanding world of virtual reality is in "Virtual Reality for Soldiers," *The Futurists,* November-December 1995, 44; and Steven A. Booth, "Hot Stuff Eye Candy," *Rolling Stone,* 10 August 1995, 66.

15. Perelman, 31–33.

16. Dee Howard Andrews, Lynn A. Carrol, and Herbert H. Bell, "The Future of Selective Fidelity in Training Devices," *Educational Technology,* November-December 1995, 32–36.

17. Negroponte, 150–52.

18. Peterson, 64–66. Perelman, 33–34, also discusses these advanced capabilities.

19. Institute for National Strategic Studies, Strategic Assessment 1995 (Washington, D.C.: Government Printing Office, 1995), 153.

20. Perelman, 39–41. Three-D presentations are also discussed in Clarence A. Robinson, Jr., "Virtual Teleconferencing Spurs Factory, Medical Collaboration," *Signal,* April 1995, 15–18.

21. Perelman, 44.

22. Ibid., 44–47.

23. Joel L. Swerdlow, "Information Revolution," *National Geographic* 188, no. 4 (October 1995): 5.

Chapter 6

Technology Assimilation

Constructing an information organization requires a new moral vision of what it means to be a member of an organization and a revised social contract that combines members of a firm together in ways radically different from those of the past.

—Shoshana Zuboff

In their article, "Scholarly Communication, Academic Libraries, and Technology," authors Richard Eckman and Richard Quandt emphasize that the mere existence of hardware and software does not give direction to future implementation of technology.[1] We must seriously consider how to direct technology to successfully integrate it for our ASF purposes in 2025. Three areas are of particular concern. First, effective technology integration will drive the decentralization of academic institutions and create new infrastructures which, in turn, will generate new roles for support personnel, publishers, scholars, and librarians.[2] Second, advanced technologies will allow easy modification and tailoring of previously distributed information and educational works; but it will also create the need for effective mechanisms to authenticate and protect the integrity and academic quality of such works. Third, technology integration will intensify the need to

account for the revenue interests of commercial information venders in order to protect intellectual property rights. Below we will examine each of these issues in greater detail.

New Organizational Structures

As the ASF integrates information technology across its many functions and organizations, brilliant warriors at all levels will gain unprecedented access to computing and information resources. If used correctly, these resources could generate increased efficiencies that will give our military the competitive edge needed for survival through the twenty-first century. Consequently, the ASF of 2025 will require all its members to manage complex information and use it to create value for their individual organizations.[3] To this end, the force will empower users at all echelons to make decisions traditionally reserved for higher bureaucratic and supervisory layers. New flat information age organizational structures will emerge as the norm by 2025. Bill Gates, the chairman and CEO of Microsoft Corporation, describes what is likely to happen to organizations as they enter the information age.

> Information technology will affect much more than the physical location and supervision of employees. The very nature of almost every business organization will have to be reexamined. This should include its structure and the balance between inside, full-time staff and outside consultants and firms. . . . If communication systems are good enough, companies don't need as many levels of management. Intermediaries in middle management, who once passed information up and down the chain of command, already aren't as important today as they once were.[4]

Already the military functions as a flat, decentralized organization during war.[5] This trend will continue as the use of advanced information technologies makes command and control and intelligence information readily available throughout the force. And the

increased use of technology to successfully support flat wartime operations will transfer to peacetime operations as the GII matures. The mission-oriented orders of wartime—which allow leaders and soldiers in the field to interpret information and make decisions based on commander's intent—will extend to other operations. By 2025, the ASF will have a new mission-oriented organizational structure which empowers brilliant warriors throughout the force to know and do more. Newly energized and reorganized learning institutions will emerge in 2025 to meet the challenges of the information age and the postulated revolution in military affairs (RMA) that will result.[6] The concept of the RMA is explained in chapter seven of this paper.

In 2025, the ASF learning institutions, like many civilian academic institutions, will be transformed from large centralized campuses to dispersed information and service network channels.[7] Residence requirements will diminish as distance learning opportunities grow. Increasingly, schools will deliver learning materials to students via the network. Technology will permit professors and educators to telecommute their services to students in ways that de-emphasize traditional academic physical and bureaucratic infrastructures in favor of widely distributed environments. Students will identify a school not by a distinct location, campus, or building, but rather by a brand or franchise of network media through which they access services and courses.[8]

Advancements in distance learning technologies are beginning to create new education and training infrastructures within the military.[9] Although distance learning has existed for decades in the form of printed correspondence courses or videotaped programs, these traditional methods did little to transform the classroom. Traditional distance learning activities were seen as passive and not on par with active, face-to-face

instruction delivered in the seminar environment. Often instruction became obsolete in the months it took to produce and distribute the courses. But new interactive technologies make real-time interaction and feedback possible, enable large audiences to participate, and provide quality instruction. In fact, evaluations have shown that when appropriate media are used, distance learning is at least as effective as resident instruction.[10] Technology will continue to reduce the need for students to travel great distances at great expense to attend courses in residence. Instead, students increasingly will come together in virtual residence. However, this does not mean that the traditional classroom, or campus, will become completely obsolete.

In the military context, the mission of the ASF of 2025 will dictate that the service retain control, standardization, and uniformity over many aspects of education and training of its brilliant warriors. Consequently, education and training technologists will incorporate standardized material into learning products. In addition, the military's unique requirements for cohesiveness, team camaraderie, and physical fitness will drive retention of some standardized residence programs. For instance, accessions education, initial unit and skills training, some leadership and professional quality development, and core values education will be conducted via resident programs which incorporate numerous hi-tech learning tools. Although scaled down significantly, the modernized schoolhouse, with the necessary administrative component and infrastructure, will continue to exist to provide standardized resident learning opportunities.

Administrative Support

As much as things will change by 2025, some areas will remain constant—such as the need for administrative support. The integrated hi-tech development, delivery and tracking systems which make up the revolutionary adaptive learning environment will create the need for an administrative infrastructure consisting of network librarians or "gatekeepers" who will manage academic programmatic issues, negotiate site licenses, and help users navigate through the information superhighway.[11] These gatekeepers will make extensive use of automated assistants to manage information spread across a widely distributed world of academic communications. The automated assistants will scan virtual libraries, select information, and build lesson plans or packages according to established end-user or instructor priorities. Gatekeepers will help instructors and students manage information in ways that best meet their learning objectives.

Additionally, in 2025, the ASF will need specialized personnel to ensure that brilliant warriors receive broadcast-quality learning materials. These production programmers, drawn from the communications and marketing (television, film, etc.) disciplines, will be expert in "edutainment"[12] and will help instructors develop multimedia presentations that maintain the attention and interest of learners. By 2025 these highly skilled professionals will be able to access sophisticated, commercial-quality digital production capabilities in order to create dazzling learning products for our brilliant warriors.

Advanced systems management processes will also be in place by 2025 to help education technologists, instructors, and students use learning systems more efficiently. In an effort to control the cost of information exchanges, to prevent overload on individuals and networks, and to ensure the privacy of its members, organizations of 2025

will establish new procedures, invoke new protocols, and implement smart software agents. On-line systems will be in place that will guide both producers and users of ALE materials to the most efficient communications medium based on the purpose of the interaction.[13]

Decision-aids and software agents will help instructors identify the best method of transmission to accomplish desired tasks based on educational, environmental, economic, and other limitations. For example, the system will guide them away from satellite-delivered, full-motion video teleconferencing, if on-line computer conferencing will accomplish the task at a lower cost. Likewise, the system will guide instructors away from synchronous voice transmissions if asynchronous data transmissions would accomplish the task. Also, brilliant warriors at all levels will be able to activate on-line filters to prevent unwanted message traffic and to instantaneously sort incoming messages based on a user-established set of protocols and priorities. All voice activated systems as well as E-mail systems will have caller identification (ID) features and a full-range of systems-generated answering services to scan and screen messages and activate automatic replies. Nicholas Negroponte describes the type of editing systems that will be available in the future in his book, *Being Digital.*

> The answer lies in creating computers to filter, sort, prioritize, and manage multimedia on our behalf—computers that read newspapers and look at television for us, and act as editors when we ask them to do so. This kind of intelligence can live in two different places. It can live . . . at the transmitter and behave as if you had your own staff writers . . . or in the receiver...depending on your interests, habits or plans for the day. The future will not be one or the other, but both.[14]

Intellectual Property Regimes

As discussed above, the delivery systems available in 2025 will allow brilliant warriors to access immense amounts of information from virtually infinite sources through the GII. This wide-open access to information presents profound implications for information integrity, and the ASF of 2025 will have to provide mechanisms to guarantee the academic integrity of the materials it makes available over the net. Likewise, the force must protect the interests of its members who publish over the net. The former will be aided by the academic accreditation process; the latter by the enactment of commercial copyright laws appropriate to cyberspace.

The Southern Association of Colleges and Schools (SACS) has taken the lead in establishing standards and criteria for academic institutions offering distance learning courses and programs. These criteria are intended to ensure the quality of the overall academic programs delivered through networks and other distance learning media. They require adequate planning, systematic evaluation of instructional results, processes for monitoring curriculum changes, provisions for student support services, and appropriate orientation and evaluation of faculty using the distance learning systems.[15] The ASF of 2025 will need to work with the SACS or other accrediting agencies to ensure that its academic programs meet all applicable standards for distributed learning materials. Only in this way will the brilliant warriors of the future, who may never come face-to-face with an instructor, know they are receiving quality and timely information over the GII.

Through the GII, education technologists and brilliant warriors will use digitized virtual libraries consisting of works converted into and created in electronic format.[16] These virtual libraries will provide access to the intellectual and cultural information and

knowledge people need in order to learn, work, and prosper.[17] Yet the potential of this integrated network of learning resources will not be realized if the informational, educational, and entertainment products protectable by intellectual property laws are not effectively safeguarded when made available over the GII.

The ASF will get help in this endeavor to authenticate and protect the intellectual products of its members by the private and commercial sectors. Publishers, for example, are very concerned about the ease with which electronic publications can be copied and shared. Publishers bring risk capital to bear when they recognize the need for new publications and can bring economies of scale to the development of the virtual libraries. But these owners of intellectual property rights will not be willing to put their interests at risk if systems are not in place that protect their interests. Because their survival depends on the revenue stream which depends on copyright protection, publishers' property rights must be protected before they will make large investments in the digitization and distribution of data over the network. Therefore in the integrated information technology environment of 2025, a new intellectual property regime must exist that will protect the legitimate rights and commercial expectations of people and organizations who create works for use over the GII. Users must have the broadest possible access to the widest variety of music, literature, art, dance, and film on terms that, in the language of the Constitution of the United States, "promote the Progress of Science and useful Arts."[18] To get there, timely adaptation of intellectual property laws to respond to technological advances will be necessary to serve copyright owners and to ensure that the body of creative works available over the GII continues to grow.

Fee-for-Service

In line with intellectual property protection, integration regimes of 2025 will include provisions for fee-setting, licensing, and payments for use of copyrighted materials. Information will be a primary commodity of the future in the new information economy. While most information exchanged over the Internet is free today, that will change in the future. First, as commercial providers continue to expand their networks and service offerings, they will also develop new marketing schemes and tariff structures to attract users.[19] Instead of subscribing to a single carrier for service, multiple options, and variable rates will be available to the user. Users will be able to choose a carrier in real-time and on demand for each individual transmission based on the most favorable rate. Users will access the network and transfer payment in the same transaction. Second, experts who offer their expertise and services through these systems (e.g., those who deliver lectures over conferencing systems) will charge honoraria and consulting fees.

Also, digital publishing houses will establish copyright, intellectual property, and licensing fees for digital publications accessed over the networks. Monetary transactions will occur over the networks in a real-time, fee-for-service basis as payment-for-data exchanges with authors, publishing houses, and experts occurs.[20] New budget and on-time accounting systems will be necessary. In the final analysis, publishers and information providers in 2025 will make use of innovative technology as well as tried and true legal devices such as licensing agreements and contracts to regulate information use and to prevent unauthorized access to data by nonpaying parties.

Now that we've discussed each of the four elements which influence the future ALE, we will turn to a brief discussion of how we believe we should get there in 2025. We will

examine a few suggestions for effectively integrating technology and some caveats which we must keep in mind as we proceed.

Notes

1. Richard Eckman and Richard Quandt, "Scholarly Communication, Academic Libraries, and Technology," *Change,* January-February 1995, 40.

2. Ibid., 43.

3. Shoshana Zuboff, "The Emperor's New Workplace," *Scientific American,* September 1995, 164.

4. Bill Gates, *The Road Ahead* (New York: Penguin Books, 1995), 153.

5. Communications platforms enable theater commanders to link directly with the national command authorities.

6. Educators and trainers currently are discussing the implications of the revolution in military affairs for education and training organizations and the structure of institutions. This subject was debated at a conference sponsored by the Office of the Secretary of Defense (Net Assessment) at US Army TRADOC, Fort Monroe, Va., 13–14 December 1995.

7. Lewis J. Perelman, *School's Out: A Radical New Formula for the Revitalization of America's Educational System* (New York: Avon Books, 1992), 57.

8. Ibid.

9. Distance leaning environments for the Air Force are described in "Curriculum Analysis and Media Selection Guide" (Paper prepared by the Distance Learning Working Group, Maxwell AFB, Ala.: Air University, 4 February 1994). Distance learning programs for the Army are described in the Army Science Board Study, "Distance Learning: The Continuing Evolution of the Digital Army Classroom," prepared by the Information Technology Laboratory, USAE Waterways Experiment Station, 5 October 1994.

10. Adelaide Cherry and Phillip Westfall. Briefing to Air University commander on status of distance learning programs at Air University, Maxwell AFB, Ala., Headquarters Air University, Plans Division, August 1994.

11. Paul Metz, "The View from the University Library," *Change*, January-February 1995, 33.

12. Cyndee Miller, "Software That's Fun and Educational—That's 'Edutainment'," *Marketing News* 27, no. 9 (26 April 1993), 2.

13. Air Force Modernization Planning, AETC Education Mission Area Plan, AETC/XORE, 19 July 1995. The Mission Area Plan (MAP) describes deficiencies and proposed solutions for education. The Education and Training Management System (ETMS), a system currently under development, will possess some of the attributes mentioned in this section.

14. Nicholas Negroponte, *Being Digital* (New York: Vantage Books, 1995), 20.

15. Southern Association of Colleges and Schools, "Policies, Procedures, and Guidelines of the Commission on Colleges" (Decatur, Ga., 1992).

16. *Comments on the Draft Report of the Working Group of Intellectual Property Rights*, US Copyright Office, September 1994, 29.

17. *Intellectual Property and the NII*, Draft Report of the Working Group of Intellectual Property Rights, July 1994, 6.

18. Congress's authority to grant intellectual property right is derived from the US Constitution art. 1, sec. 8, clause 8.

19. G. A. Redding and J. D. Fletcher, "Technical and Administrative Issues in Distributed Training Technology," in Robert J Seidel and Paul R. Chatelier, ed. *Learning without Boundaries, Technology to Support Distance/Distributed Learning,* Defense Research Series 5 (New York: Plenum Press, 1994), 85–86.

20. Hal Varian, "The Information Economy," *Scientific American*, September 1995, 161–62.

Chapter 7

Technology Integration

My God, if there was anything that helped us get through those eight years, it was plebe year. And if there was anything that screwed up that war, it was computers.

—Vice Adm James B. Stockdale

Today, the Air Force has already begun its process of integrating information systems technology into its activities. Some Air Force functional areas, such as command and control and intelligence enjoy significant benefits of advanced computer systems and wideband connectivity. Others have barely begun. In the education and training arena, we have started to implement a satellite distance learning network, and we are upgrading many of our correspondence courses with multimedia capabilities. However, we have a long way to go before we arrive at a mature ALE, so as we proceed along our integration journey, we would be wise to learn some "how to" guidelines for technology integration derived from academic and civilian organizations. There is a growing body of information in this area as more and more organizations are trying to integrate technologies into their operations. They are learning what to do and what not to do. We should glean all we can from their experiences.

The first guideline comes from education and technology experts Kenneth Green and Steven Gilbert. They suggest that effective technology integration should occur over the course of several years in a well-considered implementation cycle.[1] The first stage of this cycle involves some planning, investigation, and experimentation. During this stage the organization recognizes that some of its people can work better/faster using computers, and it allows small groups to proceed.

The second stage is characterized by frustration. Here the organization marks a few years of planned capital investment in technology. The results are often surprising increases in operating expenses with little reduction in other areas. They also experience significant, unexpected delays in implementing even the most obvious applications.

Stage three involves a few years of readjustment where costs and annual investments in technology stabilize while capacity continues to grow and new functions develop. (Or, the organization rejects "automation" and/or leaves the business that was being automated.)

Finally, in the last stage, the organization achieves new levels of efficiency and effectiveness as a result of its technology investments. In this stage the organization is no longer pursuing its old objectives or working in old ways, because technology has driven it to alter many of its core business processes.

At the end of this cycle we find that the successful integration of information technologies is almost always associated with significant structural change—the kind of change that educational institutions routinely resist. Often budget limitations and school traditions are the cause of this resistance in civilian education institutions, and these in turn fuel two basic problems in technology integration. Green and Gilbert emphasize that

"infrastructure and limitations in user support are the central issues that prevent colleges and universities from reaching stages 3 and 4 in the educational use of information technology."[2] In fact, they note that colleges and universities often operate at one-half to one-fifth of the support levels normally invested by corporations, suggesting that important support tasks are "probably not being done well or right, or at all."[3] As noted above, the ASF of 2025 will need the high capacity of the GII and a significant support staff in order for our ALE to succeed. Moreover, while today's Air Force has embarked on the technology integration process, we must keep our vision in focus over the next several years to ensure we successfully achieve stage 4 across the force by 2025.

Our second suggestion serves as an adjunct to this lengthy implementation process. We must remember the most overlooked of Jack Edwards' rules for getting started on technology: Solve problems—don't buy toys.[4] As we proceed to integrate technology to build our adaptive learning environment, we must determine the learning problems we need to overcome and then target the technologies we need to resolve them. We cannot afford to allow "cool" technology to overshadow the more critical goal of educating and training our brilliant warriors. Technology must not be the focus of our integration efforts; people and their ability to learn must remain central.

We believe that these rules present an excellent foundation for integrating technologies that will hold true through 2025. Moreover these suggestions present **three caveats** we must remember in order to smartly integrate technology en route to the ALE.

The medium isn't the message. Obviously, this corresponds closely with the suggestion to solve problems with technology instead of buying toys. Even the most sophisticated technology will not change the fact that the mission of education and

training in 2025 will be much the same as today—to give brilliant warriors the best possible learning opportunities. We want to make them as productive as possible as quickly as possible and then keep them productive throughout their careers. As information systems technology and human factors research mature, we envision the emergence of a content-independent ALE of 2025 which can deliver what *New World Vistas* calls "Precision Guided Training."[5] In much the same way that precision guided munitions can strike a very specific target, the ALE will be able to specifically tailor learning materials to a particular brilliant warrior's own individual learning styles, to his/her required learning objectives, and to the unit's mission goals.[6] These factors constitute the learning triad shown in figure 4.

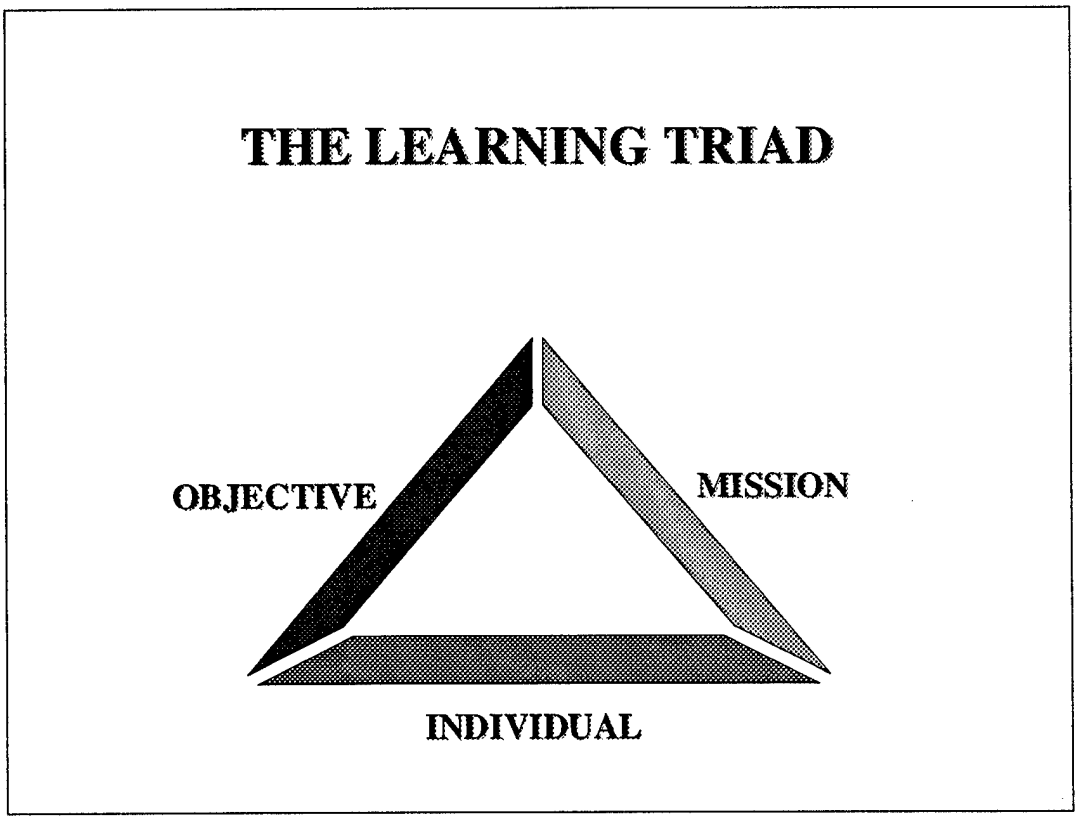

Figure 7-1. The Learning Triad

To develop an ALE which can quickly respond to the dynamic relationships among these three factors, we must capitalize on those technologies which are content independent. Then our education/training technologists can concentrate on content, secure that the appropriate medium will deliver it tailored to a particular learner's need when and where required. Here the medium, the technologies, become transparent and the focus remains on the information and the learner.

It will not happen quickly. The process described above emphasizes that successful integration of technology does not happen immediately; it takes place over a matter of years. While money and the state of technology both influence the length of this process, one of the key factors is people. Significant evidence suggests that technology grows much faster than our society and its members can adapt to it. As Shoshana Zuboff of the Harvard Business School notes, "So far patterns of morality, sociality, and feeling are evolving much more slowly than technology."[7] In today's Air Force, we see this phenomenon every day. People express their frustration with a new computer system they don't understand; they vent their anger at incoming E-mail lists which seem to mushroom despite diligent efforts to work through them; they resent having to re-do documents for minor changes simply because it's easy on a computer. In our ongoing quest to integrate technology, we must not forget the people part of the integration equation. As Roger Schank and Chip Cleary, experts in cognitive psychology and educational technology note, "It is easy to install a computer program—changing people and entrenched systems is difficult."[8]

It will not save money soon. Green and Gilbert express the crux of this issue very well: "The academic enterprise can do great things with—and will experience significant

benefits from—information technology. But, it won't be cheap, and it will not save money soon."[9] Initial costs for system hardware, software, connectivity, and support are significant. In the awkward transitional phase, costs increase as organizations have to do business both the old way and the new way. The rapid turnover of technology suggests the need for continued investment in system upgrades. This issue has been a problem for the Air Force in the past; however, we are learning ways to overcome it through better acquisition contracting agreements.

To succeed in our journey to a mature ALE by 2025, we must be willing to make adequate investments in the right technologies to get us there. We must not be deceived into thinking that technology will benefit us most in cost savings. Instead, "what information technology does best—or will do better as it improves—is deliver content and provide access to information and to other people."[10] By 2025, the ASF may enjoy cost savings as a result of technology; however, its main benefit will be more effective, tailored, and ubiquitous learning opportunities for its brilliant warriors and others who need to learn about ASF issues.

This brings us to our third suggestion. As we build toward the ALE of 2025, we must look beyond simply our ASF. The current trend in the United States military is toward jointness. Congressional mandate, smaller force structures, and new joint structures such as the Joint Requirements Oversight Council and the Joint Warfighting Center are pushing all the services more and more toward joint operations, joint doctrine, and joint weapons systems. Therefore, it stands to reason that we should educate and train our military personnel in the same way that they plan to fight—jointly.[11]

Two areas of jointness particularly lend themselves to joint education and training: joint weapons systems and joint doctrine. In the area of joint, or interoperable, equipment employed across the services, logic and economics suggest the wisdom of joint training on that equipment. The same can be said for both education and training on joint doctrine. The bottom line here is that as we mature in our execution of joint operations, our development of joint doctrine, and our acquisition of joint equipment in the next 30 years, our need for joint education and training will also grow.

In response to this increased need for joint learning, Robert B. Kupiszewski, chief of the Curriculum Affairs Division at the Army Command and General Staff College, has proposed a joint education command comprised "of universities that provide a joint environment for developing doctrine and teaching while offering service-unique curricula."[12] His proposal involves a three-phase implementation from 1995 to 2015, resulting in a single joint education command dedicated to integrating joint doctrine and educational programs, resources and facilities.[13]

Even if Mr Kupiszewski's proposal does not come to fruition, a couple of lessons here are clear. First, in an increasingly joint environment, we must develop our ASF ALE to accommodate and enhance joint learning opportunities for both our brilliant warriors and members of other services. Second, people outside today's Air Force are thinking hard about how to make the changes necessary to adapt our military education and training institutions to take on a greater joint emphasis. The Air Force's efforts to build the ALE of 2025 could put us in the forefront of this effort. The delivery, development, and tracking systems we envision for the ALE would work equally well to provide joint learning opportunities for members from all services. Moreover, they offer options for

nonmilitary government agencies, private relief agencies, and our allied/coalition partners to learn with us, as well.

Just as our military leaders are increasing their emphasis on joint activities, they are also sharpening their focus on another issue related to information age education and training—the revolution in military affairs (RMA). Adm William Owens recently wrote, "Building the force of the future requires harnessing the revolution in military affairs brought about by technological leaps in surveillance, C^2, and longer range precision guided munitions."[14] Our final suggestion concerns this widely discussed information age RMA and its relationship to the ALE of 2025.

In a *Joint Force Quarterly* article titled "Military Education for the New Age," Lt Gen Ervin J. Rokke (USAF) offers some insights relevant to the integration of information technology into the learning environment. His comments suggest that the prospective RMA currently affecting the conduct of military operations also will impact military education and training. We agree. In fact, the notion of an RMA fits our thesis—that changes to one element of the learning environment creates changes in other elements. We recognize the three requirements for an RMA—technology innovation, new concepts, and changes in the organization[15]--are beginning to converge into what will become the adaptive learning environment of the future. What is revolutionary in this RMA, as in all RMAs, is how we employ or apply our technology and how that application changes the way we view ourselves and what we do. We must attend to all three dimensions of the RMA, not just technology.

With the potential for technologies being almost infinite in 2025, it is the idea-based RMA that captures the imagination of the visionary thinker as opposed to the technology-

focused military technology revolution (MTR). The MTR is happening now As with each MTR, it brings about operational innovation, new doctrine, and organizational change, which in turn, leads to an RMA (fig 7-2). The mystery, and our key challenge, is to define and pursue new operational concepts and organizational structures which will allow us to harness revolutionary technologies to make something new and better in 2025 instead of the same old thing dressed up to look new.

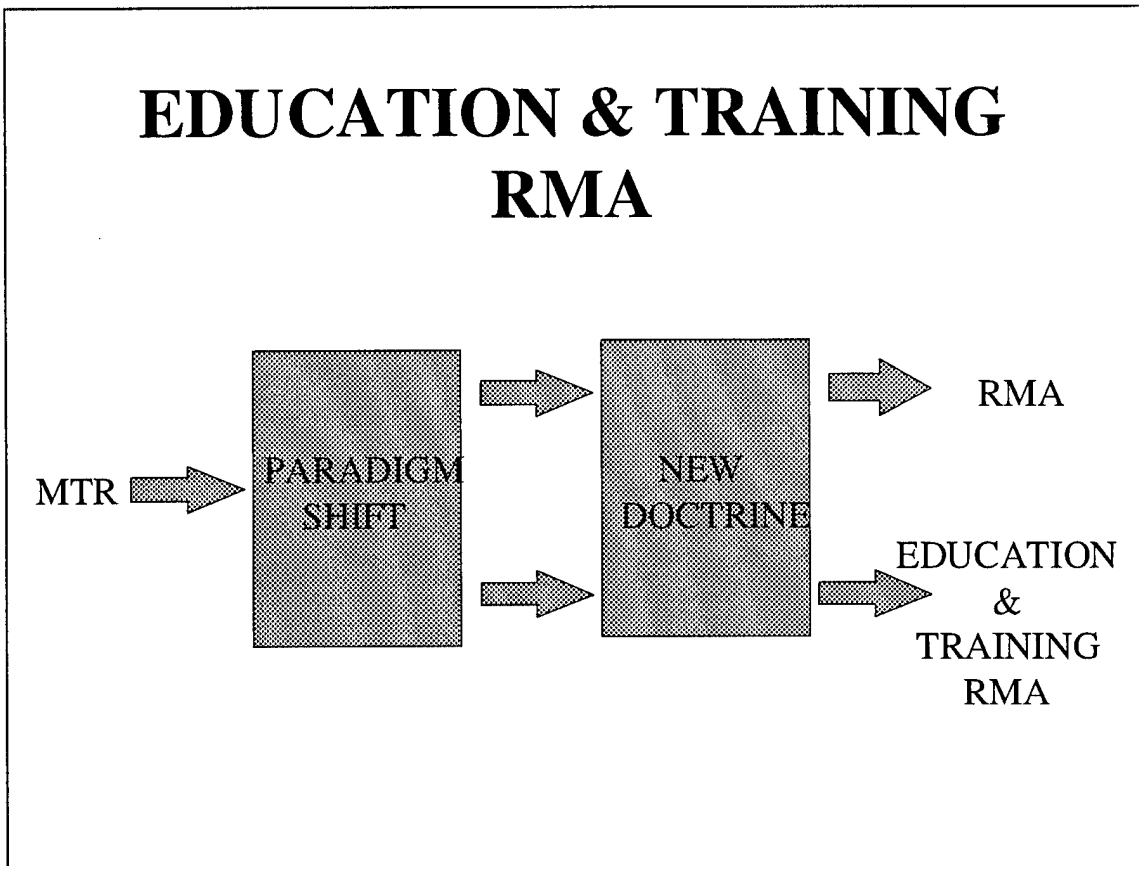

Figure 7-2. The Parallel Education and Training RMA

Lt Gen Rokke concludes his article by referencing changes in professional military education (PME) and the need for a paradigm shift similar to the one we have described in this paper.

> There is a current revolution in PME that parallels the RMA. In both cases core functions and procedures are undergoing fundamental changes. In both cases, we are seeing disparate rates of progress among the constituent parts. And in both cases, we are facing difficult resource tradeoffs between traditional approaches on the one hand and information age alternatives on the other. . . . The war colleges must provide the intellectual capital for changing the existing paradigm. The stakes are high in the revolutions in military affairs and professional military education. Significant obstacles and inertia must be overcome. The RMA has the potential to alter priorities among service capabilities. Similarly, the revolution in PME—challenging curricula and teaching methods—has the potential to transform war colleges into innovative centers that spawn and foster new concepts of warfare. In the final analysis, both revolutions demand changes in culture. Since PME shapes and promotes service and joint cultures, it would be difficult if not impossible for the RMA to succeed without a corresponding revolution in war college curricula.[16]

We also forecast a parallel RMA, the education and training RMA. Its result is the adaptive learning environment brought about by innovative application of technologies; new curriculum areas and learning theories; and a fundamental paradigm shift in the way instructors design and deliver instruction and the way students prefer to learn. But we go a step further. We believe that these changes must be managed so that thoughtful integration occurs.

Notes

1. Kenneth C. Green and Steven W. Gilbert, "Great Expectations," *Change,* March-April 1995, 11.
2. Ibid., 14.
3. Ibid.
4. Jack L. Edwards, "Getting Started on Technology," *The Education Digest*, January 1994, 46–47.
5. USAF Scientific Advisory Board, *New World Vistas: Air and Space Power for the 21st Century* (unpublished draft, the human systems and biotechnology volume, 15 December 1995), I-1.
6. Ibid., I-10.
7. Shoshana Zuboff, "The Emperor's New Workplace," *Scientific American*, September 1995, 162.
8. Roger C. Schank and Chip Cleary, *Engines for Education* (Hillsdale, N.J.: Lawrence Erlbaum Associates, 1995), 72.

9. Green and Gilbert, 18.

10. Ibid., 16.

11. Robert B. Kupiszewski, "Joint Education for the 21st Century," *Joint Force Quarterly*, Spring 1995, 72.

12. Ibid., 73.

13. Ibid., 76.

14. Adm William A. Owens, "JROC: Harnessing the Revolution in Military Affairs," *Joint Force Quarterly*, Summer 1994, 56.

15. Earl H. Tilford, Jr., "The Revolution in Military Affairs: Prospects and Cautions," in Maj Pat Battles et al., eds., *Theater Air Campaign Studies* (Maxwell AFB, Ala.: Air University Press, 1995), 406.

16. Lt Gen Ervin J. Rokke, "Military Education for the New Age," *Joint Force Quarterly*, Autumn 1995, 23.

Chapter 8

Conclusion

The ASF of 2025 will be a far more complex and technical force than the current one. It will be third wave, incorporating new technologies, new operational concepts, new tactics, and new organizational structures. Accordingly, war and conflict in the information age of 2025 will involve far more than pulling a trigger. The changed nature of warfare and the military will increase the value of military education and technical expertise. Smart weapons will require smart soldiers, sailors, marines, and airmen. The military of the future will need warriors who can use their brains, deal with diversity of people and cultures, tolerate ambiguity, take initiative, ask questions, and even question authority.[1] Brilliant warriors entrusted with the defense of our nation will need to be well trained, able to control and work with machines and information systems efficiently, and be mentally and physically superior to the enemy.

To achieve these goals, the ASF will develop an integrated adaptive learning environment to ensure the objectives of education and training are met through the incorporation of advanced information systems technologies such as high capacity global networks, digital knowledge bases, smart software, and virtual reality systems. Moreover, it will nurture more efficient and effective organizations of our academic structures and

processes to instill in our future force the skills, knowledge, and competencies required of brilliant information age warriors.

Education and training in the information age will rely only partly on the application of advanced technologies; the human element will remain the most critical element to successful information technology integration and exploitation. By 2025, we will see the advent of an educational RMA, reflecting the paradigm shift from "providing instruction" to "producing learning." Included in the RMA will be incorporation of other fundamental changes in the academic culture, curriculum, and teaching methods. The RMA will reflect, as stated by Donald A. Norman, professor emeritus of cognitive science at the University of California, the notion that technology be designed and integrated to conform to the needs of the people it serves.[2]

The integration of technology for education and training is a balancing act. A balance between doing what is "faster" and "cooler" than before and providing what the learner needs in all its forms. At its most complex, integration is an exploration of the point where human psychology, group dynamics, and science intersect. Ideally it forces the integrator to answer the who, what, why, when, and how questions regarding the application of technology to the adaptive learning environment of the future. If successful, technology integration will provide the best education and training possible for ASF personnel, units, and others. It will employ a variety of delivery media to allow learners around-the-world to engage in education and training activities tailored to their individual needs on demand. It will exploit computer technology to create ultrarealistic simulations that enhance training. It will make vast amounts of information available through global networks and digitized libraries to speed and improve critical decision-

making. Ultimately, it will harness the tremendous technical power of the information age to educate and train brilliant warriors who are better prepared to fight and win the conflicts of the future.

Notes

1. Alvin and Heidi Toffler, *War and Anti-War* (New York: Warner Books, 1993), 85.

2. Donald A. Norman, "Designing the Future," *Scientific American*, September 1995, 160.

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