

## Chapter 8

# Gagné's Influence on Military Training Research and Development<sup>12</sup>

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*"This I sat engaged in guessing, but no syllable expressing  
To the fowl whose fiery eyes now burned into my bosom's core;  
This and more I sat divining, with my head at ease reclining ..."*

Edgar Allen Poe

*The educational psychology research and development literature is filled with references to the works of Robert M. Gagné. This is most especially true with regard to military publications in the specific area of instructional systems development (ISD). Gagné's contributions to educational psychology and instructional technology are quite significant based on such simple measures as numbers of references and citations in refereed publications. When deeper measures are applied, then his significance and impact grow dramatically.*



My familiarity with Gagné occurred in the context of research and development in support of military training. I shall present a brief overview and indirect critique of his many contributions in this area. Because Gagné has been so prolific for such a long while, I cannot do justice to all that he has contributed to military training research. What I can do is highlight some of his more recent contributions that will illustrate an active and inquiring mind still at work on challenging problems. In discussing a career of dedication to improving education and training in the military, I shall present a picture of the quality and character of the person who has made these contributions.

## A Review of Gagné's Military Research and

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<sup>12</sup> The ideas expressed herein are solely those of the author and do not express the views of the United States Air Force nor of Syracuse University.

## Development

I shall divide this short section reviewing Gagné's contributions to military training research into four sub-sections. The first will focus on his work at several research laboratories. The second section will review his contribution to an automated tool to support the design of instruction. The third will highlight his role in starting a new research journal intended partly as a publication vehicle for work initiated at government laboratories. Finally, I will mention the key role his ideas have played and continue to play in prescribing how instruction is developed in the military.

### Research at Military Research Laboratories

Gagné had a long and distinguished record of involvement with military training. He served as an aviation psychologist during World War II. At the end of World War II, as a young officer in the Army (U.S. Army Air Force), Gagné was part of the Psychology Branch, Aeromedical Laboratory at Wright Field in Ohio. This unit included a number of distinguished psychologists, including Paul Fitts, the chief of the Psychology Branch, Judson Brown, Launor Carter, Albert Johnson, and Walter Grether, all of whom subsequently made many contributions to aviation psychology and other areas of psychology (see Fitts, 1947).

The Air Force formed a center for personnel and training research that contained a number of laboratories at several locations. In the 1950s, Gagné served as the Technical Director of the Air Force Maintenance Laboratory at Lackland Air Force Base, Texas, and also as the Research Director of the Perceptual and Motor Skills Laboratory at Lowry Air Force Base, Colorado. Gagné published an article in the *American Psychologist* in the early 1960s which represented a consolidation of many of his findings from military research. The article highlighted a variety of areas ranging from perceptual abilities to personnel selection research (Gagné, 1962), and formed the basis for *The Conditions of Learning* (Gagné, 1965).

Gagné then pursued a remarkable academic career at Florida State University. He retired with the rank of Professor Emeritus in the mid-1980s. During this academic period, Gagné continued to consult various military laboratories, including the Air Force Human Resources Laboratory, which later became part of Armstrong Laboratory. During this period, he was a frequent presenter at conferences and meetings arranged by the various military training research laboratories. For example, Gagné was the featured speaker at several meetings of the American Educational Research Association by invitation of the Military Special Interest Group. He was also the keynote speaker at many government training research meetings, including an international conference on the subject of distance learning hosted by Armstrong Laboratory in 1990.

**Gagné's Influence on Military Training Research and Development; J. Michael Spector**

Subsequent to his retirement from academia in 1991, Gagné went to Armstrong Laboratory as a National Research Council Senior Fellow and worked with a research team building tools to support designers and developers of military training. More details about his activities while there will be discussed later in this chapter.

This represents 50 years of involvement with military training research and development, a record that is not even closely approached by any other individual. To say that Gagné influenced military training has to be one of the understatements of the century. It would be more accurate to say that he was instrumental in defining a framework for effective military training.

**Guided Approach to Instructional Design Advising (GAIDA)**

In 1989 Gagné was invited to be one of seven academic advisors on the Advanced Instructional Design Advisor (AIDA) project (Spector, 1990). The overall goal of the AIDA project was and is to provide subject experts who have little experience in course and lesson development with guidance and support tools to enable them to perform more effectively.

The initial result of the first phase of this project was that three types of approaches were suggested as worth pursuing. Gagné (1993; Gagné, Tennyson, & Gettman, 1991; Spector, 1993) argued that a useful approach would be to provide content specialists with meaningful examples of good instruction similar to types they were expected to design, along with high level guidance for instructional design elaborated in terms of those examples. Merrill proposed a system inspired by transaction theory (Merrill, 1993). Tennyson (1993) provided a vision of an elaborate suite of tools and a rich library of instructional design resources. The Laboratory decided that Gagné's proposal could be prototyped and tested. The chief of Instructional Design Research, Scott Newcomb, invited Gagné to join our research team as a National Research Council Senior Fellow for this purpose. The result was the creation of a program that initially had one sample lesson and an elaboration of its design principles. We called this program the Guided Approach to Instructional Design Advising (GAIDA). (We had intended the 'G' to stand for 'Gagné', but he was much too modest to allow this to happen.).

GAIDA began to generate some interest both within the Air Force and with outside users. Additional sample lessons or cases were added with appropriate elaboration as to why they were designed as they were. The cases were selected to represent key types of learning (verbal information, intellectual skills, and cognitive strategies), and when GAIDA was formally released to the Air Education Training Command in 1995, there were six cases. One case was aimed at an identification task (recognizing naval officer insignia). Another case was aimed at a classification task (classifying electronic resistors

**Gagné's Influence on Military Training Research and Development; J. Michael Spector**

in accordance with the color code). Two were aimed at procedural tasks, one performed with a checklist (checking the gatling gun on an F-16 aircraft), and one which had to be performed from memory (testing a patient's breathing capacity). One case involved both intellectual and physical skills (handcuffing). The sixth case in the 1995 edition involved complex skills that had to be performed in close coordination with others (flying formation procedures). Other cases have since been added, including the use of multimedia in classroom instruction, handgun safety instruction, and guidance pertaining to discussion groups and lecturing.

The overall lesson framework for all the cases was the nine events of instruction. At that time (in the early 1990s), the Air Force Human Resources Laboratory had close collaborations with the Navy Personnel Research & Development Center and with the Army Research Institute. As a consequence, findings from those laboratories made their way into GAIDA, and GAIDA made its way into the Navy and Army as well as the Air Force training research communities.

These inter-service exchanges led to a particularly useful feature of GAIDA, inspired by Gagné's commitment to and respect for differences in individuals as well as in organizations. The feature is this: everything in GAIDA was designed to be replaceable. The individual cases could be replaced or new cases could be added by following a simple convention of indicating where the guidance program could find an instance of each of the nine events. The generic elaborations of the nine events could be replaced by improved versions or by versions more in line with local practice or local language usage. The specific elaborations for the design of the lessons were also easily alterable or replaceable. Finally, the guidance offered specifically for the design of multimedia was just as easily replaceable. A special booklet describing how to customize GAIDA was produced and distributed with early versions. The general assumption behind this modularity was that learning was at least partly influenced by local learning cultures, practices, and language usage (Spector, 1995).

While I believe this assumption is still valid, I must also report that in the three years of GAIDA use in this highly modularized form with more than 100 users, there was never a single case of the program being modified in any of the ways just indicated. This might be a result of reluctance to undertake what might be viewed as a programming task, although in most cases the changes involved only the alteration of text using a word processor. No formal study was conducted to determine why GAIDA was never customized to fit local practice. Informal reports, however, indicate that GAIDA was easily used and that users quickly graduated to higher levels of competence, so that such modifications were not necessary.

### **Training Research Journal**

While working on the GAIDA project at Armstrong Laboratory, Gagné consulted with a variety of researchers on many topics. One thing that Gagné found particularly attractive about the Laboratory was its inter disciplinary approach to training research. There were and are a significant number of cognitive psychologists, computer scientists, human factors specialists, organizational psychologists, and the odd philosopher. Gagné found this mix of people and expertise intellectually stimulating.

One problem he decided to personally address was the lack of publication opportunities for such interdisciplinary research in the area of training. He was instrumental in founding the *Training Research Journal* and serves as its consulting editor. This journal was published by Educational Technology Publications, and had as its stated purpose the synthesis of theory and research pertaining to training from multiple fields. Its original editorial board included two researchers from Armstrong Laboratory, a Navy researcher, and a researcher from the Institute for Defense Analysis. This annual journal represented a major contribution to the publication of research and development initiated in military settings, and its first publication in 1995 contained a recent article reflecting Gagné's continuing strong interest in internal cognitive processes and their implications for the design of instruction (Gagné, 1995).

### **United States Air Force Manuals on Instructional Systems Development (ISD)**

The United States updated and revised its regulations and procedures pertaining to the design and development of instructional systems in the 1990s (USAF, 1996a; USAF, 1996b). The previous regulations and procedures were significantly influenced by Gagné and reflected much of his work and writings in the 1970s and 1980s (see, for example, Gagné, 1985). Missing in the Air Force procedures and practices of that era were guidelines pertaining specifically to the design and development of interactive courseware and procedures reflective of actual and desirable practice (e.g., rapid prototyping of courseware with early formative feedback from targeted learners).

The Air Education and Training Command (AETC) had advisors working with the AIDA research team, especially in the needs assessment and training requirements analysis phase. As a consequence, Gagné and others from the AIDA research team were recruited by AETC (then called the Air Training Command) to update and revise Air Force policy pertaining to instructional systems development.

In addition to having a very direct say with regard to Air Force policy in the area of instructional systems development (a major enterprise in the Air Force), Gagné's work on GAIDA made its way onto a CD-ROM which was distributed with the revised policy

manuals and handbooks. As of this writing, this material is also available on the Internet at this address: <http://www-technet-aetc.af.mil/links/isd.htm>.

## Illustrative Encapsulations

### Individual Differences

Gagné's works do not typically involve deep or sustained treatment of individual differences. This is not an indication that he had no particular interest in this area. Rather, it reflects his belief that the design of instruction (as opposed to its delivery or its interpretation) is based more fundamentally on an analysis of the subject matter. Gagné (1995) is certainly aware of internal cognitive processes as well as significant cultural and individual factors which might influence the design of instruction, as indicated by the design of the original GAIDA architecture, applying principles typically associated with situated learning and cognitive apprenticeship and socio-historical perspectives. The following story is intended to illustrate Gagné's understanding and thoughts pertaining to individual differences in the area of map interpretation.

As previously mentioned, Gagné was a National Research Council Senior Fellow at the United States Air Force Armstrong Laboratory in 1991–1992. Gagné's specific task and challenge was to guide the construction of the lesson planning advisor he had devised as a consultant on the AIDA project (Gagné, 1993; Spector, Polson, & Muraida, 1993). He began with an open-minded revalidation of his nine events of instruction in the context of military training. Those nine events (see Chapter 4) are as follows: gain attention; inform the learner of the objective; stimulate recall of prior learning; present the stimulus material; provide learning guidance; elicit the performance; provide feedback; assess performance; enhance retention and transfer (Gagné, 1985). The primary question that he was investigating was whether military trainers in fact designed and delivered instruction in ways that were compatible with those nine events. A secondary question was the degree to which his explanations of those events were easily understood by military trainers. The outcome of these investigations was generally positive, and the system already described as the Guided Approach to Instructional Design Advising (GAIDA) was eventually constructed, evaluated, and implemented (Gagné, 1992).

Gagné had visited the security police-training group at Lackland Air Force Base and had worked with a new instructor there who was teaching handcuffing procedures, among other subjects. Gagné first observed a few lessons and then decided to have the instructor videotaped along with a videotaped segment by Gagné concerning the nine events of instruction. This particular novice instructor was intuitively following the nine events, and he appeared to be both enthusiastic and successful in training this particular

**Gagné's Influence on Military Training Research and Development; J. Michael Spector**

handcuffing procedure, making him an excellent choice for an illustrative video for military trainers concerning the nine events. In the course of Gagné's year and a half at Armstrong Laboratory, this videotape was digitized and became one of the lesson exemplars in GAIDA.

Near the end of Gagné's tenure at Armstrong Laboratory, he decided that he would like to have several copies of the videotape, especially for colleagues who had learned about this activity. I had the pleasure of driving Gagné back to the audio-visual office at Lackland Air Force Base. I knew about where the office was, and I naively assumed that if I got close Gagné would recognize the particular office. This strategy failed, and we circled for some time looking for a building that he might recognize. Finally, after a bit of frustration, Gagné suggested that we leave the Air Force Base and re-enter through the very same gate that he had used on his initial visit to the audio-visual office. I resisted this suggestion since I knew we had to be quite close, but he managed to persuade me that this strategy would work. When we re-entered the base, he looked at no landmarks. He merely recited from memory the instructions that he had received on a piece of notepaper a year and a half earlier that he had long since thrown out. His memory was perfect. We arrived at a building just next to where we had been less than a half-hour earlier. He then repeated the instructions to get us from the parking lot to the specific entrance and office; his memory was again perfect.

Gagné demonstrated extraordinary memory capabilities on other occasions as well. I recall a dinner at the Association of Educational and Communications Technology Conference in Nashville. I introduced Gagné to Gustav Schulz, a visiting German researcher at the Laboratory working on a German version of GAIDA. Gagné apologized for not remembering any of the German he had learned in his university studies, but then managed to recall a somewhat lengthy poem in German, which Gustav immediately recognized as a popular favorite.

This experience re-locating the audio-visual building sparked a discussion on the way back to Brooks Air Force Base about the need to take into account individual differences and preferences when designing both maps and instruction. Gagné reported his clear preference for lists of instructions as opposed to visual landmarks with regard to maps. I remarked that I could more easily recall descriptions of visual landmarks and suggested that map designers might be more successful if both kinds of preferences could be accommodated. He said this was most probably true, but that the analysis of the domain was essentially not changed. There remained a common need to identify an end point or goal and to assume one or more starting points. Many of the relevant in between considerations remained the same for both representations as well (e.g., the length of time required to get from one point to another). What changed were presentation details

of the instructions for each type of representation.

He mentioned two additional items. First, the visual representation was not entirely visual. Good visual representations typically included a great deal of textual information. Moreover, cost and time to produce the instructions might be a factor. Listing a sequence of turns was quick and easy and would work with the widest possible audience. He said something to the effect that it is not always necessary to pander to particular preferences; people were neither stupid nor irrational.

Gagné's confidence in the general ability of people to make sense of complicated matters came through on many other occasions, and it formed the initial hypothesis behind GAIDA: Given appropriate high level reminders and good examples, inexperienced courseware designers could and would manage to design meaningful lessons. The courseware designers in question were enlisted military training specialists with extensive subject matter knowledge who were typically highly motivated, task-oriented, practically-minded individuals. Gagné's intuitions with regard to GAIDA have certainly held true. It became widely used in the Interactive Courseware Developers course at Sheppard Air Force Base and was distributed within the Air Force on a CD-ROM containing the revised Air Force manuals on instructional systems development.

Again, this is an indication that the extent of his involvement in military training research and development went well beyond research to close and careful case studies with enlisted personnel as well as to the highest levels of policy making. His influence has been *pervasive*. In addition, these activities late in his career clearly demonstrate that his interest in and influence on military training were not a passing fancy. In 1992, Gagné was officially recognized for these many achievements by the Commander of the USAF Systems Command, General Ronald W. Yates. General Yates specifically cited Gagné's long-standing commitment to improving the quality of military training and his many significant influences on military personnel and training research.

### **Learner Engagement Story**

On another occasion, Gagné and I were driving around Phoenix looking for a particular restaurant. This time, however, he had no list of instructions to recall as another person had previously taken him there. To complicate the situation, he did not remember the name of the restaurant—only that the food was excellent. Not surprisingly, it took us quite a while to find the place. While driving about, we happened to take up the subject of learner engagement. I was worrying about how to construct guidelines for designers and developers of military training environments. Specifically, I was concerned with the possibility of constructing automated mechanisms for dynamically engaging learners when they began to lose interest and motivation or when progress appeared to be

**Gagné's Influence on Military Training Research and Development; J. Michael Spector**

lagging. I was wondering how one judged another's level of engagement. If we did not know how human tutors did this, then it seemed unlikely that machines could be programmed to judge and respond to learner engagement. His initial response was that this was easy as there were obvious verbal and visual cues used by human tutors.

I was skeptical as I recalled an AIDA meeting which included a panel of expert instructional design researchers and psychologists, including Henry Halff, David Merrill, Harry O'Neil, Martha Polson, Charles Reigeluth, Robert Tennyson, along with Bob Gagné and various military advisors. After a break for lunch at the Brooks Officers Club, the meeting proceeded with a discussion about the appropriateness of the instructional model used in one of Merrill's more recent systems (Merrill, 1993). There was a lengthy discussion about a technical matter pertaining to learner control. The discussion was partly brought about by Merrill arguing against the general advisability of extensive learner control when teaching novice maintenance technicians about the fundamentals of a particular device and yet allowing so much learner control in lessons generated using ID Expert 3.0. Gagné had long since put his head on the table and appeared to have been asleep for most of this hour-long debate. All of a sudden we heard two fists pound down on the conference table, followed by a short expletive—Gagné had been fully engaged following this discussion while we all thought he was asleep. His summary of the discussion clearly indicated that he had not been sleeping, and his critique indicated that he had followed all aspects of the argument.

Gagné said trainers need to guide learners when the learning goals were specific and well structured, as is typically the case in military training. He went on to say that insofar as learning is a purposive and goal-driven activity, then we should apply some principle of rationality, implying that goals can be identified as well as effective means to achieve those goals (Spector, 1995). Completely open-ended learning environments follow a principle of irrationality in the sense that learners are not expected to have specific learning goals or know effective means to achieve those goals. Gagné found such assumptions deeply troubling, which is why he had reacted so strongly.

Anyway, I had remembered how impressed I was at the time by his intellectual stamina and by how easy it was to make mistakes with regard to someone's level of attention and involvement. While driving about, I reminded him of this incident, and he smiled in recognition of that meeting. He said something about the fact that mistakes can be identified and corrected, so my objection lacked substance. Gagné had this wonderful ability to tell you that you were confused without making you feel small or stupid. On the contrary, he spent a great deal of time while at the laboratory talking with researchers and technicians at all levels about any number of subjects.

**Gagné's Influence on Military Training Research and Development; J. Michael Spector**

Not wanting to drop the discussion, but not knowing how to proceed, I then asked what makes a poem memorable, remembering his recollection of the German poem. Without hesitation, Gagné answered that the rhyme and meter made poems memorable. We discussed the distinction between ease of memorizing and being memorable, as I worried that something had been overlooked. I asked him if he remembered any poems. Then, a most remarkable event occurred. He proceeded to recite the entire poem "The Raven," by Edgar Allen Poe, without pausing to recall a single part. For those readers who may not know this poem, which also happens to be one of my favorites, it is quite long—more than 1,000 words, usually occupying several pages. I asked when he had learned that poem. He said it was about 50 years ago, and he had not given it much thought or attention since. I was intrigued. I asked if he had learned it for a literature course, which is where I first encountered it. He replied that he had found it on his own when he was first dating Pat, whom he subsequently married. Why had he committed it to memory? He said that he was concerned about matters of the heart, especially the ability of love to endure, as a consequence of his relationship with Pat.

The conversation then shifted briefly to love—a holistic kind of engagement, as opposed to the more cognitive kinds of engagement we had been discussing. As I recall, we both came to the conclusion that we knew very little about this deeper kind of engagement, and then we somewhat unexpectedly happened to find the restaurant. I should add that he managed to nurture and enjoy a lifelong marriage with Pat. My conclusion at the time was that he had an incredible capacity for memory as well as for love.

## Conclusion

I realize that my review of Gagné's many contributions is much too abbreviated to be complete and thorough. I also realize that many others could recount countless anecdotes to illustrate Gagné's character and encapsulate his perspective on training in the military. I chose to relate the above stories because I wanted to emphasize the quality of his memory, his great respect for people performing complex and demanding tasks, and his generosity of time with very junior researchers and technicians. In addition, I have mentioned a bit about his dedication to family. I should add that he had an insatiable appetite for ideas. He borrowed and read numerous of my books on epistemology. He was most intrigued by Hume's *A Treatise of Human Nature* (1978) for some reason or other.

I have attempted to say in a number of ways just how much military training professionals owe to Gagné. Perhaps the debt is so obvious that it stands on its own without further elaboration. Believing that to be true, I have offered a different kind of elaboration—one that is intended to provide a more personal glimpse of a truly great

mind and a wonderfully engaging individual.

“Ah, distinctly, I remember it was in the bleak December  
And each separate dying ember wrought its ghost upon the floor.  
Eagerly I wished the morrow; vainly I had sought to borrow  
From my books surcease of sorrow ...”

From “The Raven,” by Edgar Allen Poe.

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**Gagné's Influence on Military Training Research and Development; J. Michael Spector**

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