THE ORIGINS OF

TECHNOLOGY IN EDUCATION

The Role of Federal Interventions and National Emergencies

During the Early Evolution of Instructional Technology and Media

(1940–1960)

Thesis

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ABSTRACT

THE ORIGINS OF TECHNOLOGY IN EDUCATION: THE ROLE OF FEDERAL INTERVENTIONS AND NATIONAL EMERGENCIES DURING THE EARLY EVOLUTION OF INSTRUCTIONAL TECHNOLOGY AND MEDIA, 1940 –1960

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The purpose of this Master's thesis is to explore, review, and describe known historical events and contexts that impacted, and gave impetus to, the evolution of technology in education. In doing so, this study historically traces two significant themes that are interwoven throughout the history of American education that have led to the introduction, and promoted the use, of early forms of instructional technology and media in education: federal interventions in education and scientific research, especially during periods of wartime preparedness and postwar concerns about the status of America's system of education; and the emergence of, gradual advances made in, and the acceptance of instructional media and technology in the nation's classrooms—particularly as a result of federal interventions during the years1940–1960.

Prominent among the war preparedness events mentioned in the study are the military and civilian wartime training programs and institutes, conducted on college campuses and military installations. The need to rapidly train tens of thousands of new military personnel, and civilian workers to support the war production created a heightened interest in applying educational research in a

systematic way and helped to propel forward systematic efforts to design instruction. During the early Cold War Years, federal legislation such as the National Science Foundation Act of 1950 and National Defense Education Act of 1958, and subsequent amendments, paved the way for introducing more mechanical and electronic technology and teaching aids to facilitate science, mathematics, and language instruction. Through this legislation, education was called upon to support the national agenda of competition with the Soviet Union (following the successful launch of Sputnik) and to assist the nation in reclaiming its global leadership in science and technology.

Early instructional technology took the form of visual and audio teaching "aids" that were introduced during the advent of the visual and audiovisual movements, as alternate methods to books and lectures to deliver information. It was during this early period in the history of technology in education that filmstrips, motion pictures, audio recording, and radio were invented and used in educational settings.

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Section I:

INTRODUCTION

> The absence of romance from my history will, I fear, detract somewhat from its interest; but if it be judged useful by those inquirers who desire an exact knowledge of the past as an aid to the interpretation of the future, which in the course of human things must resemble if it does not reflect it, I shall be content. In fine, I have written my work, not as an essay which is to win the applause of the moment, but as a possession for all time. (Thucydides, *The Peloponnesian War,* Book I, 22)

Purpose and Rationale

The purpose of this Master's thesis is to explore and review current literature and present relevant findings that identify and describe known historical events and contexts that impacted, and gave impetus to, the evolution of technology in education. In doing so, I am not concerned with the total sphere of education, nor the complete history of technology in education and instructional theory; rather, my primary intent in this study is to historically trace two significant themes that are interwoven throughout the history of American education during the 1940–1960 period that led to the introduction, and promoted the use, of early forms of instructional technology and media in America's classrooms:

(1) Federal interventions in scientific research and educational matters—particularly in higher education—during times of national crises as education was called upon to support the national agendas of wartime preparedness, manpower training, competition with the Soviet Union, and reclaiming global leadership in science and technology: What were the significant historical events that prompted federal intervention, in terms of research sponsorship and funding of education? What role did instructional technology and media play during periods of national crises in terms of military training and industrial manpower preparedness? What events prompted the National Science Foundation (NSF) Act of 1950 and the National Defense Education Act (NDEA) of 1958? What were the influences and outcomes from the aforementioned federal legislation that impacted science and math education, and advances in the utilization of new instructional technologies, materials, and teaching aids in the classroom and in scientific and technical training programs?

(2) The emergence of, and gradual advances made in, instructional technology and media, and their contributions to facilitating teaching and learning: What roles did the wartime preparedness, industry workforce training, training in the sciences, and federal

legislation play in the development of modern instructional methodologies? How did instructional technology—as *visual instruction,* and later as *audiovisual communications*—in education evolve in the United States?

In looking back in time, I am attempting to demonstrate the important roles that federal interventions in time of national crises and early innovations in instructional technology and media played in the development, introduction, and acceptance of instructional media and more modern mechanical and electronic teaching aids in America's classrooms.

Each section in the study begins with one or two paragraphs that I utilize to introduce the section's theme or topic. Certain terms and phrases (e.g., higher education, Negroes, etc.) are used in the early portions of the study because their meaning and/or historical longevity was deemed as being more appropriate to the context or period in time where used in the study, or because they were utilized by sources listed in this study. This terminology gradually changed over time (e.g., postsecondary education, African-American, etc.), and the study reflects the same.

Throughout the study, I use the terms "basic research" or "pure science," often interchangeably. While there is little agreement on a precise definition, most scientists during the era covered by the study used these terms to refer to work that had no immediate practical application and thus it was distinct from

"applied research." Likewise, the terms "educational technology" and "instructional technology" are used interchangeably.

Audience

My intended audience involves students whose academic concentrations are in the area of instructional technology. Also, teachers and researchers specializing in the field of curriculum design and development, instructional methodology, and educational technology will benefit from the study's findings. It is my belief that educators should investigate and become aware of this history as an important step in developing a personal perspective of the bigger picture of technology in education, and the role that it has and can continue to play in learning environments. Hopefully, this study can help to develop a cognitive framework in the mind of readers through which one can view the past, today's realities, and tomorrow's potential for technology in education.

The Plan of this Study

Section II introduces readers to the general, historical background information pertinent to the major topics or themes of this study as they evolved prior to World War II: early federal interventions in educational matters, the status of the nation's schools and institutions of higher education, scientific research, and early instructional technologies and media. Each of these topics is later expanded upon in subsequent sections of the study.

The status of scientific research is described in terms of the establishment of agricultural extension services at land grant universities, creation of the nation's first research universities, the role of private and industry foundations in funding scientific research, and the efforts of the National Research Council during World War I. Previously, and as late as the early nineteenth century, scientific research was primarily undertaken in the domain of self-supporting amateurs, having little or no contact with industry, academia, and the federal government.

The earliest view of educational technology and one that continues to this day is that of technology as *media and audiovisual communications*, which grew out of the visual education movement during the early nineteenth century, visual instruction movement beginning in 1918, and the audiovisual movement that began in the 1930s—all as alternate methods to books and lectures to deliver information. Classroom "apparatuses" and "aids" are introduced as early forms of instructional media during the advent of the visual education movement. Visual education, as a movement, has its roots in the efforts of reformist educators and theorists, and later American progressive educators, who revolted against formalism and verbalism in educational practice during the nineteenth and early twentieth century and sought to emphasis the role of the senses in learning. In 1918, the movement evolved into *visual instruction,* as the use of aids in the classroom gained momentum. It was during this early period in the history of technology in education that filmstrips, motion pictures, audio recording, and radio were invented and used in educational settings.

Section III discusses war preparedness training and the role of scientific research and audiovisual media. Prominent among the war preparedness events and training institutions mentioned in this section are the role of military and civilian wartime training programs conducted on college campuses; the U.S. Office of Education's Division of Visual Aids for War Training, and its efforts in both industrial and military training programs; and, the United States Armed Forces Institute, which offered training and correspondence courses to military personnel. War preparedness and wartime training made extensive use of the emerging instructional technologies and media of that era, and propelled the evolution of instructional media from the visual instruction movement—leading to the emergence of the new audiovisual communications movement.

This section also describes the role of private foundations and their support of pre- and wartime research—particularly the origins of the National Science Foundation (NSF), beginning with the first of its predecessor organizations, the National Defense Research Committee, as one of the earliest concrete attempts to centralize organization and control of scientific research in the United States. During World War II, first the National Defense Research Committee, and later the Office of Scientific Research and Development, provided direction for research and the development of the nation's military technologies.

Section IV addresses the topic of postwar interventions in higher education and science by the federal government. The section begins with a discussion of the passage of the Servicemen's Readjustment Act of 1944, which

is mentioned within the context of the changes it brought to college campuses and the need for new classroom and laboratory facilities. The instructional research efforts during the war contributed to the growth of standardized testing (a form of instructional assessment and evaluation); and, subsequent federal intervention and impacts in education following World War II. Also, the period covered by this section witnessed the establishment of the National Science Foundation (NSF) in 1950, and key national and international events that preceded passage of the National Defense Education Act (NDEA) of 1958.

Section V describes the social and political debates over the effectiveness of American education, and the national politics of federal aid to education. Education was called upon to support the national agenda of competition with the Soviet Union following the successful launch of Sputnik, and to assist the nation in reclaiming its global leadership in science and technology. The primary focus of this section is legislation that gradually increased federal involvement in education and established the precedent for more general, as opposed to categorical, forms of federal aid. The NSF Act and the NDEA established scholarships and fellowships, and provided aid for new programs in specific fields of study; both eventually became a significant source of funding to university faculty and students for basic and applied research. More importantly, for the purposes of this study, the NDEA and subsequent amendments to the original legislation led to the introduction of more modern mechanical and electronic teaching aids in education.

Section VI completes the discussion concerning instructional technology as it evolved as media and audiovisual communications, during the time frame when television emerged as a mass communications and instructional media. Leaders of the visual instruction movement became uneasy about the adequacy of the visual instruction label as the newer technologies such as audio recordings and radio enter into the equation. During the late 1950s and early 1960s, a second approach—technology in education as *instructional systems*— began to take root and is described briefly in this section. This approach emphasized a system's or programmed instruction approach to utilizing instructional technology in education and was an outgrowth of the systematic approaches used in the military and in business data processing of that time period.

The concluding section—Section VII—examines the historical contexts of the origins of federal interventions in education and scientific research and the early evolution of technology in education, in light of the events of the time. Likewise, my reflections are expressed regarding the events described in this study and their importance to the development of instructional technology and media.

Section II:

EARLY FEDERAL INTERVENTIONS IN EDUCATION AND SCIENCE, AND THE ADVENT OF VISUAL INSTRUCTION

The Constitution of the United States does not include a provision that directs the federal government to provide for the education of its citizens. Even so, throughout our nation's history one can note events, legislation, and other evidence of a gradual and significant federal involvement in educational matters. The national welfare, defense of the nation, and racial desegregation, among others, have been issues that provided legislators and presidents with rationale for federal intervention and financial aid.

Early Federal Legislation Supporting Education

"From the beginning of our country the role of federal government in education has never been clear. Even though education began as a local responsibility and concern, and became a state responsibility, the federal government has provided support for education almost since the birth of the nation" (Harden, 1981, p. 4).

Among the well-known examples of federal involvement in education, cited by Kaestle and Smith (1982), that occurred before 1940 are the Northwest Ordinance of 1787, the Morrill Acts of 1862 and 1890, the Smith-Hughes Act of

1917, and several of Franklin Roosevelt's New Deal programs that affected public schools. "Federal involvement in pre-collegiate education began long before 1940, and its history since then is complex" (p. 385).

The practice of land grants—endowments given to the states for educational purposes—was not novel in American history. Instead, the precedents are numerous and longstanding since the colonies received this heritage from the English Crown. As the states replaced colonies, they continued the practice of giving land grants for higher education. It was, however, the Northwest Ordinance of 1787 that "led to the practice of giving each newly admitted state (unless carved out of the original thirteen) two entire townships for a 'seminary of learning'" (E. L. Johnson, 1997, p.223).

The Ordinance stated that "schools and means for education shall forever be encouraged" (Harden, 1981, p. 4). The intent was to set aside a plot in each township and use the proceeds from the rental of that land to support common schools. "The fact that the law did not work is seldom noted in educational histories. The effect of the Northwest Ordinance on common schooling was almost nil. Land-based school funding could not work in an area where unimproved land was plentiful and almost as worthless as rental property....The development of income-generating state school funds was not a high priority in the frontier Midwest" (Kaestle and Smith, 1982, p. 387). Nevertheless, this Ordinance did become the first national grant for the support of higher education (Hamilton and Laufer, 1975).

The Morrill Land-Grant Acts of 1862 and 1890 represented the next federal venture into education designed to affect higher education (Kaestle and Smith, 1985). Introduced in 1859, Morrill's first land-grant legislation was vetoed by President Buchanan, who questioned its constitutionality—though it was alleged he feared the land grant issue. "During the Buchanan years, there was a division between the Eastern and Western States regarding the sale of public lands. The Western States opposed the sale of public lands because they feared it would lead to speculation. Under the proposed Morrill Act, the Eastern States, which no longer had any available public land, were to receive money for available lands in the newer states. Thus, benefits from public lands in the West would have been extended to institutions in the older Eastern States" (Hamilton and Laufer, 1975, p. 5).

The passage of the Morrill Land-Grant Act of 1862, during the outbreak of the Civil War, is especially significant in that it is generally regarded as the first direct involvement in education by the federal government in the history of the United States. The Morrill Act encouraged the expansion of higher education by the establishment and support of land-grant colleges and universities for science, agriculture, engineering, and the mechanical arts. Its passage is fascinating and worth mentioning, given the fact its impact is still significant today for education in general and all land grant institutions in particular: "It introduced the idea of public service to the missions of higher education; it emphasized expanded access to higher education; and, it began federal support of agricultural research" (Kerr, 1994, p. 31).

The passage of the first Morrill Act, according to Hamilton and Laufer (1975), is significant for several other reasons: (1) It brought into practice the federal policy of categorical grants for higher education—providing for the 'general welfare' in strengthening manpower development in certain fields; (2) the act encouraged agriculture, the mechanical arts, and military training in the new land grant colleges. Therefore, it is interesting to note that the first major federal program in support of higher education is also one that encouraged the participation of higher education in the nation's defense. It was followed, in 1867, by the creation of a Department of Education. "Legislation affecting higher education did not conclude with the Morrill Act of 1862; rather, the precedent was established for future federal involvement" (p. 6-7).

The year 1890 brought the passage of a second Morrill Act. It was significant in that Congress adopted a policy of annual appropriations to land grant institutions, delimited the purposes for which funds could be used, and doubled their size (Hamilton and Laufer, 1975).

Land grant universities were intended to support research of use to farmers and the rural population. Passage of the Morrill Acts occurred within a socio-political environment that was characterized by a growing dissatisfaction with higher education and the emergence of agricultural organizations devoted to advancing the interests of farmers. In 1887, the land grant legislation was strengthened by the passage of the Hatch Act, which provided federal support for the establishment of agricultural experiment stations and a "context for the

systematic application of scientific research to agricultural problems" (Kleinman, 1995, p. 28-29).

Previously, the federal government had little connection to, or involvement with, scientific research. A strict interpretation of the Constitution had the effect of limiting government involvement in science to the granting of patents. However, the government did support some topographical research to benefit commerce and the military. In the early nineteenth century, there was an expansion of the Coast Survey and government research to develop charts and maps for use by commercial interests; and, in 1803, the federal government sponsored the Lewis and Clark expedition. Later, the Civil War led to increased government activities in support of research—such as funds to improve naval armaments, ships, steam engineering; and, other military technologies for both the Army and Navy. A major science-related development during the Civil War was the creation in 1863 of the National Academy of Sciences (NAS), chartered as an organization for consultation to government in scientific and military matters during the war and recognized by some in the science community as an attempt by prominent scientists in the U. S. to centralize control over American science (Kleinman, 1995).

After the Civil War, Congress created the Allison Commission to investigate existing science agencies in light of growing criticism on Capital Hill regarding the ineffectiveness and inappropriateness of much government-supported research. This commission asked the NAS to undertake this investigation, develop a study, and determine the feasibility of creating a single

agency or department of science to undertake research not conducted in universities or by the private sector. While the Academy's report, submitted in 1886, favored the creation of such an agency or department, "the commission decided against promoting a department of science on the grounds that it was not in the national interest and was not politically feasible" (Kleinman, 1995, p. 48).

The next major milestone in terms of federal intervention in higher education matters was in 1914, with the passage of the Smith-Lever Act. It provided matching funds for extension services to benefit the agricultural segments of the country, in the areas of agriculture and home economics—curricula and services offered by land grant universities. Moreover, the outbreak of the First World War in Europe this same year brought the federal government and higher education into closer proximity with the passage, in 1916, of the National Defense Act. This act was passed to establish the Reserve Officers Training Corps (ROTC) at four-year universities to qualify students for leadership position in the military during national emergencies (Hamilton and Laufer, 1975).

An important element of the National Defense Act was that it was a result of an overall preparedness movement begun in 1914 that advocated military discipline and training in non-military settings as a character building tool, and this was especially reflected in Section 27 of the Act, which called for soldiers to receive both military training and education to prepare for jobs in civilian life. The programs were to be voluntary. Although the Corps was disbanded in 1918, the

Act was amended in 1920 calling for its reestablishment (Stubblefield and Keane, 1994).

The Nation's Schools and Federal Aid Prior to World War II

Legislation impacting elementary and secondary schooling did not occur until World War I. In 1917, the year the U. S. entered World War I, the Smith-Hughes Vocational Education Act provided federal categorical aid to public secondary schools for vocational education programs governed by very specific structural agreements. Where the Morrill Act of 1862 had provided for technical education in the land grant colleges, this new legislation sought to introduce its counterpart in the public secondary schools (Krug, 1966). According to Kaestle and Smith (1982): "This legislation, and subsequent Congressional measures, supported local vocational programs, despite the absence of evidence that such programs actually resulted in effective vocational placement....The coming of World War I served to hasten an already existing successful reform movement to achieve federal funds for vocational education. Industrial training was a part of President Woodrow Wilson's preparedness program, but the 1917 bill was a faithful embodiment of the recommendations of the National Commission on Vocational Education, appointed in 1913" (p. 388-391). The bill gave vocational educational its first real impetus through support for home economics, agriculture, trade, and industrial education (Harden, 1981).

The Smith-Hughes Act, likewise, is significant from the perspective that it is one of many examples of educational legislation that were influenced by factors and events outside of education—in this case, World War I. A demand for action surfaced and brought about passage of this legislation when draft boards discovered that close to 25% of the draftees were illiterate, many did not speak English, and the great majority of the one-third of the inductees who were deemed physically unfit suffered from defects that could have been detected and remedied at school age (Munger and Fenno, 1962).

Krug (1966) lists several arguments that prompted interest in the passage of the Smith-Hughes Act: "the decline of apprenticeship, the presence of many pupils who allegedly had neither interest in nor talent for the academic program, the need for trained workers to keep the United Sates abreast of other industrial nations...and the need for economic growth" (Krug, 1966, p. 112). Other important contributing factors included the decline of a teen-age labor force, it came during a profound expansion of secondary school enrollments, and the desire of legislators and educators to utilize vocational education as a means to differentiate curricula—a form of equal opportunity, based on the notion that high schools could serve all youth only by offering a variety of curricula (Kaestle and Smith, 1982). Despite the concerns of those who questioned the separate curricular tracks as class bias, according to Urban and Wagoner (2000), support for differentiated studies came from all classes: "For example, many in the organized labor movement and from the working and lower classes saw

vocational studies as a recognition of the dignity and honor of their own way of life" (p. 212).

"The broad ideological and technological appeal of vocational education allowed it to survive as the only pre-World War II categorical federal aid program to elementary and secondary education despite periodic commission reports demonstrating that it was ineffective. Smith-Hughes was the major precedent for the federal government's categorical initiatives in 1958" (Kaestle and Smith, 1982, p. 388).

Following World War I, Congress passed the Vocational Rehabilitation Act of 1918, which provided aid to train veterans who were unable to find employment. A year later, educational institutions received war surplus in the form of military property, and the establishment of special collegiate programs for disabled veterans (Hamilton and Laufer, 1975).

During the 1930s, the United States was continuing its efforts, as a nation, to recover from the Great Depression. While there were several short-lived upturns during 1930s—partially as a result of the unprecedented efforts of Franklin Roosevelt's administration—there were also several significant downturns. According to Bennett (1996), by 1929, "the flappers' party was over, and by 1932 only one in four men had a job. Economic necessity forced all too many students to disappear from the classroom as soon as they got into long pants or started using bobby pins" (p. 6). By the time Franklin Roosevelt took office, America's schools, like other segments of the economy, had taken a severe beating and were financially under siege. Some schools, mostly in rural

areas of the country, were forced to close, and almost all school districts were forced to reduce their budgets often by as much as one-third, cutting deeply into teacher staffing and salaries (Fass, 1986). Urban and Wagoner (2000) add:

> The economy grew in fits and starts and never completely shook off the effects of the stock market collapse of 1929. It is now the general consensus among historians and economists, that it was the arrival of World War II and the conversion to a full-employment war economy that convincingly ended the decade-long Great Depression...despite the upheavals in the economy and the cutbacks that took place in the educational community during the depression years, schooling itself continued to follow the familiar patterns of the 1920s. (p. 279)

During this period the federal government's relative absence from direct involvement in educational matters was curtailed, following a long history of federal quiescence in which educational matters and funding rested with the states, local school districts, and private schools. The reform activities that President Roosevelt initiated to cope with the economic and social devastations of the Great Depression were not only unprecedented in many ways, but also marked the beginning of more active and direct federal intervention in education that was a critical ingredient in New Deal legislation (Fass, 1986).

According to Hamilton and Laufer (1975), often the agencies and programs that were created to employ the unemployed also sponsored educational programs designed to supplement the established local education

systems. The Federal Emergency Relief Administration (FERA) supported the various educational programs although education was not its primary focus. One such educational program was the College Student Work Program, given the FERA's concern over the effects of the Great Depression on college enrollments. It is estimated that 1500 out of the 1700 colleges eligible participated in the program, benefiting approximately 620 thousand students— though "many of the jobs that college students found themselves working on were not related to their academic interests and were indeed menial in nature" (p. 13).

During the aforementioned time period, another federally-funded program involved payments to 40,000 teachers who taught in adult education or rural schools. Likewise, the Reconstruction Finance Corporation, as a result of an amendment passed by the 72nd Congress, was allowed to make federal loans to states and municipalities for educational purposes. These loans assisted colleges and universities in areas of capital improvements and related outlays (Munger and Fenno, 1962).

The Civilian Conservation Corps (CCC) and the National Youth Administration (NYA) were two of the most famous of the New Deal work relief programs that established significant educational components. The first of these two agencies, the CCC, began in 1933 as a public works program that housed unemployed, unmarried male youth between the ages of eighteen and twenty-five. On the average CCC enrollees had completed either eight or ninth grade in school, though many had dropped out of school and came from broken homes. They were housed in rural camp settings, run according to quasi-military routines

that placed emphasis on basic literacy skills, moral training, and developing values of hard work and disciple. It was the mission of the CCC— controlled by the Army and assisted by the Forest Service and the National Park Service—to preserve the nation's forests and other natural resources (Stubblefield and Keane, 1994). Educational activities in CCC settings grew out of a need to provide recruits with constructive activities during their off-work hours (Urban and Wagoner, 2000).

On the other hand, the NYA was a non-residential program, centered primarily in towns and cities, that provided direct aid payments to current high school and college youth for doing various types of jobs—usually at school sites; and, developed job and training programs for youth already out of school (Urban and Wagoner, 2000). The program, part of the Works Progress Administration (WPA), enrolled 2,677,000 young people, of which 45 percent were female (Stubblefield and Keane, 1994).

Soon after America entered World War II in 1941, New Deal educational programs were dismantled; the CCC in 1942, and the WPA and NYA in 1943. Both the CCC and NYA provided training for the war, but enrollment had dropped as young men entered the military or were employed by defense industries (Stubblefield and Keane, 1994).

The George-Deen Act of 1936 was passed to replace the George-Elizey Act of 1934, both of which provided funds to vocational education that originated with the Smith-Hughes Act of 1917. The George-Deen Act was later replaced, in

1946, by the George-Barden Act. It, too, authorized additional money for vocational education (Harden, 1981).

The Lanham Act of 1939 is among the emergency school aid measures passed by the 76th Congress toward the end of the Great Depression. This legislation provided funds for school districts in areas sharply affected by federal activities and was administered by the Federal Works Agency (Munger and Fenno, 1962). The Act, a predecessor of the federally impact legislation of the 1950s, was important in that it provided funds to compensate communities for domestic federal ownership of land for installations, such as military bases, that sent children to local schools, but were exempted from paying property taxes. This Act was expanded by legislation in 1950, the year that the Korean Conflict began. Otherwise, most federal education programs during the depression and war years were for manpower training in non-school or higher education settings (Kaestle and Smith, 1982).

The New Deal altered beliefs and perspectives about the role of the federal government, provided the origins for the idea of education as an entitlement, and effected federal intervention in education on the behalf of racial and other educationally deprived groups. "In this sense, the New Deal anticipated the educational developments of the post-1960s period..." (Fass, 1986, p. 22). While the New Deal, as the federal government's primary response to the Great Depression, significantly changed the relationship of the federal government to education, it did so in "'ironic and problematic ways" (Fass, p. 23)— Roosevelt did not have a policy of equality, nor did he challenge

segregation in school systems and CCC programs. The educational programs of the New Deal were not anchored in long-term commitment, as Roosevelt never intended to usurp the traditional principle of local control of schooling, and he did not support general federal aid to education (Fass, 1986).

Changes Brewing in Higher Education

Though most economic aspects of American life suffered during the Great Depression, "higher education benefited somewhat from the fact that few young people could find jobs, and, therefore, attended colleges and universities in greater numbers" (Hamilton and Laufer, 1975). Nevertheless, changes in higher education had been slow in evolving prior to the war. Although higher education had begun to play a more prominent role in American life during the interwar period, colleges and universities remained the citadels of the upper-middle class and retain its overwhelming association with the genteel elite (Clark, 1998).

Moreover, in the 1940s, "almost no one in America, any more than in Europe, believed that a college education should be available to everyone who wanted it and was willing to work for it" (Bonner, 1986, p. 44). College was only for those who were properly prepared for it, or had the money to attend. Many Americans were ambivalent toward higher education, given that attendance at college was associated with the consumption of the upper-middle class—something aspired to by some but often resented or dismissed as frivolous and of no practical value (Clark, 1998).

Nationwide, less than a million and a half students—predominately male (approximately 60 percent) and overwhelmingly white (97 percent), largely from middle and upper income families—attended colleges and universities in 1940. Therefore, colleges and universities, prior to the war, were basically elitist institutions serving only the very few, charging tuition only the middle and upper classes could afford, and discriminated against women, Negroes and the poor. Very little was expected of higher education in terms of change, broadening opportunities, or improving the quality of life through research. "Furthermore, no one seemed to care....This elite group had been carefully screened, and they overwhelmingly chose to study the liberal arts or one of the tradition professions. Higher education...was supported almost wholly by student tuition and state government...except for the relief given poor students by the National Youth Administration" (Bonner, 1986, p. 45).

Nonetheless, changes were brewing in higher education. Once fortresses of privilege and emblems of wealth, with only the few able to contemplate study beyond secondary education, the academies gradually began to open their doors to a growing proportion of the population. "In the decade before World War II, Jews were admitted one by one, and one was too many; blacks were rarely let in the door and, in many elite campuses, women as well. There was a near-exclusion of Catholics, who were stigmatized as people who believed everything the Pope told them to believe and therefore incapable of scholarship" (Neusner and Neusner, 1995, p. 31). Bonner (1986) adds:

> The higher education establishment's credo in 1940 was rooted in early modern Europe, heavily influenced by Protestant denominationalism, and had ridden West with the freer social climate of the frontier. Then, permanently changed by the German research university concept and land grant acts of the late nineteenth and early twentieth centuries, the American university became an amalgam of the German graduate school uneasily joined to the English residential college for the benefit of American students. (p. 44)

Viewing this change from the perspective of Neusner and Neusner (1995): "Heirs of the academic riches of Middle Europe...American universities remade themselves. American disciples then transcended their Middle European masters, the men and women of reason revolted by Germany's descent into racism and irrationality, who, *en masse,* formed the first large body of great scholarship to root itself on our shores, then enriching an already lavish but deeply local intellectual heritage of our own" (p. 21).

The Evolution of the American Research University

Typically, historians date the origins of the American research university as following the Civil War. According to Neusner and Neusner (1995), "scholarship was not necessarily wedded to the university. Good work took place wherever it happened, and no one assumed—in Europe or, surely, in the United States—that the great work in science and humanities would come from the

campus" (p. 39). The authors also noted that many of the greatest ideas of the nineteenth century came from outsiders to the academy: a Viennese doctor, Sigmund Freud; a Swiss bureaucrat, Albert Einstein; and, a German journalist, Karl Marx. However, the idea of a casual scholar was gradually giving way to the ideal of an institution of scholarship, a legacy whose origins began with the nineteenth century German universities (Neusner and Neusner, 1995).

Prior to the nineteenth century, higher education in the United States focused on general, culture and the classics, rather than specialized education. Professors were generally teachers, not researchers. It was not until the late 1860s and 1870s that the genesis of research-based graduate studies occurred: In the late 1860s, Josiah Willard Gibbs, the first internationally recognized American theoretical scientist since Benjamin Franklin, was awarded a doctorate by Yale University, an institution that led the way in establishing the research model of graduate level education. Fifteen years later, the founding of Johns Hopkins University marked the creation of the modern research university and original investigations by faculty were encouraged. It was modeled, in part, on the great universities of Europe, where American students went to German universities to acquire advance education and research that was not available at universities in the United States. In 1902, the Massachusetts Institute of Technology (MIT) developed close links with the American Telephone and Telegraph Company, which provided regular research support; and, in 1908, MIT created the Research Laboratory of Applied Chemistry, becoming the first

academic entity that was dedicated to performing research for industry (Kleinman, 1995).

The evolution of the scientific research and the modern American research university represent key events during the 1940-1960 period: Kleinman (1995) states that as late as the early nineteenth century, scientific research was primarily undertaken in the domain of self-supporting amateurs, having little or no contact with industry, academia, foundations, and the federal government. By the middle of the century, the technical means of discovery and production of scientific knowledge increasingly outgrew the capacity and control of individual scientists, and from this perspective compelled organization and increased controls. Scientists became more dependent on external sources of support; laboratory methods gradually replaced the existing methodology of the times, and the scientists themselves moved from independent laboratories to universities, private industry, and government laboratories.

Neusner and Neusner (1995) argue that a growing social acceptance of the purpose and meaning of higher education contributed to the evolution of the modern research university. State universities, in particular, devoted themselves to particular goals: "In research, this meant an expansion of scholarship in emerging or ignored areas. In teaching, this meant emphasizing relevant and practical matters over theoretical ones" (p. 41). Before World War II, research hardly defined the vocation of higher education in the United States, and even large universities had placed only marginal value upon faculty research and publication (Neusner and Neusner, 1995).

It was during 1940s that "the American university came of age....Still in the thrall of European learning after World War I in most major fields, American scientists and scholars had established themselves at the frontiers of knowledge in virtually all fields by the eve of World War II. This accomplishment essentially took place within the universities, where research and graduate education were expanded in scope and made more rigorous in character" (Geiger, 1997, p. 278-279). The first all-electronic digital computer, for example, was developed at Iowa State University, a land grant university, in 1939 by John Atanasoff and Clifford Berry (Newby, Stepich, Lehman, and Russell, 2000). The university in the U. S. had become "a place where scientists could develop their cultural capital, and the value of this capital became clear to those outside the university when university scientists helped developed technologies used in the war" (Kleinman, 1995, p. 27).

Teaching Apparatuses, Visual Aids,
And the Origins of the Visual Education

As early as 1830, educators began to recognize that new teaching apparatuses could make invaluable contributions to the educational field. Reformers like Mann and Barnard began to require their schools (in Massachusetts and Connecticut, respectively) to report regularly on apparatuses acquired and their use. In fact, in his Second Annual report as Secretary of the Board of Commissioners of Commons Schools in his state, Henry Barnard was

critical of his state for not utilizing teaching apparatuses more effectively (Anderson, 1961).

Although the terms *visual education* and *visual instruction* did not evolve until about 1906, many developments and trends were already crystallizing into a distinctly new movement in American education (Saettler, 1990). Prior to the Civil War, the most common educational apparatuses used were timepieces, maps and globes, slates and blackboards, textbooks, and the abacus or numeral frames. "Most of these apparatuses were extremely simple and required very little engineering in their manufacture. And, though there was knowledge as to the existence of these items, very few found their way into the average school of the times" (Anderson, 1961, p.19).

Visual apparatuses or aids, in terms of their first role in elementary and secondary schools also included field trips to museums—serving as aids for teachers, both inside and outside of the classroom. Such aids included museum exhibits, charts, photographs, illustrations, lantern slides, and maps (Heinich, Molenda, and Russell, 1989). "In America, museums were one of the most significant early influences on instructional media. While this might seem odd, museums have a long history of cooperating with schools and assuring a clear instructional role in their communities" (Newby et al., 2000, p. 317).

This situation gradually improved following the Civil War and the emergence of industrialization across the nation, though the unprecedented technological advances of that era had little impact on education. "Few new instructional implements were introduced. It was mainly a period of polishing and

streamlining what already existed, though mass production methods did lower prices and extend the benefits of existing apparatuses to more areas" (Anderson, 1961, p. 34). During the post-Civil War period, there was a flood of educational publications in the form of journals, reviews, and weeklies. Moreover, states began to publish their own educational journals to keep teachers informed. All contained articles and advertisements from the school furniture and apparatus companies: "Their enticing illustrations and glowing sales claims probably went far in persuading teachers that the newest in educational apparatus was a basic necessity" (Anderson, 1961, p. 35-6).

As early as 1886, the education department of the State of New York had begun, through legislative appropriations of $50,000—a considerable sum at that time—to encourage the concept of visual education in schools throughout the state (Saettler, 1990). In 1904, New York State organized the first visual instruction department, which was responsible for collecting and distributing lantern slides to school districts throughout the state (Newby et al., 2000).

Opposition to new educational apparatuses revolved around issues such as the perception that they were too complicated, nightmares of schools being converted into educational factories where the teacher would be little more than a mechanic manipulating the apparatuses, or that the apparatuses were used more for showmanship, status, or prestige symbols by schools rather than as implements for teaching (Anderson, 1961).

Nevertheless, many had begun to see inherent instructional value in the new media that were becoming available. Saettler (1990) categorizes media advocates of this era into two groups:

> One composed of social workers and a few imaginative educators; the other consisted of commercial producers and distributors of such new visual media as stereographs, lantern slides, maps, models, slidefilms, and motion picture films, who envisioned an extended market for their wares. It was easy to see why the commercial promoters soon christened this new movement 'visual education.' The name was formally declared in 1906, when the Keystone View Company of Meadville, Pennsylvania, published Visual Education, a teacher's guide to Keystone's 600 Set of stereographs and lantern slides. (p. 123)

The Advent of Film and the Visual Instruction and Audiovisual Movements

The film industry began in Chicago, in 1907, when Albert S. Howell, a farmer boy from Michigan who had studied engineering at night, and Donald H. Bell, a movie projectionist, developed one of the first precision film projectors. The Bell & Howell Company designed and built complete systems of photographic equipment that vastly improved upon the popular nickelodeon films and corrected many of the technical flaws for which the early movies had been dubbed 'flickers.' The company also solved another industry-wide problem: standardization. Previously there existed a variety of films sizes; each manufacturer produced equipment in customized sizes. Bell & Howell

standardized their equipment to the 35mm size, coordinating this standard across their line of projectors, perforator, and printing equipment. This coordination found wide favor in Hollywood, which by 1920 all movie studios accepted the 35mm as the movie industry's standard (Dent, 1969).

The first films for instructional uses were usually theatrical films for general purpose or entertainment interest. Later, in the 1920s as the motion picture industry began to expand, it was thought that theatrical films had educational value as well. Otherwise, most instructional films at the time of World War I and afterwards were for industrial, government, and military training. The earliest forms of educational film were the newsreel, travelogues, and scientific motion pictures. "News events and foreign expeditions began to be filmed and travel films were used on lyceum circuits" (Saettler, 1990, p. 96). One of the earliest non-theatrical film companies was Atlas Educational Films, organized in Oak Park, Illinois, a suburb of Chicago, in 1913. The company produced historical motion pictures and launched the Atlas Education Weekly, the forerunners of later documentary films shown in leading movie theaters across the country. In 1912, Herman A DeVry introduced the first DeVry suitcase 35mm motion picture projector. The Victor Animatograph Company, of Davenport, Iowa, introduced a similar product that same year (Dent, 1969).

The use of film in education was brought about by the success and popularity of illustrated lectures on the Lyceum and Chautauqua lectures circuit, and the impetus provided by the effectiveness and extensive use of training films during World War I. An important figure on the lectures circuit at this time was

Elias Burton Holmes, who made two significant contributions to the visual education movement: First, he was an important figure who popularized illustrated lectures and, second, he created the largest and most valuable early source of films that could be successfully used in the classroom. "The adult education movement of this era was an important aspect of the American intellectual life and established the mold of academic respectability for the visual instruction movement" (Saettler, 1990, p. 123-124).

As educators gradually began to recognize the significance of instructional films, an important new movement in American education—known at that time as *visual instruction*—first developed from the mainstream of instructional technology during the period of 1918-1924. During this time frame, the first formal credit courses in visual instruction were offered for teachers at the college and university level, visual instruction journals and professional organizations appeared, and the first systematic visual instruction research studies were reported (Saettler, 1968).

The first school use of motion pictures was in 1910 in the City of Rochester (NY) public schools, where the school board adopted films for regular instructional use (Newby et al., 2000). In 1917, the Chicago school system organized a visual education department; and, in the years following World War I, other large school systems established similar department or bureaus. "Classroom use of films became a symbol of progressive teaching practices, just as the microcomputer is today. In the 1920s and 1930s, the black window shades, silver screen, and 16mm projector lent an aura of modernity and

innovation to classrooms" (Cuban, 1986, p. 12). "Like other media at the time, instructional films were considered aids to teaching rather than self-contained sequences of instruction" (Heinich et al., 1989, p. 18).

In the city school systems, visual instruction usually progressed in three distinct phases: (1) the school museum, (2) organization of slide libraries, and (3) the establishment of film libraries (Saettler, 1990). Almost since the introduction of the visual aids, state agencies established separate visual instruction divisions to support the state-wide use of visual film, publish visual instruction materials, and served as lending libraries for visual materials and a resource for training teachers and administrators. Likewise, university extension divisions offered on-site and correspondence courses and in-service training, sponsored conferences, and published texts and materials in audiovisual education (p. 144). "Some higher education instructors proposed that media such as slides and film delivered information in more concrete, and therefore more effective, ways" (Roblyer and Edwards, 2000, p. 6).

The first official credit course in visual instruction was offered at the University of Minnesota in 1918. Other courses were later established at the University of Kansas and North Carolina State University Teachers College in 1921 (Saettler, 1990). Among the prominent educators to stress the need for incorporating visual instruction in teacher education programs was F. Dean McClusky, director of visual education for Pennsylvania. McClusky urged that teachers be given an opportunity to learn the advantages and disadvantages of

visual instruction through formal and informal training, and that such courses of study should be introduced into normal schools (Saettler, 1968).

"Much of the theorizing behind the methodology of film use was based on the concept that the pictorial is inevitably real, concrete, and meaningful; that is, the film medium not only brought visual reality but added concreteness through the quality of motion" (Saettler, 1968, p. 118). Film was a medium for "breathing reality into the spoken and printed word that stirred emotions and interest while taking up far less instructional time..." (Cuban, 1986, p. 11).

According to Dent (1969), Thomas Edison was reported to have predicted that the motion pictures would one day take the place of most books below the ninth grade. However, Otis W. Caldwell, of Columbia University, differed with Edison's expectation in an article published in the very first edition (January 1920) of SVE's new magazine, *Visual Education:*

> The relationship of visual instruction to reading is fundamental....Motion pictures concerning travel, industry, manufacture, and social and civic situations can stimulate a student's interpretation and understanding of things that are read. Proper visual instruction, therefore, both encourages the use of reading and enhances the intellectual aspects of reading. (p. 22)

Caldwell also expressed a curriculum-coordinated approach to using films in education: "It must be clear that motion pictures will not serve their proper use

in schools unless they are selected and organized with direct reference to the subjects of the curriculum" (p. 24).

At the beginning of World War I, a Committee on Public Information was organized to disseminate information concerning the war activities of the government. During the war, the War and Navy Departments had organized film divisions for the two-fold purpose of supplying informational films to the public and of instructing officers and men in the science of war (Saettler, 1990).

In 1919, the Society for Visual Education (SVE) was created, following months of planning under the leadership of Dr. Forest Ray Moulton, of the University of Chicago. It was backed by Dr. Harry Pratt Judson, the University's president, "who was eager to extend the school's educational facilities to activities that would improve instruction in the schools" (Dent, 1969). In 1923, the National Education Association (NEA) established its Department of Visual Instruction. This department later, in a merger in 1931, incorporated the two existing national visual instruction organizations—the National Academy of Visual Instruction and the Visual Instruction Association (Saettler, 1968). After its reorganization in 1988 as an independent entity, it became the Association for Educational Communications and Technology (Roblyer and Edwards, 2000). The name change was intended to reflect the evolution of the field from visual education to educational technology (AECT, 1977).

Among the factors Saettler (1968) lists as contributing to the emergence of the visual instruction movement include:

- The long tradition of revolt against formalism and verbalism in educational practice as reflected in the work of men like Comenius, Rousseau, Pestalozzi, Froebel, Herbart, and Dewey.
- A growing realization that current instructional practices were inadequate to meet the needs of increased school enrollments.
- The subsequent conviction that film was destined to revolutionize educational practice and it would simultaneously reduce the costs of instruction.
- The success and popularity of illustrated lectures on the Lyceum and Chautauqua circuits convinced many educators that this same instructional technique could be used in the classroom.
- The extensive and effective use of training films during World War I gave an impetus to the new movement. (p. 120)

During the 1920s, teachers were beginning to carry larger teaching loads and, in many instances, had grown dissatisfied with older teaching methods—seeing them as slow, ineffective, and often wasteful. As a result, many educators gradually became receptive to the faster, more direct teaching process provided by instructional motion pictures. On the other hand, there were the teachers who had misgivings about this new technology and feared that motion pictures would bring commercialization into the classroom (Dent, 1969).

The costs associated with visual equipment was another issue: schools had begun to complain that the high cost of projectors had become prohibitive to

the use of motion pictures for teaching purchases. This led to the development of the lower cost, and less bulky, Sellograph filmstrip projector. In 1923, the Sellograph was, in turn, updated by the Arto. Both the Sellograph and the Arto projected still pictures advanced manually from 35mm filmstrips, later called 'Picturols,' one frame at a time. The Arto, however, differed in that it was equipped with a heat filter located between the lamp and the filmstrip, which allowed each picture to remain on the screen indefinitely without damage from the lamp's heat (Dent, 1969).

The "audio" portion of what was soon to be known as the audiovisual movement began soon after the introduction of recorded sound and radio broadcasting. Sound recording was integrated with film during the 1920s (Heinich et al., p. 18). In 1920, the Radio Division of the U. S. Department of Commerce was established and it began to license commercial and educational radio stations. Classroom broadcasting to enhance instruction spread rapidly during the decades preceding World War II (Cuban, 1986).

During the 1920s and 1930s, radio became the focus of a number of educational experiments. Among these was the Ohio School of the Air in 1929, launched in a joint effort by the State of Ohio, Ohio State University, and a Cincinnati radio station. During the same time period, other universities around the country experiment with educational radio. Typical broadcasts included lectures and performances by college bands and orchestras (Newby et al., 2000).

The advent of the sound film in the late 1920s introduced a critical period in the instructional film history. Just as educators were becoming convinced of the educational merits of the silent film, the advocates of sound realized that they would have to fight the old battle all over again to gain acceptance of this new technology, especially since they believed many educators feared that sound would obsolete their silent film equipment. Aside from this battle, the commercial education film enterprises were failing at an alarming rate during the late 1920s and early 1930s as the Great Depression was in progress. "Ironically...commercial instructional film producers seemed to fail just when research findings were emphasizing the particular usefulness of the film as a medium of instruction" (Saettler, 1968, p. 110).

The early years of the audiovisual movement were characterized principally by the formation of professional organizations and distribution. School districts, universities, and state bureaus of visual instruction concentrated on the collection and distribution of a wide variety of visual media. Technological advances were made in the film in terms of film media, projectors, etc. (Saettler, 1990).

The early period in the history of audiovisual instruction came to a close with the advent of World War II, when the audiovisual movement and instructional technology began to more closely align; and efforts to develop self-contained sequences of audiovisual instruction were developed to effectively address wartime preparedness training within the industrial and military sectors during the war (Saettler, 1968).

Section III:

ORGANIZING TO DEVELOP THE NATION'S MILITARY PREPAREDNESS, SCIENTIFIC RESEARCH, AND MANPOWER TRAINING CAPABILITIES

World War II, according to Urban and Wagoner (2000), was destined to have long-range significance on education: "Interestingly, in some respects the World War II years provided more changes for education and educators than the depression years. Yet, these changes, as so often is the case in the history of education, were influenced by external events and forces more than by the premeditated designs of educators or educational policy-makers" (p. 279-80).

Wartime Preparedness Training on the Home Front

A significant change took place in high schools, as the nation prepared for war—particularly as teen-age boys began to enlist in the military and, later, when Roosevelt lowered the draft age from 21 to 18. The phenomenon of youth unemployment that was so prevalent during the 1930s had practically disappeared, as the demands of war and wartime production came to the forefront. Moreover, high schools no longer faced a threat from government agencies such as the NYA and CCC, both of which had disappeared as alternatives for high school aged youth. "To help prepare these boys for military

service, many high schools began offering vocational courses to teach them the skills they would need either in the military or in military-related defense industries. The schools were simply contributing to the nation's effort to fight a war with multiple enemies on several fronts" (Urban and Wagoner, p. 280). World War II also marked the turning point in federal policy toward higher education in several important respects: non-commission and commissioned officer training programs conducted on college campuses, cooperative development of standardized testing, the emergence of education-by-correspondence for military personnel, federal support for university based research; and, student financial assistance for the returning veterans.

Concerning the officer training programs, Hamilton and Laufer (1975) noted that the Army Specialized Training Program (ASTP) was established in 1943 on more than 350 public and private campuses. The purpose of the program, and that of the Navy's V-12 College Training Program, was to send thousands of military personnel to some of the best schools as part of the services' officer candidate training, until the ROTC programs were reestablished again in 1946 (p. 15). Stubblefield and Keane (1994) add that the ASTP and V-12 programs, "along with similar programs, accelerated college education, expanded science and technology courses, and introduced new methods of instruction. In making college education available based on ability and not on social status, the program (sic) had the unintended sociological consequence of democratizing higher education. Because of their experience, many trainees return to college after the war" (p. 242).

Stubblefield and Keane (1994) state that wartime demands on American industries increased the need for training more workers in the sciences and engineering, and more rapid training was required for skilled positions: "Civilian manpower needs were anticipated in June 1940 when Congress made its first appropriation for national defense training. Both the federal government and private industry took initiative to train the civilian work force. The War Manpower Commission, created in April 1942, established policies and regulations to meet the needs of industry and agriculture" (p. 239-240).

The civilian counterpart to ASTP and V-12 military training programs was the Engineering, Science, and Management War Training Program, which gave operating grants directly to colleges and universities to provide "courses of critical importance to citizens" (Hamilton and Laufer, 1975, p. 16). These programs also helped to keep these schools financially solvent at a time when enrollments had dropped due to war-related manpower needs (Hamilton and Laufer, 1975). "In 1942-43, 800,000 men and women took college courses to promote productivity. The courses lasted from three to six months and were usually coordinated by extension and engineering divisions" (Stubblefield and Keane, 1994, p. 240).

American higher education was also instrumental in working closely with the armed services in developing standardized intelligent and achievement tests, given to every man and woman before he or she entered the military. "For the first time, there was documented proof of the poor quality of education administered by the states. Thousands of men were draft rejectees on the basis

of low scores on the entrance exams" (Hamilton and Laufer, 1975, p. 17). Although the United States eventually built an armed forces of approximately 12 million people, the Selective Service also rejected 676,00 men because they had not completed four years of schooling. The Depression had sharply reduced the financial resources available to the nation's public school systems and colleges, exposing the deficiencies in American education (Stubblefield and Keane, 1994).

Though the war brought the aforementioned projects to the larger colleges and universities, most institutions of higher learning suffered during the war—particularly the smaller ones. "The large, prestigious universities had been able to sustain reasonable enrollments by offering draft-deferrable hard science and engineering courses and by housing the mass of student soldiers and sailors whose training brought them to the college campuses with full federal funding to pay their way" (Nasaw, 1979, p. 177).

Although the war entailed difficulties for colleges and universities, according to Freeland (1987) "their extensive involvement in the military effort stirred a new awareness of the social importance of academic work. This 'habit of thought' extended into the postwar period, as educators, exhilarated by wartime patriotism, looked for new ways to contribute to social problem solving. As they did so, they exhibited a further effect of their recent experience: a tendency to focus on national concerns—as distinct from regional or local ones—far more intensively than they had done before 1940 (p. 587).

The Role of Foundations in Supporting Prewar Scientific Research

Prior to the war, "outside of the agricultural research undertaken at the land grant universities, the federal government sponsored little university research. Most nonagricultural research sponsored by the government was undertaken by federal agencies and in federal laboratories" (Kleinman, 1995, p. 29). The prewar scientific research environment provided a context within which the federal research connections with private industry and research universities would soon begin to take place. Several U. S. industries had developed autonomous research capabilities. This defined their interest in pre- and post-war policies that maintained the federal government's support for basic, but not applied, research. Firms from these industries focused on applied research and wanted no competition from government in this area. Instead, they saw a role for government in basic research, which was not directly profitable, but ultimately an important basis for their own work (Kleinman, 1995).

Private industry was a regular supporter of university research during the inter-war years, between World War I and II. However, industry-oriented research did not substantially boost the research capacity of universities, given the fact industry tended to support graduate students in selected fields. Centers for conducting engineering research began to emerge at MIT and the University of Michigan at Ann Arbor. Linkages with universities also became commonplace in the chemical, electrical power, computer, pharmaceutical, and telecommunications industries. Foundations were, in contrast, most influential in

transforming university research: they were recurrent sources of support for the direct expenses associated with conducting research, in a period of time when the pronounced emphasis was the 'collegiate syndrome' of peer pressure, athletics, and extra-curriculum in college life—"giving tangible backing to the academic side of the university" (Geiger, 1986, p. 280).

Absent from the abovementioned university-based research scenarios was the federal government. Prior to the World War I, tuition proceeds helped support research. In addition, ad hoc philanthropy was an important source of research support for private universities and state universities relied on state government funds. Universities initiated fund-raising efforts and among the early supporters were alumni and local communities. Foundations, created by leading industrialists such as John D. Rockefeller and Andrew Carnegie, provided large donations and, as in the case of the University of Chicago, helped to establish new colleges and universities. The exception to the role of the federal government in supporting university-based research was agricultural research at land grant universities. By 1940, of the $13 million of federally sponsored research in universities throughout the country, most of this was provided by the U. S. Department of Agriculture (Kleinman, 1995).

During World War I, the relationship between America's universities and science-based industries and foundations began to take shape and solidify: wartime research initiated at colleges and universities was not financed by the federal government, but rather it was paid for by the institutions themselves or the National Research Council (NRC), operated by the Rockefeller and Carnegie

Foundations (Hamilton and Laufer, 1975). The NRC's creation facilitated the establishment of a "social network between business, science, and foundation elites. This network proved important in defining research policy during World War II and ultimately the postwar period" (Kleinman, 1995, p. 39). For example, the Rockefeller Foundation supported the NRC's fellowship program, and the Carnegie Corporation supported the Council with a $5 million grant for housing its principal offices and an endowment (Geiger, 1986).

Prior to 1920, foundation support centered on research with practical applications consistent with foundation's founding commitment to improving human welfare. Most often this support was made to establish independent research institutes, typically under foundation control. In addition, funds contributed to individual university endowments could be used in any way the recipients desired. In the waning days of World War I, there was a shift in foundation policy toward postdoctoral fellowship programs. These fellowships strengthened the research focus of American universities by giving scientists time away from teaching, thus foundations increasingly targeted their support within universities. Significantly, a million dollar Rockefeller fellowship granted to Ernest Lawrence led to the development of the cyclotron, which played a crucial role in the development of the atomic bomb; and, twenty-three members of the Manhattan Project, in the early years, were Rockefeller Fellows (Kleinman, 1995).

Through the NRC, created by a group of the nation's academic and industrial science elites as a spin-off of the National Academy of Sciences, the

federal government was advised on matters of science and technology. In turn, on the basis of support from the Carnegie and Rockefeller foundations, along with some federal funding, the NRC established a committee that informed universities about projects and problems the federal government was interested in. The NRC was an important force in the war effort. Its strategic military importance is exemplified by its oversight of projects that achieved large-scale production of optical glass, nitrates, and poison gas. The NRC legitimized the concentration of research support in a few research universities and established what would later be an important principle of research by contract: "Contract research allowed scientists to remain at their 'home' universities rather than work in central government laboratory" (Kleinman, 1995, p. 18). For industry, the NRC forged the beginnings of close ties between universities and industry: In the 1920s, firms hired university-trained scientists and technicians, some companies provided university fellowships to expand the scientifically literate workforce, and others hired university scientists as consultants (Kleinman, 1995).

Research relationships mentioned above, that formed before and during World War I, did not fundamentally alter the nature of support for university research following the war and during the interwar years. As was the case prior to World War I, a significant portion of university budgets came from student tuition and fees in private colleges and universities and from state appropriations for public universities. The concentration of research funding to a small number of universities during the war also continued. For example, during the period between 1902 and 1925, the Rockefeller General Education Board awarded

nearly two thirds of its total science grants to just eight institutions—California Institute of Technology, Princeton, Cornell, Vanderbilt, Harvard, Stanford, Rochester, and Chicago. Similarly, the Carnegie Endowment, established at roughly the same time (Carnegie in 1911 and Rockefeller in 1913), followed the same pattern of funneling research funds to a relatively small number of universities. Both foundations saw the emergence of universities as major spheres of scientific research, and their funding of university research shaped postwar research policy making and, thus, the postwar scientific field. The foundations were, in fact, a source of the important precedent of supporting the university by contract (Kleinman, 1995).

The NRC was followed in the 1920s by proposals for a national research fund raised by private industry and used to support university research in basic science. In the 1930s, the Science Advisory Board (SAB), a government-funded but privately-directed advisory board within the National Academy of Sciences (NAS), tried to coordinate federal research activities and promote basic science. When that effort failed, NRC fellowships and foundation grants for pure science were conducted at a limited number of universities. However, an effective solution was not found until June 1940, when President Roosevelt established the National Defense Research Committee (NDRC)—the brainchild of Vannevar Bush, then chairman of the National Advisory Committee on Aeronautics (NACA)—composed of Bush, Karl Compton, President of the Massachusetts Institute of Technology, James Conant, President of Harvard University, and

Frank Jewitt, a top executive at American Telephone and Telegraph Company (Rowan, 1985)

Wartime Research and the Office of Scientific Research and Development

Prior to World War II, the federal government's role in higher education focused primarily on aid and grants made for limited and specific purposes. World War II marked the beginning of a period of expansion in the federal government's involvement in higher education. With the war came the federal government's decision to rely on universities for basic and applied research, and to establish partnerships in developing training programs for armed services personnel. World War II marked the beginning of federally sponsored university based research, largely devoted to defense contracts. In the 1940s, research was entirely a private undertaking with few exceptions. A year prior to America's entry into World War II, the Federal government was spending only $74 million for research and development, conducted primarily in government-owned labs. "The World War II-era decision to rely on universities for basic and applied research had enormous consequences for universities. Only ten institutions could be called research universities in 1940, whereas 125 are today" (Kerr, 1994, p. 31).

Bonner (1986) states that, "the vast changes that crumbled the ivory tower of 1940 were not only unforeseen and unplanned, but were largely unintended

and sometimes unwanted. Educators did not control these developments but were carried along on the swift social and demographic currents that washed over their hermetic little world—the demands of war, returning veterans, international crises, economic growth....While university leaders, by and large, responded intelligently and imaginatively— sometimes heroically—they were never able to delineate with confidence the shape of higher education or determine what it should be. Like the French generals of 1940, they were always too busy plugging the gaps in their defenses from the last war" (p. 44).

The federal government poured money into university research labs and enlisted the aid of university scientists to help with the war and defense efforts. "The federal government and higher education assumed the roles of buyer and seller respectively. The federal agencies bought the services of the universities and their facilities. The agencies were interested in promoting their specific goals, not in advancing the cause of higher education" (Hamilton and Laufer, 1975, p. 16).

The NRC, as noted previously, followed a practice of concentration and contract research during World War I. In the late 1930s, a similarly small group of universities dominated research; and, during World War II, the practice of concentration and contract research would be reinforced by government practices. Of the sixteen universities spending the most on research, all but four were among the top twenty-five non-industrial contractors to the Office of Scientific Research and Development (OSRD) during World War II. Among the elite research universities under contract to the federal government during World

War II, aside from those mentioned previously: the University of California, Columbia University, University of Illinois, University of Michigan, University of Minnesota, Yale University, University of Wisconsin, Johns Hopkins University, Massachusetts Institute of Technology (MIT), University of North Carolina, University of Texas, and Ohio Wesleyan University (Hamilton and Laufer, 1975).

Key to war-related initiatives, and the funneling of research dollars to the universities, was the formation of the National Defense Research Committee (NDRC), the predecessor to the OSRD, headed by Vannevar Bush. "The urgency of developing technology for the war meant that money was not hard to come by for the NDRC, and this significantly enhanced the committee's freedom....By June 1941, the NRDC had signed 207 contracts to forty-one universities and 22 companies. Thus, in one year, the NRDC had become a major player in U. S. war preparations" (Kleinman, 1995, p. 62).

Bush's background, appointment to head this elite vanguard of science, is important to mention at this juncture because of the social capital he amassed within the previously mentioned network of business, science, and foundations. Previously, he spent his early career at MIT working on borderline basic and applied research, applying the theories of Norbert Wiener to the construction of 'machines for mathematical analysis'. This research led to the development of a sophisticated differential analyzer, which is considered a mechanical antecedent to the electronic computer. He later became the dean of engineering and vice president of MIT in 1932, and remained there until he became president of the Carnegie Institution in Washington in 1939. While at MIT, Bush became linked to

the federal administration of science through his role on government boards, such as the Science Advisory Board (SAB) headed by MIT's Karl Compton, to whom Bush reported. SAB was a Depression-era body to provide science advice to government agencies and promote government support of scientific research. Later, he was appointed to the National Advisory Committee for Aeronautics (NACA), which had been created in 1915 to supervise and coordinate American aeronautical research. He became its chair prior to America's entry into World War I. His appointment to the presidency of the Carnegie Institution in Washington in 1939, the nation's largest private research organization outside of the universities, gave him entrée into the highest levels of national scientific research and development policy (Kleinman, 1995).

The NDRC later became a part of the Office of Scientific Research and Development (OSRD), a civilian dominated organization devoted to applying scientific know-how to the war effort and reported directly to the President (Gruson, 1977). OSRD's creation was based on recommendations of a report Bush submitted to the Bureau of the Budget on the NDRC's limitations, and in July 1941, a year after the NDRC was created, President Roosevelt signed an executive order (prepared with the assistance of Bush and Conant) creating the OSRD as part of the Office for Emergency Management. "Scientists gained a kind of autonomy and power of which they could have only have dreamt in the past" (Kleinman, 1995, p. 64-5). Bush became the chair of the OSRD, and Conant succeeded him in the NDRC (England, 1982).

Bush's OSRD group subcontracted specific projects to campus-based scientists, who continued to work in university laboratories (Freeland, 1997). Essentially, it followed the same standard as the NRC in terms of providing research funds under contract for specific projects to an elite, concentrated group of research universities; and, one that allowed scientists to undertake the research at their home universities (Kleinman, 1995). "In making these agreements, the committee was given complete latitude, including the freedom to promote projects that were neither requested nor desired by the military. This, of course, set a precedent for the ultimate project of Bush's scientific vanguard: to assure scientist control over government resources for research" (p. 62). According to Lomask (1975), President Roosevelt took "an active and personal interest in the OSRD's activities and problems. Indeed, Vannevar Bush's easy access to the presidential ear was one of OSRD's greatest assets" (Kleinman, 1995, p. 39).

OSRD cooperated with the military but was not controlled or dominated by it. Its mission was to contract with university laboratories for scientific products and services, and do this in such a way as to minimize the scientists' fears of government intrusion into scientific and academic freedom, except in instances when secrecy was required. Vannevar Bush, James Conant, Karl Compton, and Frank R. Jewitt were key leaders in the drive to mobilized the nation's scientific community under the direction of the OSRD: "The response of the university scientists was quick, and the application of highly sophisticated knowledge and manpower, working relatively free from governmental 'control', had spectacular

results. The atom bomb, radar, the proximity fuse, and sonar, were the most highly publicized among scores of other scientific and technological innovations" (Gruson, 1977, p. 4). Of special note here is the federal government's practice of using civilian scientists on a part-time basis to serve on government committees and policy boards. Therefore, Bush was able to retain his full-time position at the Carnegie Institution, Conant at Harvard, and Compton at MIT. Not surprisingly, the largest amount of funds allocated to any university was granted to MIT, where Bush had been vice president. Harvard, where Conant was president, ranked third; and, the Carnegie Institution was in the top fifteen non-industrial recipients (Kleinman, 1995).

Given the OSRD's success, President Roosevelt appointed a cabinet-level committee, the President's Scientific Research Board, to consider the federal government's future interest in scientific work. One of the committee's principal recommendations in its 1947 report was to "propose a National Science Foundation (NSF) to administer federal grants for basic research and channeling support to university-based investigators" (Freeland, 1997, p. 588). "Franklin Roosevelt's decision early in the war to heed Vannevar Bush's advice and use the talent and facilities of the universities, rather than build separate laboratories, for war research resulted in a vastly expanded university capability in science, a national commitment to basic research on a newly grand scale, and such government-university partnerships as the National Science Foundation" (Bonner, 1986, p. 45-47).

The consequences of the OSRD's success after the war were several. First, the military services recognized that support of basic science could have large 'pay offs' for them. The Department of Defense and the Atomic Energy Commission became major supporters of basic scientific research in universities after the war. Second, after considerable political debate, the National Science Foundation was created in 1950. "For the first time the nation had a governmental agency the primary purpose of which was to support basic scientific research. In the main, the National Science Foundation has prospered without resorting to the principle that projects meriting its support serve an immediate national purpose" (Gruson, 1987, p. 5).

A third consequence of the OSRD's success is that by the time the NSF was established, the influence of federal support was so pervasive that, for example, ninety percent of natural science research in the United States was funded by the federal government. Another important facet of the NSF's mission is to provide graduate fellowships and scholarships, further strengthening graduate education on the nation's college campuses and improving science education. Together, the NSF, the Atomic Energy Commission, the Department of Defense, and the Public Health Service "provided the bulk of grants and scholarships for the next fifteen years. The allotment of funds was limited to a few select institutions" (Hamilton and Laufer, 1975, p. 22).

Finally, OSRD research led to advances in blood substitutes and immune globulins to combat infections, penicillin production (which was central to saving lives on the battlefield), brought malaria under control, the development of the

atomic bomb, gun-fire control systems controlled by radar technology, proximity fuses, allowing detonation of artillery shells at a distance calculated to do the most damage, and other projects (Kleinman, 1995).

Wartime research also dramatically changed the rate of technological progress in information processing. During the war, desktop calculators (adding machines) were used in the design and operation of military equipment. Punched card equipment was used, for example to maintain records of people inducted into military service, mobile punched-card units followed them into battle to identify those with special skills and to record injuries and deaths; punched card units controlled the flow of production in defense plants and the flow of military supplies; and, it was used (along with electronic vacuum tube computers) to decipher enemy codes and to design the first atomic bomb. Through the Naval Computing Machine Laboratory in Dayton, Ohio, electronic equipment for decrypting enemy codes during the war led to the development of the first high-speed storage device in the form of a magnetic-drum storage unit, leading the way toward stored programmed computers. "Government leaders responsible for developing new technologies for national-security purposes put major emphasis on electronic computers in the immediate post-World War II era. The timing was good. Competing requirements for other types of military electronics had been reduced by the cessation of hostilities" (Pugh and Aspray, 1996, p. 7-10).

Preparing for War— Military and Industrial Manpower Training Programs

During the years immediately preceding and during World War II, two federal agencies working in cooperation with the nation's educators, began to develop training techniques and visual aids that would positively impact the gradual emergence of instructional technology: the U. S. Armed Services Institute and the U. S. Department of Education's Division of Visual Aids for War Training. The first of these, the U. S. Armed Forces Institute (USAFI), headquartered in Madison, Wisconsin, served twelve million military personnel on active duty, providing these men and women "the most extensive adult educational program in our nation's history....Here was an experiment in the education of adults without parallel in any civilian undertaking. Never before in history had such a vast program of education and information been made available to a comparable group of American citizens" (Houle, Burr, Hamilton, and Yale, 1947, p. 1).

In every major war in the nation's history, civilian welfare groups provided recreation, entertainment, and some literacy skills development activities for soldiers. The Commission on Training Camp Activities coordinated these activities, with the backing of the War and Navy departments, during World War I. The Commission was headed by Raymond B. Fosdick, President of the Rockefeller Foundation, and its creation based on his report to the Secretary of War regarding the poor morale of Army units stationed along the border with Mexico. The commission itself was a loose confederation of welfare groups such

as the YMCA, YWCA, the Knights of Columbus, Jewish Welfare Board, and others: "The groups had military recognition and cooperation, but depended on public contributions for financial support....During World War I, it became clear that the existing arrangement was not satisfactory" (Houle et al., 1947, p. 14; Strehlow, 1967, p. 15). Limited resources were invested in a soldier's education by the military, other than the science of war (Brown, 1944).

The dissatisfaction regarding the current arrangements prompted the Army to back a postwar education plan, proposed and, at first, largely financed by the YMCA. Later, the YMCA officers involved with administering the plan were transferred into an Army Education Corps. The plan become known as the Education and Recreation Program, and was active for a short while following World War I in Army camps across the United States. The program was curtailed, following the war, due to the drastic cutback in Army appropriations (Strehlow, 1967).

When the Mobilization Regulations of October 28, 1939, were developed, morale was defined in terms of physical welfare (e.g., food, leaves of absence, discipline, and recreation) and a committee—composed of civilian and military experts in welfare and community-service activities—was appointed to advise the Secretary of War on these matters. This committee was also expanded at the direction of the President to include the Navy and Marine Corps, and became the Joint Army-Navy Committee on Welfare and Recreation. It was this committee that was instrumental in fostering the USO, a joint endeavor between the Army and the Red Cross. The regulations proposed by the committee were put into

effect in mid-1940 (Houle et al., 1947; Strehlow, 1967). In 1941, as proposed by this special committee, the Army began to assume responsibility for soldiers' morale by establishing a Morale Division as part of The Adjutant General's Office. This division included the following units: Army Motion Picture Service, Recreation and Welfare, War Department Exhibits, Decorations, and Morale Publicity. The significance of the Morale Division is that it developed and established the first network of educational and recreational facilities "which became familiar to every soldier in every post or camp in the United States and overseas" (Strehlow, 1967, p. 20).

In 1942, the Morale Division was renamed the Army Institute and located in Madison, Wisconsin. Initially, the programs that were developed placed emphasis on study by mail on the principles of 'leisure time self-teaching', aimed at military personnel who had been in the service for four months or longer. Their purpose was to provide a resource for service men and women to further their education or to make profitable use of their leisure time (Poste, 1944).

In July of 1943, the Army Institute was reorganized as the USAFI. Through it and the Army Education Program, under the overall directorship of the Army's Adjutant General, formal literacy programs were introduced. These programs included correspondence courses (in cooperation with some of the nation's leading colleges and universities) for soldiers at training camps and military installations, leisure time activities, counseling, and foreign language training (Strehlow, 1967). Approximately eighty-five American universities cooperated with the USAFI in providing correspondence courses, and many

more civilian schools and colleges made it possible for service personnel to apply for academic credit for the various types of service related education courses and experiences. Instructors were obtained from local military and naval personnel, and supplemented by educators from nearby school systems, business communities, colleges, and universities (Houle et al., 1947).

Aside from military preparedness training, World War II brought an unprecedented need to train millions of industrial workers as rapidly as possible to support the war effort. It was the U. S. Department of Education, under the leadership of Commissioner John W. Studebaker, which would assume the major burden of meeting this enormous challenge. In 1941, the Department formed the Division of Visual Aids for War Training with Floyd E. Brooker as director. Previously, Brooker was an associate director of the American Council on Education's (ACE) research studies in the area of instructional technology and had gained significant experience and expertise in instructional film production (Saettler, 1968). When the War Manpower Commission was created in 1942, a Bureau of Training was later created within the Commission to coordinate the work of the Apprenticeship Training Service, the Training Within Industry Service, and the War Training Programs of the U. S. Office of Education (Stubblefield and Keane, 1994).

Wartime Instructional Design and Development, and Media Technology

The development of instructional technology and the use of media in America's schools slowed down during the war years, because of a lack of

materials, equipment, and instructional specialists. Conversely, a period of expansion began in the industrial and military sectors (Saettler, 1968). With the war threat a reality as a result of the surprise attack on the Navy's Pacific fleet at Pearl Harbor, airplane factories were hastily constructed and soon turned out 10,000 planes a month. Shipyards were constructed across the country and private American industries converted to war production— automobile factories turned to the production of tanks and other vehicles, factories that had produced typewriters or vacuum cleaners began to turn out machine guns and ammunition, During the course of the war, the U. S. was able to produce approximately 297,000 planes, 86,000 tanks, and nearly 12,000 ships (Dent, 1969).

Newby et al. (2000) suggest that the war "gave a big boost to the field of instructional design. The need to rapidly train tens of thousands of new military personnel created a heightened interest in applying educational research in a systematic way. Many educational researchers participated in the war training effort, and this helped to propel forward systematic efforts to design instruction. During the war, the fruits of this effort were seen primarily in increased use of educational media to train military personnel" (p. 317).

Instructional technology was recognized by the armed services as holding important implications for military training and readiness. During World War I, the Army and Navy had introduced training films and had begun to establish procedures for the instructional uses of such media as slides, filmstrips, and models. Civilian educators exerted the dominant influences in the character of military training programs: many had previously conducted experimental

research on instructional media and had developed various forms of instructional technology. They were grouped with artists, communications specialists, advertising personnel, and theatrical and motion picture professionals to develop a technology of instruction applicable to military needs. Military direction provided stability and continuity in the training programs. "There had been recognition in the armed services prior to World War II that instructional technology held important implications for military training....The urgent and rapid expansion of military training due to World War II created a new demand for training materials" (Saettler, 1968, p. 166).

World War II provided a new dimension and enormous challenge due to urgent and rapid expansion of military training, which in turn created a tremendous demand for training materials. In the process, the armed services experienced many problems in addressing this challenge during the first eight months following the nation's entry into the war. Instructional equipment was generally obsolete or lacking, and instructors were often inadequately trained and inexperienced, and frequently failed to use what visual media that was available at the appropriate time or in effective ways. Scarcity of adequate equipment and instructional materials was commonplace, and the demand was sudden and nearly overwhelming. Therefore, military schools and instructors improvised a number of instructional devices for use in their training programs, resulting in a lack of uniformity until standardization began to be implemented in 1943 (Saettler, 1968).

Instructional media and materials used by military included projected motion pictures, graphics (illustrations and cartoons), posters, sound, and charts— supplemented by manuals, self-instructional devices and materials, handbooks, bulletins, and other training related literature. To more fully utilize the usefulness of films for both experienced and inexperienced instructors, a visual film unit was produced consisting of the motion picture film, a silent filmstrip correlated with it, and instructor's manual. Each unit in a series was considered to be the equivalent of a lesson, based on the specific tasks or subject matter to be learned (Saettler, 1968).

"When World War II began, the use of educational films was made a part of the official policy of the War Department, the effect of this policy was that the armed forces produced more than six times the number of films than had ever been produced before for educational purposes. Moreover, the demand for training millions of industrial workers as rapidly and effectively as possible brought about a historic production of educational films for training purposes" (Saettler, 1968, p. 114). Educational films and other media became an integral part of the training effort for the war. Heinich et al. (1996) document the following:

> During the war years, the U. S. government produced over 800 training films and filmstrips, purchased tens of thousands of projectors, spent about one billion dollars on training films, purchased over 55,000 film projectors, and produced 457 training films at a cost of over a billion dollars during the war. This rapid deployment of large quantities of

> mediated instruction certainly influenced the field and contributed to the perception that media can be very useful for educational training. (p. 24)

One training device that was especially popular was the filmstrip projector. For example, the filmstrip was the medium that answered the demand for a fast, efficient, mass training of mechanics to serve in industry and the military—becoming the ideal, fast, and indispensable tool for training. The motorization of America's mushrooming armed forces, and the sustaining of its numerous mechanized units, required more than a hundred thousand mechanics (Dent, 1969). Another useful device was the microfilm reader, which had been in production since 1938 to preserve important records and duplicate library materials in such a way to save valuable storage space. These readers were used by the U. S. military and by industries for research and testing purposes during and after the war (Dent, 1969).

The worldwide Armed Forces Radio Network with 177 Army and Navy stations, 54 government and commercial stations, and 149 sound-reproduction systems was also instrumental in wartime training efforts. Each week 77 popular American radio programs were transcribed for the entertainment and information of armed services personnel. The Army itself—with the help of famous stage, screen and radio stars—produced 15 program hours every week; and, some 66,000 transcriptions were completed and distributed overseas for rebroadcast every month (Houle et al., 1947).

Among the training aids designed and produced during the war was the aircraft recognition program, initiated at the Ohio State University and developed in cooperation with the editors of *Flying Magazine*. This program involved the manufacturing of tens of thousands of 2" x 2" slides, produced from photos of American and allied aircraft, as well as the aircraft of enemy nations, to teach military personnel to instantly recognize enemy planes and distinguish between friendly and unfriendly aircraft. The slides were projected onto a screen by a projector equipped with a camera shutter device. This machine became known as a tachistoscope. Another wartime program involved the development of a bomb-spotting trainer, used to train and grade the efforts of a plane crew's bombing efficiency (Dent, 1969).

Numerous training aids that were developed during the war, later found use in the civilian sector following the war. Among these one can include the Link trainer, which provided a cadet pilot with a moving view of the earth accompanied by realistic sounds of aircraft on recordings; mockups, exhibit rooms, and 'breadboards' of simulated maps, equipment, battle front layouts and equipment operation. Audio recording and playback devices were especially prominent in foreign language training (Saettler, 1968). Another device, the Viewgraph was designed and manufactured by a company of the same name. This early version of the overhead projector replaced the clumsy opaque projectors that were in use prior to the war, and was used by the Navy for map briefings and instruction. The Viewgraph was considered as being more practical

than opaque projectors because notes could be written directly on Viewgraph's material (Heinich et al., 1996).

One important wartime development that directly influenced educational policies during the postwar period was intelligence testing. Intelligence testing has its origins in the Progressive Era of American education and was used in World War I, by the Army and the American Psychological Association, to develop group intelligence tests as a means to identify appropriate candidates for officer training school and screen recruits to determine their mental capacities to handle the demands of military service. These developments continued throughout World War II, and their successes led to the development of standardized testing products that were designed to be used in the nation's schools to measure the educational potential and achievement of students (Urban and Wagoner, p. 234). After the war, the testing and assessment programs that were developed out of joint efforts of the U.S. Armed Forces Institute, the U. S. Office of Education and the ACE led the way to the formulation of the present General Education Development (GED) program in 1956. This effort laid the groundwork for the statewide equivalency degree ultimately developed in all states, and the basis of Federal and state commitments to adult education through preparatory programs linked to the GED (Rose, 1994).

World War II was also instrumental in the evolution and development of visual aids as an instructional media. The widespread use of this media to accelerate military and industry training during the war "brought to the public after the war an influential endorsement of the teaching value of visual aids....In

the minds of the men and women who had trained or been trained during the war, a general sentiment regarding teaching methods pervaded: visual aids can teach more people more things in less time" (Dent, 1969, p. 99).

Meanwhile, thousands of men and women with wartime visual aids training experience, whose educations had been interrupted by the war, returned from overseas and took advantage of the educational opportunities provided by the Servicemen's Readjustment Act of 1944, better known as the GI Bill of Rights. In a 1945 article published in the SVE *Visual Review,* S. A. Mckay, who had been director of the Visual training Program for the Royal Canadian Navy expressed his concern regarding the new set of demands on postwar educational methods by the large ranks of returning military service personnel. In the article, MacKay warned educators that many traditional methods of high school and college lecturing had been outdated by war training techniques and procedures. He predicted that returning military veterans would insist that they receive an education in the modern way with lectures and textbooks amply augmented by visual aids: "Many of these young men and women have been trained by the streamlined methods of the services, and they will not have patience with any method of teaching that does not provide the maximum of learning in the minimum of time" (Dent, 1969, p. 100).

Section IV:
SIGNIFICANT POSTWAR INTERVENTIONS IN HIGHER EDUCATION AND SCIENTIFIC RESEARCH

Even as World War II waged in Europe, Africa, and later in the Pacific—its favorable outcome for the U. S. and its Allies far from being certain—Congress and President Roosevelt began to initiate plans for two major legislative bills that would have significant social, economic, and political impacts on the nation. The first concerned the postwar adjustment for America's returning veterans, and an attempt to advert unemployment and dislocations following the war. This legislation, the Servicemen's Readjustment Act, was signed into law by President Franklin Roosevelt on June 22, 1944. The second was intended to continue the federal government's role in the sponsorship of scientific research and science training. Continuing the wartime achievements in science and technology was considered as crucial to the postwar economy and to winning the Cold War competition with the Soviet Union. The end result of this legislative process came in 1950, in the form of the National Science Foundation Act.

Early Planning for the Return of America's War Veterans and Demobilization

Even as the nation simultaneously trained and prepared for war during the 1940s, the image of servicemen returning home after the war increasingly

became a political issue. Many history texts cite the fear of the potential adverse impact that returning servicemen would have on the economy as the primary justification for passage of the GI Bill of Rights of 1944. Although this is true, the reality is that plans were in the making as early as 1940 to prepare for the return of World War II veterans. World War I and the plight of its veterans were, in part, the impetus for early planning for the return of WW II veterans (Olson, 1994).

The individuals and organizations responsible for planning and sponsoring the GI Bill legislation were mindful of, and respectful toward, the past. The past provided ominous lessons: America had traditionally granted postwar benefits to able-bodied veterans, except after World War I (Olson, p. 18). A postwar bonus for World War I veterans would be paid only after a march on Washington, where two veterans and two children died after soldiers commanded by General Douglas MacArthur stormed the parade to disperse the protesting veterans (Bennett, 1996). "It was the first instance in which ordinary Americans marched into Washington to demand benefits to which they thought they were entitled" (Bennett, p. 67).

The bitterness and disruption following the release of World War I veterans into an economy jolted by the shift from war to peacetime production; memories of the Depression of the 1930; the riots in other countries after the end of World War I; and, the role that unemployed European veterans had played in the rise of fascism and Hitler and his Brown Shirts—all evoked an additional element of fear in the minds of many Americans (D. E. Johnson, 1970). "After the conclusion of World War I, the U.S. went through almost three years of

ethnic, racial, and labor-management strife before normalcy returned" (Bennett, 1996, p. 4). "One did not have to be a very astute student of history to realize that returning veterans without jobs could become a revolutionary mass just waiting to explode" (Nasaw, 1979, p. 173).

Therefore, prior to the nation's entry into World War II, plans were being developed for the post-war adjustment of service personnel and the conclusion of the war. In 1940, the Educational Policies Commission' report on Education and Economic Well-Being in American Democracy designated longer secondary education, in junior and senior high schools, as the vehicle for prolonging the average period of schooling in the United States. These recommendations were not made solely in the name of education, but also as an instrument of manpower readjustment. "Advocates of manpower readjustment envisioned educational institutions as both training grounds and holding places. The prolongation of education would delay labor market entry and thereby check unemployment in the wake of postwar demobilization" (Kett, 1994, p. 416).

The "best solution" to this unemployment problem, according to Nasaw (1979), would have been to guarantee employment for returning veterans: "The Selective Service Act of 1940 attempted to provide the first draftees with such a guarantee, requiring employers to rehire at the same rate of pay, in the same position, workers who had gone off to war. The postwar planners would have been only too happy to guarantee work to all veterans. But they knew better. There were simply not enough jobs to go around, nor could enough be created to put all the demobilized soldiers back to work (p. 174).

In anticipation of a great influx of returning veterans into higher education after the war, educators strongly voiced the concern that the GI Bill legislation would "open postsecondary education to a floodtide of unqualified students and consequently depress academic standards" (Moorefield, 1974, p. 25). Educators worried that among those who took advantage of the GI Bill's educational benefits, many would be veterans who previously had no hope nor intention of going to college. James Conant, president of Harvard at the end of the war, thought that the bill was a mistake. He felt that it did not "distinguish between those who can profit most by advanced education and those who cannot" and could bring the "least capable among the war generation" into the colleges. Others worried about the ability of older men with obsolete education credentials to be successful in college (Bonner, 1986, p. 46).

The American Council on Education (ACE), with funding from the Carnegie Corporation, undertook several studies when it established the Commission on the Implications of Armed Services Educational Programs. One result of the studies was a recommendation by the Council that an accreditation program be established. Its purpose would be to assess the knowledge and skills that servicemen and women had acquired through the USAFI training and correspondence courses, and to assist the military in assessing the educational significance of military experiences. "Accordingly, the University of Chicago developed end-of-course tests, examinations to determine proficiency in subject matter, and examinations to determine returning veteran's level for future schooling. In 1944, the ACE published A Guide to the Evaluation of Military

Experiences in the Armed Services, a handbook for civilian educators describing military courses and recommendations for credit. Accreditation was important for higher education officials and veterans alike because it accelerated veterans' progress in postwar education" (Stubblefield and Keane, 1994, p. 245-6).

As events during the war turned in favor of the Allies late in 1943, D. E. Johnson (1970) notes that the nation's politicians began to seriously contemplate the return of millions of war veterans and the potential impact they would have on the economy, particularly when one considered the sheer number of returning veterans. "Fearful of the untoward consequences of a massive influx of new workers into the economy, the President, Congress, the American Legion, and the American Council on Education considered early in the war how to reintegrate veterans into American society. On June 22, 1944, President Roosevelt signed into law the Servicemen's Readjustment Act, popularly known as the GI Bill of Rights" (p.226).

A Bill of Rights for GI Joe and Jane...and the Nation!

"It was called the GI Bill of Rights because 'G.I.' was the catchall name for enlisted men and women in the American military forces of World War II, an abbreviation of 'general issue', the name for all standard equipment, clothing and weapons" (Bennett, 1996, p. 22). The American Legion originally coined it "a Bill of Rights for GI Joe and Jane" (Bennett, p. 90).

The GI Bill of Rights of 1944 represents one of the most lasting, significant and radically empowering Federal legislative actions in the twentieth century.

The centerpiece of this legislation was the unemployment relief, often referred to as the 52-20 Club, the weekly payment of $20 for fifty-two weeks to veterans who could not find jobs in the first year following discharge from the service. The bill also included incentives for veterans for home and farm mortgages, business loans, job counseling, insurance, pensions, medical benefits, education, and mustering-out pay. Aside from these benefits, the original GI Bill fully subsidized education or job training for over 7.8 million World War II men and women veterans, making higher education and career oriented training a realistic expectation rather than an impossible dream for many. This legislation supported various forms of education that ranged from adult literacy classes, high school completion, and college and university education, to professional and vocational training (Moorefield, 1974; Bonner, 1986).

Veterans were eligible for education benefits if they served for at least 90 days of active duty, and received other than a dishonorable discharge. They were entitled to a maximum of 48 months of training, depending upon the length of service. The Veterans Administration (VA) paid the schools veterans attended a maximum of $500 a year for tuition and other costs. In addition, married veterans received a $65 / month allowance and single veterans, $50 (Rose, 1994). One requirement of the bill was that in order to qualify for schooling, veterans must be 25 years or younger. Veterans who entered the armed services beyond the age of 25 years were limited to one year of schooling, unless they could demonstrate that the war had interrupted their education. The

age restriction was removed by an amendment to the bill in December 1945 (Kett, 1994).

Most colleges and universities altered their admission policies to admit non-high school graduates and provided "catch-up" help on campus. However, this generosity was based on the assumption that few veterans would take advantage of this opportunity to enter college after the long interruption to their education caused by the war (Bonner, 1986). "No one really anticipated the huge numbers of veterans who made use of the GI Bill. This flood of returnees entering schools and colleges brought new meaning to the notion of equal educational opportunity" (Urban and Wagoner, 2000, p. 282). "In March 1945, Earl McGrath, a World War II veteran and a dean at the University of Buffalo (and later U.S. Commissioner of Education), analyzed three wartime studies of veteran's attitudes toward higher education and concluded that in no coming academic year would more than 150,000 veterans become full-time students in colleges and universities" (Kett, 1994, p. 417).

In reality, veterans flooded into the nation's institutions of higher education. "Rarely have educators had so pleasant a shock as in the years following the war" (Bonner, 1986, p. 46). Of a veteran's population of 15.4 million, the original GI Bill fully subsidized education or job training for over 7.8 million (or, 50 percent of) the former World War II service personnel. Of that number, over 2.2 million of them attended colleges and universities. The total cost of the program was $14.5 billion (Rose, 1994). "Tuition fees almost doubled in many cases; state colleges and universities were allowed to charge all

veterans out-of-state tuition to help pay for the added cost caused by the massive influx of students. Colleges and universities had to absorb the overhead costs of veterans' offices which handled the administrative 'red tape' created by the G. I. Bill" (Hamilton and Laufer, 1975, p. 16).

GI Bill legislation made higher education and career oriented training a realistic expectation rather than an impossible dream for many. Two years before WW II began, approximately 160,000 students graduated from colleges and universities each year. Clark (1998) suggests that veterans, like most Americans during the prewar years, were initially skeptical of the benefits of an education "unless it paid dividends or was somehow practical". Therefore, veterans did not begin to descend en masse on the college and university campuses until the 1946-47 time period; and, "only then did the public and the media become infatuated with the GI Bill Phenomenon" (p. 174).

The peak enrollment year was 1947 when veterans accounted for 49 percent of U.S. college and university enrollments, and in 1950 the annual graduation rate soared to nearly 500,000 (Bennett, 1996). Seventy percent of all male college students in 1947 were GI Bill veterans (D. E. Johnson, p. 227). "The fresh faces came in droves, attracted by the blank-check promise of a free college education" (Neusner and Neusner, 1995, p. 52).

Although the surge of veterans into higher education caught most planners off guard, Kett (1994) states that the near doubling of the proportion of 17-year-olds that graduated from high school during the 1930s in a sense had prepared the way. Among these graduates were those who had intended to

attend, or had entered, a college or university after graduating from high school; in the wake of Pearl Harbor, their plans were thwarted when President Roosevelt lowered the draft age from 21 to 18. Moreover, many whose high school experiences were interrupted by the war rejected the notion of returning to high school to take evening classes. Instead, many opted for higher education—particularly those who had been assigned to college campuses during the war to take specialized military courses or correspondence university courses through the United States Armed Forces Institute (p. 418).

The GI Bill and the success of adult students now attending college prompted a change in the nation's thinking regarding access to higher education, who should attend, and the mission of college curricula nation-wide. First, the GI Bill gave an enormous push to the long-term movement from a mostly elitist form of education before the Civil War, through the land-grant movement, and then toward universal access following World War II. Universal access meant moving from a mostly elite and upper-middle class access before the war, to one that was characterized by access by all economic classes after the war— making the U.S. one of the first nations ever to provide universal access to higher education. Half of the students who used the GI Bill came from families in which neither parent had gone to college (Kerr, 1994).

According to Neusner and Neusner (1995), many university leaders felt the elite universities "should take advantage of rising enrollments not by expanding their campuses, but by making them more meritocratic. This, they argued, would have improved not only their status, but their capabilities" (p. 53).

For example, James Bryant Conant, president of Harvard from 1933 to 1953, suggested in 1948 that universities ought to define their task only in terms of teaching the most prominent, leaving the less promising students to community colleges. While this may come across as elitist, Conant's approach anticipated an event which never came during the postwar boom years: "that a severe space crunch at the university level and an economic downturn driving down the demand for college-educated citizens...Conant's approach underscored a larger movement in American society...a movement away from higher education for the elite and a growing appreciation for the naturally gifted" (p. 55).

Second, the question of who should attend college: This question was answered by the large influx of veterans taking place at a time when "higher education was basically inhospitable to the adult student, and the possibility of millions of adult veterans descending on the nation's campuses was daunting" (Rose, 1994, p. 47). As noted previously, some educators had feared that the adult veterans would be a disruptive force and would not succeed in college, given their age and obsolete educational credentials. Instead, most veterans were hardworking and mature, and their grades soon surpassed those of their younger classmates—changing forever the perception of adult students. Therefore, contrary to the fears of the prominent educators of the day, "academic levels did not fall; in many cases, they mounted. Older students uncovered a will to study found in only the most serious of their younger classmates" (D. E. Johnson, 1970, p. 227). President Conant of Harvard referred to the veterans as

being "the most mature and promising students Harvard has ever had" (Bonner, 1986, p. 47). Neusner and Neusner (1995) write:

> The GI Bill brought a changing campus an entirely new kind of student—middle class, not just upper class; Catholic, not just Protestant; children of immigrant parents, not just children of long-established migrants. And the campus presented a curriculum able to encompass the new classes of students, not class-indoctrination in the knowledge, possession of which would signify high class status (Latin, for example), but the education of citizens able to ask tough questions—and answer them. (p. 45)

And, there were the married students: Prior to WW II, many colleges prohibited enrollment by married students (Greenberg, 1994). Yet, over 50 percent of the veterans attending college after the war were married, and of these, half had one or more children while in college (Bonner, 1986).

Third, there was a significant reordering of higher education's mission. Historically, higher education had concentrated on the traditional professions of medicine, law, the ministry, and teaching. Following World War II, emphasis was instead placed on 'high-level, occupational training'—management, engineering and technical education. Kerr (1994) elaborates:

> This was in response not only to student interests, but also to long-term changes in the labor force. Jobs defined as 'professional, managerial, and technical' increased from about 12 percent of the labor force in 1947, to 20 percent in 1970...Many new middle-class occupations were being

> created, and the GIs and their successors pursued them....However, some other missions were comparatively neglected, including liberal learning within a constructive environment for developmental growth, pure learning, and evaluation of society. (p. 29).

The GI Bill also had an unexpected benefit to American society: adult education. "Adult education prior to World War II had been confined primarily to minor avocational fields such as music appreciation, traveler's French, etc. Through this bill, adult education became the precursor of the Federal government entering the general field of education— opening the way for later Federal aid and intervention initiatives. The GI Bill comprised an entirely new approach to adult education" (Pacacha, 1976, p. 11).

D. E. Johnson (1970) credits the GI Bill with catalyzing the development of adult and continuing education, and it paved the way for the lasting and significant Federal involvement in U.S. adult and higher education. "The realization that mature people could enjoy and succeed in a more serious type of instruction brought about the great boom in adult education today" (p. 228). More importantly to adult educators—for a few years, at least—adult education moved from the margins of education to the center of education's concerns. Issues raised during this period gave new importance to the field and raised expectations about its future direction and impacts. The influx of older students on the nation's college campuses validated the premise that adult students could learn. In fact, the older students often out-performed more traditional students

and made fewer demands on college administrators (Rose, 1994). "Veterans in college removed the stigma on married students, encouraged business and technical studies, made the federal government a presence on campus for the first time, and made the crowding of thousands of students into large campuses a practical reality" (Bonner, 1986, p. 47).

Following the war, President Truman established the President's Commission on Higher Education to study the national needs for higher education. This committee drew heavily on higher education's experiences with the returning veterans. The commission's 1947 report called for a huge peacetime program of help for college students, and recommended the doubling of college enrollments by 1960, locating community colleges 'close to the people', and providing generous scholarships to offer opportunity and access—encouraging every citizen to pursue education, both formal and informal, to the greatest extent possible according to one's capacity. "For the first time in the world's history an important public body had urged the extension of mass education to the university level" (Bonner, 1986, p. 47).

Freeland (1997) states the most controversial of the commission's (also known as the Zook Commission, headed by Dr. George Zook, president of the ACE) recommendations concerned the extension of mass education to the university level such that by 1960 49% of the country's eighteen to twenty-one year-olds would receive at least two years of college and 32% would attend postsecondary schooling for a full four years: "While arguing that these proposals were consistent with recent trends and responded to needs made clear by the

veteran's program, the commission recognized that its ideas would appear to be revolutionary to many Americans. Less than 16% of the college-age population was receiving an advance degree in 1940 (p. 591).

The Zook Commission justified its recommendations on two grounds: First, it pointed out that current enrollments were artificially depressed by nonacademic barriers, including finances, regional variations in opportunity, and discrimination against religious and racial groups, especially Negroes and Jews. These inequities, the commission argued, "denied the nation the full talents of many citizens...The commission also criticized universities for focusing excessively on 'verbal skills and intellectual interests' and for ignoring 'many other aptitudes—such as social sensibility and versatility, artistic ability, motor skills and dexterity, and mechanical aptitude and ingenuity" (Freeland, 1987, p. 591-2). The commission also criticized the universities for past tendencies to stress specialized academic studies rather than fields of study relating to the national interest (p. 596). However, "America was not ready. In the late 1940s and early 1950s the nation soured on the idea of further actions by government to increase educational opportunity" (Bonner, 1986, p. 47).

The National Science Foundation

At the end of World War II, the relationship of the federal government to scientific research and development began to emerge as a significant issue: As many public and private leaders saw it, the crucial role that science had played during the war pointed the way toward the role in which scientists and research

could perform in strengthening the national defense, stimulate economic growth, and provide a smooth transition to peacetime production (Rowan, 1985). "For many observers, the OSRD symbolized the benefits of cooperation between science and government and pointed the way toward a permanent postwar union" (Rowan, 1985, p. 7).

Scientists, led by Vannevar Bush and his vanguard, sought to guarantee government support for basic research. He argued that basic research was the necessary foundation for a strong economy (Kleinman, p 188). The wartime experience led scientists, government officials, private leaders, and politicians to advocate various proposals for a government agency that could encourage and coordinate scientific research and training. "Through a process of compromise and modification these proposals resulted in the National Science Foundation Act of 1950" (Rowan, 1985, p. 1).

One approach, most closely associated with Senator Harley Kilgore of West Virginia, would have allowed considerable government coordination and planning within a public-private cooperation and power-sharing, an approach that emphasized the power of "democratic science" to reform and improve American society. It stressed the need for public control and a program that would reform patent policies, aid small businesses, insure an equitable distribution of research funds, and break the monopoly that large research universities and corporations had exercised over science and research during the war (Rowan, 1985). Not surprisingly, "the efforts to create the National Science Foundation were driven by an issue that throughout U. S. history has created division between the

legislative and executive branches: executive prerogative. In this case, the interest of elite scientists in controlling their own foundation meshed well with a history of congressional fear of ceding too much power to the president, and, indeed, presidential efforts to enhance the power of the president were certainly fresh in the minds of legislators" (Kleinman, 1995, p. 141).

Senator Kilgore's role in this debate is important from the perspective that it was his subcommittee of the Senate Committee on Military Affairs, which, in 1942, opened an investigation of wartime mobilization. Although this investigation helped to build support for a government role in research, it also stimulated the vigorous debate over the nature of that role and the proper relationship between government and private groups. The mobilization bills that emerged from his subcommittee had New Deal characteristics in the form of government controls that the military, the scientific elite, and various industrial groups attacked as a step towards government regimentation and control of science. These groups saw these bills as a threat to their control of science and basic research (Rowan, 1985). Kilgore's legislation owed much to a physicist on the staff of his subcommittee on war mobilization, Herbert Schimmel, whose beliefs about government and the economy had been shaped by personal hardships during the Great Depression and by what he saw, while war came, as the continuing failure of American industry to subordinate private profit-taking to the national interest (England, 1982).

A second approach was identified with Vannevar Bush, who had been the principal administrator of wartime research as the chairman of the OSRD: "His

wartime experience convinced him that the integrity of science would not inevitably be compromised by federal subsidies for university research and that they would be needed to meet the nation's requirements for new knowledge" (England, 1982, p. 5). Bush's approach emphasized placing control of the new agency and its funds in the hands of the scientific vanguard or elite, as was the case with the OSRD and its predecessor organizations before and during the war. Thus, his approach largely ignored Kilgore's call for government coordination and economic reform, and instead pointed in the direction more amenable to the established research network whose members believed that government support of science must not involve political controls that could threaten special interests or professional values (Rowan, 1985).

This new agency would grant public subsidies with little government direction, interference, and coordination. However, by mid-1944, Bush and most of public and private leaders recognized the practical necessity of some sort of government involvement in postwar science and were prepared to concede the government a role that went beyond the provision of financial support. The key question revolved around the extent of government involvement (Rowan, 1985).

In the middle of this debate, during the mid and late 1940s, was the Truman presidency, government agencies, and the military. The Truman administration wanted the proposed agency to be within the framework of the government, welcoming any role that it might play in coordinating the work of existing research agencies. The military wanted to continue its wartime relationships with the scientific community and recognized the value of

subsidizing basic research; but it and other government identities feared external meddling with their operations. Corporate and industrial research interests shared the viewpoint of the military's position, but worried about political control. Most scientists and large research universities backed the Bush approach, while the smaller colleges and medium-sized universities outside the established research network generally supported a more democratic approach advocated by Senator Kilgore. "These differing opinions combined with political circumstances, the Cold War stimulus to military research, and bureaucratic wrangling to determine the ultimate outcome of the NSF campaign" (Rowan, 1985, p. 3).

Given the ongoing political bickering regarding what form the new agency should take and the failure of the original NSF legislation to pass in both the Senate (S. 1850) and the House (H.R. 6448), President Truman, in October of 1946, issued an executive order that established a President's Scientific Research Board (PSRB). The PSRB comprised all of the heads of all federal agencies involved in scientific work, and served a purpose similar to that of the OSRD in terms of scientific policy review, study, and the development of recommendations to the President. The creation of the PSRB was viewed as "groundwork for the reintroduction of NSF legislation and as a valuable means of coordinating the government's current scientific efforts" (Kleinman, 1995, p. 123). Previously in that same year, and in anticipation of the elimination of the OSRD, the Secretary of the War and Navy, the predecessor to the present Department of Defense, established the Joint Research and Development Board (JRDB) to

coordinate military-related research activities. Not surprisingly, Vannevar Bush was selected as the Board's first chairman. In 1947, the National Security Act created the Research and Development Board to replace the JRDB; Bush served as its chair until October 1948; he was replaced by Karl Compton (Kleinman, 1995).

The new Senate version of the NSF bill (S. 247) was released from committee to the Senate floor in February 1950, where it was approved; and it passed a House vote in March of that same year (Kleinman, 1995). Final passage of the act came in April 1950 (Lomask, 1975). The NSF Act of 1950 directed the NSF to support basic research, award scholarships and fellowships, assist in the funding of defense research when requested by the Department of Defense; develop and encourage a national policy promoting basic research and education in the sciences; evaluate research programs of the federal government and correlate them to other public and private research; and, maintain a register of scientific and technical personnel (Kleinman, 1995).

To some degree, the act was a partial victory for Senator Kilgore: the president would select the director of the foundation, not the board he appointed to run the foundation. The bill virtually assured that the organization would be dominated by science elites—totally absent from the language of the bill was any suggestion that the organization would present a broad cross-section of social interest as Kilgore had suggested in his earlier legislation (Kleinman, 1995). Nor was there any language in the act that gave the NSF responsibility for assessing

the impact of research on public welfare, as Kilgore had clearly envisioned in his early legislation (p. 154).

The final version of National Science Foundation legislation was significantly influenced by Bush's ideas and promoted by Karl Compton, who had become the head of the Research and Development Board. It allowed considerable private power within a public-private framework, emphasized basic research and advanced scientific training, stressed support for what Bush frequently referred to as the 'best science', and provided the autonomous control that advocates of the original Bush plan had always sought (Rowan, 1985).

Though the fight to establish the NSF was a long and difficult one, the struggle for its operating budget became just as challenging in an era of federal budget cutbacks. It was created with an appropriation of $500,000 and $15 million annually thereafter. When, in 1952, the NSF submitted a budget of $14 million, the House initially attempted to drastically cut its request to $3,000,000. In the end, a House-Senate conference committee compromised on $3.5 million, down from the Senate's recommended $6.3 million (Rowan, 1985). However, according to Lomask (1975), in 1955 the Foundation began administering the funds, $43.5 million in all, that Congress had sanctioned to help finance the nation's participation in the International Geophysical Year (IGY), a world-wide venture. For 18 months, beginning in July of 1957, some 30,000 scientists and technicians from 66 nations cooperated in a study of the earth (p. 137).

Budgeting restrictions severely limited the scope of research projects it could fund and delayed the implementation of science training, scholarship, and

fellowship programs. The summer of 1957 in particular was a season of discontent for the NSF. Government budgetary retrenchment, in which the NSF shared, made it more difficult to recruit and hold first-rate talent (England, 1982). Appropriations for the NSF would not appreciably increase until the Soviet Union's launching of the Sputnik in October of 1957 (Rowan, 1985).

Section V:
CRAFTING A NATIONAL AGENDA FOR EDUCATION, SCIENCE, AND TECHNOLOGY

Most Americans greeted the end of World War II with relief, anticipated a period of relative peace, and had expectations of economic improvement and increased prosperity. Instead, the decade following the war was one of uncertainty and characterized by crises both at home and abroad.

Federal education legislation during this time frame was initially stimulated by the nation's fixation on education as a response to a Cold War emergency, brought on by the launching of Sputnik, and in reaction to forces of social and technological change working in America. The expansion in the science training role of the National Science Foundation and passage of the National Defense Education Act (NDEA) of 1958 represented the first critical milestones in federal education-related efforts that attempted to find solutions to those events, needs, and concerns by directly funding the nation's schools and universities.

National and International Crises Erupts

During the 1940s and 1950s, Progressive Education was the conventional wisdom of the educational field from kindergarten through teachers colleges (Clowse, 1981). Urban and Wagoner (2000) state that "pedagogical

progressivism, at least the versions such as Dewey's or Young's that shared much of their agenda with liberal progressivism," had already began to recede in influence after the 1920s (p. 245). "While few schools were wholeheartedly committed to progressivism,...curriculum decisions were almost always the result of local conditions and the schools' interaction with local leadership" (p. 269). Among these conditions were the Great Depression and resulting impacts on school finances, conservative teachers' unions, and the resistance of teachers "to change their traditional roles" (p. 274-279).

As the country emerged from the war, its schools generally showed more continuity than change when compared to the prior two decades. The basic curriculum remained unaltered, as did administrative structures and school governance, teacher training, classroom teaching practices, and most educational polices (Urban and Wagoner, 2000). It would be the major crises that emerged during the 1954–1957 period that would belie the standard picture of the post-World War II years as being a period of relative domestic tranquility, and would project educational policy into the forefront of national politics and as a critical element in America's response to another national emergency: the advent of the civil rights era, Sputnik, and the continuing debates over educational priorities (Urban and Wagoner, 2000).

The year 1957, in particular, would be one in which Americans began to face a variety of unsettling concerns in the national and international arenas. On the domestic front, President Eisenhower and Arkansas Governor Orval Faubus deadlocked over implementation of school desegregation in Little Rock's Central

High School. Previously, the court-approved plans for the desegregation of the high school had proceeded smoothly, with the admission of a selected group of Negro children. Though mild in his initial reaction to the court decision, Governor Faubus retreated from this moderate stance and opted not to break from the ranks of the Southern governors who were opposed to school desegregation. Eisenhower would have preferred to stay aloof from the school desegregation process, initiated by the *Brown v. Board of Education of Topeka (1954)* decision. Yet, Faubus' defiance pushed the president into making a decision when, on the court-appointed date for desegregation, Faubus ordered the Arkansas National Guard to prevent the court's plan from being implemented. President Eisenhower then became a key, if unwilling, leading participant in this drama when he immediately dispatched federal troops and nationalized the Arkansas National Guard to enforce desegregation at the high school (*Copper v. Aaron,* 358 U. S., 1958; Clowse, 1981; Urban and Wagoner, 2000).

Brown, as described by Urban and Wagoner (2000), was an unusual decision involving an issue of educational policy and practice that had effects that were felt both inside and outside of the nation's schools: "It may have been one of the few occasions in our history when an educational policy was the catalyst for substantial changes in social relations and policies outside the schools" (p. 288-9). In 1957, Congress passed a civil rights law that placed it on the side of racial equity, though the law was mild in terms of its intent and approach to the issue of school desegregation (Urban and Wagoner, 2000).

Late Friday afternoon, October 4, 1957, from Moscow came word that an artificial satellite had been launched by the Soviet Union. Clowse (1981) provides the following observation:

> The Soviet news agency Tass called the device Sputnik, a Russian nickname for 'Artificial Fellow Traveler Around the Earth.' The world's first man-made satellite and its instrument package, weighing 184 pounds, were circulating the earth once every ninety-six minutes. In Washington, the news of the Sputnik had reached the Soviet embassy while a party honoring scientists in the IGY program was in progress. Applause broke out among the scientists, who congratulated their Soviet colleagues on the achievement. Over the next few weeks, however, the event did not seem quite so fortuitous as all of its implications sank into popular consciousness. (p.6)

"This satellite represented a tremendous breakthrough in space research" (Dent, 1969, p. 144). It was apparent that the Russians had made a coup in an area where many Americans presumed continuing superiority, the application of scientific research to technological production. For instance, the Sputnik satellite was eight times heavier than a satellite that the U. S. planned to launch into orbit as part of the International Geophysical Year (IGY), the Sputnik's three-stage rocket was nearly twenty times more powerful than the IGY-Vanguard rocket, though the nation did have more powerful rockets available. President Eisenhower had decided to separate and conceal military advances in rocket

technology from the scientific IGY project (Clowse, 1981). Before the U. S. could respond with a successful satellite launch of its own, on November 3 the Soviets performed an even more astounding feat when Sputnik II blasted into orbit. It weighed 1,120 pounds and carried a dog, wired for medical monitoring. Americans began to face the prospect that the Russians were preparing to send a man into space, leaving America far behind in the space race (Clowse, 1981).

The Soviet Union's success in launching the first Sputnik in 1957 produced a peculiar and definite mixture of depression and panic in America that lasted for months. The public mood was one of expecting the national government to take quick action to correct the conditions that allowed the country to suffer such a scientific and technological defeat at the hands of the Soviet Union (Clowse, 1981). Though the United States responded with a successful satellite launch of its own just four months following the first Sputnik that success did not take place until after the humiliation of an unsuccessful launch painfully witnessed by many Americans on their television sets (Urban and Wagoner, 2000). The U. S. successfully launched a Explorer I satellite in January of 1958 (Dent, 1969).

With the successful launch of Sputnik, a consensus grew that the nation's educational institutions were largely to blame for this Cold War defeat. By the late 1950s, America had come to believe that its survival was under threat from international Communism. The successful launching of Sputniks, the Earth's first artificial satellites, gave the perceived threat shocking tangibility and raised it to crisis proportions. Americans began to feel that their education system had failed

them, the Soviet Union was superior in science, mathematics, and technology development; and, that America was on the verge of losing the Cold War and in the preparation of scientists (Dent, 1969; Clowse, 1981).

That Americans blamed their system of education is not surprising: Americans had become more and more accustomed to viewing education in the context of the then existing Cold War ideology. In the spring of 1957, for example, President Eisenhower had addressed a meeting of the National Education Association (NEA) and stated that the nation's schools "are strongpoints in our National Defense...more important than Nike batteries, more necessary than our radar warning nets, and more powerful even than the energy of the atom" (Clowse, 1981, p. 27).

As a more immediate response to the Sputnik launch and the criticism of his administration that followed, President Eisenhower appointed a full-time science advisor to the White House staff and sought to implement programs to persuade more youngsters to enter national-security related fields, thus establishing a linkage of scientific achievement to education. Previously, in 1955, his administration had debated the ramifications of a possible shortage of scientists and engineers. If proved true, such a shortage would have implications for the Cold War as well as education. Meanwhile, the American Council on Education (ACE), an influential voice for higher education institutions, related the Soviet success to a lack of interest in and financial support for American education (Clowse, 1981).

Most detractors claimed that reformist approaches to schooling had failed to equip students with the skills essential to an educated person, given that it was too concerned with social development and oriented around life adjustment. Others saw America's educational lapses in relationship to the Cold War: by allowing students to shun tough courses, they argued, educators were to blame for shortages in fields vital to national security. This argument increased in its dimensions after 1955 when it became widely known that the Soviet Union graduated more scientists and engineers than the United States (Clowse, 1981).

Leaders such as Dr. Edward Teller, Father of the H-Bomb, and Admiral Hyman Rickover, Father of the Nuclear Submarine, spoke out frequently, invoking long-standing educational criticism to explain why the U. S. was behind in the space race. Critics such as these claimed that Progressive Education, flabby educational curricula, and the shirking of basic subjects were robbing America of competent, trained manpower. Sputnik launches that year were perceived by many in America as not only a defeat in the Cold War, but as a judgment upon the goals and values of American education (Clowse, 1981).

Rickover was an early advocate of federal financial assistance to education, the imposition of national standards, national testing, and special educational opportunities for gifted students; and, he was a formidable friend of education and devoted inordinate amounts of time to scourging politicians for their neglect of education. He decried the American tradition of local control over education, which he felt left the direction of educational policy in the hands of

thousands of citizens who "seldom qualify as educational experts" (Clowse, 1981, p. 35).

Furthermore, in his book Education and Freedom, Rickover (1959) expressed the opinion that John Dewey's insistence on practical learning and children's interests had led to inferior intellectual training in the United States:

> The kind of school which prepares young people adequately for life in a less complicated environment is of little use today. Nor do we need schools that concentrate primarily on adjusting the children of immigrants to this new country; on helping them become Americans quickly and painlessly. Today we must have schools which develop in all children—talented, average, and below average—the highest level of intellectual competence of which they are capable; schools that help young people to understand the complex world of today and how it came to be what it is. This means that our schools must return to the traditional task of formal education in Western civilization—transmission of the nation's cultural heritage, and preparation for life through rigorous training of young minds to think clearly, logically, and independently. (p. 17-18)

Rickover states further that "apart from the life-adjustment fallacy so prevalent among American educationists, our schools seem unable to concentrate on training young minds because of partiality for so-called 'useful' knowledge" (Rickover, 1959, p. 24).

The target of the critics, such as Arthur Bestor, in reality, was "life adjustment education" that grew out of the reform literature during the immediate post-World War II years and was promoted most notably by Charles Prosser, a noted vocational educator. This curricular approach was intended to serve what he referred to as "the un-served middle 60% of students in high school" for whom neither college preparatory, nor vocational, courses adequately prepared them for modern society. "The long-term decline of traditional academic subjects that seemed to culminate with the life adjustment movement of the later 1940s was startling" (Urban and Wagoner, 2000, p. 291).

Bestor argued that life adjustment education shortchanged students by preventing them from having contact with challenging academic studies, forced colleges and universities to deal with generally unprepared students, and society would be saddled with "a youth cohort that was unversed in academic knowledge and skills and thus unprepared to meet the intellectual and civic challenges of the twentieth century" (Urban and Wagoner, p. 292). Bestor also called upon schools to restore what he called 'basic education' to its rightful place in the classroom and to raise "up a nation of men and women highly literate, accurately informed, and rigorously trained in the process of rational and critical thought." Otherwise, he said, "the country could never hope to deal with the complexities of the postwar period" (Clowse, 1981, p. 32-3).

Howard Meyerhoff, the executive secretary of the Scientific Manpower Commission, cited the lack of excellence in schooling as a denial of opportunity to the individual and a threat to the nation's security. Moreover, he felt that

priority should go to improving science instruction at all levels of schooling or to funding advance research that might prove crucial in waging the Cold War (Clowse, 1981).

Although it certainly caught the attention of America and provided ammunition for critics of the nation's schools, according to Kaestle and Smith (1982) "the Sputnik achievement was not the product of a superior school system; nor did it take a technological embarrassment to move academic critics of American progressive education into the spotlight....The United States launched Explorer I within four months of Sputnik, although the American manned-satellite program had begun years after the Soviet's" (p. 392).

Challenges Facing Federal Aid and Educational Reform Advocates

Sputnik, and America's reaction to it, provided a much-needed impetus to a growing movement in support of federal aid to education. Clowse (1981) writes:

> Once the Sputnik panic became an educational crisis, it coalesced with the long and hitherto inauspicious struggle for federal aid to education. A significant breakthrough had eluded advocates of federal aid in the postwar era....The Sputnik crisis transformed the politics of federal aid to education; it altered the terms of the debate and temporarily neutralized much of the opposition. The cold war rivalry seemed to dictate that the nation mobilize her brainpower, including schoolchildren and undergraduate and graduate students, on an emergency basis. (p. 3)

Previously, while the federal government had provided land grants for schools and aid to vocational education and school construction, bills to provide general funds to education were routinely defeated. "Education did not necessarily carry negative connotations; but federal support for it was not politically popular. Improvement of education was not yet considered to be a worthy national goal" (Harden, 1981, p. 6). Many in education had long favored general federal aid to the states. "Such aid, it was contended, would leave states and local communities free to use the funds for whatever instructional purposes they saw fit" (Krug, 1966, p. 141).

Complicating the debate over education, and the implementation of reforms and financial aid, were several important factors and potential obstacles: The first of these was the baby boom that was under way. It was projected that 44 million students would enter the nation's elementary and high schools by 1965, straining already inadequate facilities. Furthermore, during the war, educators had begun to abandon their profession for higher paying jobs in the private sector, and the trend was expected to continue, creating a deficiency in numbers and qualifications. Second, the fiscal basis of American education seemed paltry, given the tradition of local control meant that financing of public education came largely from real estate taxes (Clowse, 1981).

Connected with this was a third issue: control. Any aid from the federal government was presumed to bring some form of control. Kaestle and Smith (1982) provide the following insight:

> The overriding issue in the support and control of elementary and secondary education since 1940 has been the role of the federal government. One might reason that the increasing role of the national government in public education is only an extension of the same historical processes that led to the creation of state school systems....However, a notion persists that public educational responsibilities is constitutionally reserved to the states. (p. 384-5)

Fourth, the tradition of separation of church and state: private schools might be able to share in financial assistance to education if unrestricted aid flowed to the states, as some educational aid advocates had proposed. If this occurred, Congress could not institute a blanket prohibition against federal aid to private schools without violating the principle of local control (Clowse, 1981).

Fifth, there was the increasingly tense issue of school desegregation. "The Supreme Court's monumental ruling in *Brown v. Board of Education (1954),* ordering an end to segregation in public schools based on race, marked the beginning of the federal government's active involvement in education" (Russo, 2001, p. 46). Those fighting to retain segregated school saw federal aid as a potential weapon of integration (Clowse, 1981).

Prior to 1958, federal aid to education advocates had focused on three devices for channeling funds to education: aid for construction, unrestricted grants to the states, and revenue from tidelands oil (Clowse, 1981). For example, in 1987, the first session alone of the 85th Congress witnessed approximately

100 bills to authorize direct or indirect federal assistance (Kerr-Tener, 1987). None of the devices of federal aid advocates fared well on Capital Hill:

> As of 1950, the only federal aid to elementary and secondary education was for vocational education (about $28 million), school lunches (about $92 million), federal dependents (about $29 million), and native American children (about $15 million). Furthermore, the Congress continued to resist arguments for general aid to local school systems, despite lobbying by such groups as the NEA. The federal research effort in education was tiny, and the federal courts had little impact on local schooling. (Kastle and Smith, 1982)

Thus, the principal means of offering federal funds continued to be through schools districts qualifying as federally impacted areas or when an individual veteran qualified for the GI Bill (Clowse, 1981). No long term, general federal aid and involvement in educational matters occurred during this time frame (Munger and Fenno, 1962). "Federal programs initiated in the successive national emergencies of the Depression and World War II were considered temporary and affected elementary and secondary schooling only indirectly" (Kaestle and Smith, 1982, p. 389)

The Eisenhower administration was yet another challenge for educational advocates. Eisenhower's overall record in office can be characterized by the fact he generally sought to restrain domestic change; his record in the area of federal aid to education was no exception. However, "as modern presidents go, Dwight

Eisenhower was better versed in educational maters than most. He arrived at the White House with two years' experience as president of Columbia University and as a member of the prestigious Educational Policies Commission. He also availed himself of the counsel of distinguished private educators (including Harvard University president John Conant and, of course, Dr. Milton Eisenhower, president of Johns Hopkins) and made himself regularly available to education advisors within the administration" (Kerr-Tener, 1987, p. 473-4).

Eisenhower's administration would sponsor the first White House Conference on Education in 1955 and, following Harry Truman's example, and appoint a public higher education commission (the Committee on Education Beyond High School) chaired by Devereux Josephs, a former Carnegie Corporation president (Kerr-Tener, 1987). However, Eisenhower had taken office in 1954 without much commitment to federal aid. Although his administration sponsored bills to provide construction loans and grants to education in 1955, 1956, and 1957—Eisenhower demanded that aid be temporary, strictly contingent upon need, a stimulus to state funding, and was careful to ensure that various protective language and devices were written into aid legislation to ward off the potential for federal controls (Clowse, 1981). Kerr-Tener (1987) states:

> It is well known that Eisenhower found little to commend in Democratic-sponsored bills for public school construction aid. His strategy for responding to these perennial initiatives was to offer his own modest, 'emergency' aid bills partly as alternatives— and partly as foils— to the opposition's more expensive proposals. This strategy usually produced

deadlock because of longstanding inter- and intra-party divisions on the school aid question. (p. 473)

Nevertheless, and contrary to assertions regarding his opposition to most Democratic proposals on this issue, "Eisenhower was not irretrievably uninterested in using federal means to aid education. By official lights, including those of a White House aide who worked on education issues and high-ranking HEW [the Department of Health, Education, and Welfare] officers, Eisenhower was cautious about federal involvement in the financing of education but was also open to reasoned argument" (p. 474).

The Eisenhower Administration, and its approach to aid for higher education, likewise reflected the mood of restraining aid to education. The Committee on Education Beyond High School saw no need for federal help to college students as recommended by the Zook Commission. No comprehensive plan for higher education was developed or desired, and colleges conducted themselves much as they did before the war. However, in the 1950's it was recognized that returning GIs influenced higher education in yet another way: the Committee in 1956 gave wide publicity to a projection that the postwar births would cause college enrollments to double and perhaps triple by 1970. Furthermore, the Committee predicted that there would be an increased demand for technical and scientific education in the 1950s that would outstrip the ability of America's higher education to cope with it. "Nevertheless, for all of the urgency

of the...committee report, the nation was in no hurry to respond to its recommendations" (Bonner, 1986, p. 47-8).

Congress and the Eisenhower administration had considered a number of approaches to federal aid to education prior to Sputnik, but there is no doubt that the Soviet space successes had galvanized American politicians into action on the educational front (Urban and Wagoner, 2000). And, advocates of federal aid to education had found a way to link education to national security (Clowse, 1981). The advocates of the NDEA tied the act's federal aid to the national defense effort, thereby disarming much of the conservative opposition to the measure: "The most effective argument for federal educational aid at the time was that the Soviets were dangerously close to a superiority in science and technology, and perhaps in other fields as well. Thus, federal aid was a way to help America close the gap" (Urban and Wagoner, 2000, p. 296).

"The most significant educational consequence of Sputnik, even more important in the long run than the attention paid to academic studies, was the impetus it gave to federal financing of public education" (Urban and Wagoner, 2000, p. 293). Though Sputnik produced interest in the federal role in education, its importance to the nation's educational policymaking process revolves around the fact it disarmed opposition to federal aid per se and to the specific provisions of two bills leading to the passage of the National Defense Education Act of 1958 (Clowse, 1981).

Developing Brainpower for the Cold War: The Politics of Linkage and the National Defense Education Act of 1958

"The successful Soviet launchings, as contrasted with the slow and only partially successful U. S. efforts, led to some unexpected consequences in American educational circles. The first of these was the passage of the 1958 National Defense Education Act" (Urban and Wagoner, 2000, p. 295).

During 1957, in the wake of the successful Sputnik launches and stimulated by personal meetings with the nation's leading scientists and a July 1957 report of Josephs' Committee, Eisenhower had expressed his interest in issues associated with shortcomings in math and science education with HEW Secretary Marion Folsom and his Assistant Secretary Elliot Richardson. The report, which was highlighted by its "doleful commentary on the state of graduate education and the shortage of topflight college instructors," provided a springboard for the Administration's consideration of new higher education program and led to the creation of a small HEW departmental task force to evaluate the committee's recommendations (Kerr-Tener, 1987, p. 475). The task force's objective was to develop legislation for submission at the opening of the January 1958 congressional session. The October 1957 news of the successful Sputnik launch gave a boost to the work of the task force and increased the prospects that its proposals would not only be regarded as educationally sound, but also politically justified and necessary (Kerr-Tener, 1987).

The task force's proposals included a generous need- and merit-based scholarship provision, graduate fellowships, and federal matching grants to

universities for expanding graduate-level programs. Eisenhower demanded that the proposals also include support for improved high school teaching of math and science, aid to colleges for constructing science and technical teaching facilities, and a college scholarship provision for study in defense related fields (Kerr-Tener, 1987). "While the bulk of the task force's proposals had undergone a long incubation period prior to being pressed into service, there is no doubt that the events of July and October, 1957 hastened their political coming of age" (Kerr-Tener, p. 482). "The Sputnik crisis finally created a political environment in which an enlarged federal role was viable" (Freeland, 1997, p. 602).

The general provisions of the NDEA articulated the Cold War motives of Congress and the Eisenhower administration: "To strengthen the national defense and to encourage and assist in the expansion and improvement of educational programs to meet critical national needs; and for other purposes" (Committee on Labor and Public Welfare [CLPW], 1958, p.23). Congress declared "that an educational emergency exists and requires action by the federal government. Assistance will come from Washington to help develop as rapidly as possible those skills essential to the national defense" (Clowse, 1981, p. 162). Thus, for the first time the federal government gave direct help to education and greatly increased funds for research, though the new aid was targeted only to areas of study central to the nation's defense. The bill "was a clear response to specific national needs..." (Bonner,1986, p. 48).

The NDEA more than doubled federal expenditures for education, authorizing the Office of Education to administer much of the NDEA with $4

billion over a four-year period with an initial appropriation of $115.3 million. For higher education this included funding for federal student loans programs, graduate fellowships in science and engineering, institutional aid for teacher education, funding for capital construction, and a surge of funds for curriculum development in K-12 and higher education for the sciences, math, and foreign languages (CLPW, 1958). Special consideration for student loans was recommended for those with superior academic backgrounds. For those who became science, math, engineering, or foreign language teachers, parts or all of their NDEA-sponsored loans were canceled (Krug, 1966).

The NDEA also provided funds for technological, audiovisual, and media services; and, added funds to existing vocational legislation to improve the education of technicians (Urban and Wagoner, 2000). These provisions of the NDEA include:

- Title III of the NDEA provided financial assistance to the state educational agencies for strengthening science, mathematics, and modern language instruction at the elementary and secondary levels. This assistance also provided grants and loans to nonprofit private schools to acquire or remodel laboratory and other facilities, obtain special equipment, etc. that would be suitable for use in providing education in science, mathematics, or foreign languages. (CLPW, 1958)
- Title VII of the NDEA authorized the Commissioner of Education, assisted by the Advisory Committee on New Educational Media in

the Office of Education, to make grants to public and nonprofit private agencies and to individuals, or through contracts, to study the need for increased and more effective uses of television, radio, motion pictures and related media for educational purposes; and foster new audiovisual techniques for teaching (CLPW, 1958). In addition, Title VII authorized the NSF to provide a representative for the aforementioned Advisory Committee on New Educational Media. Twelve other representatives were to come from the communications media, elementary and secondary fields, and higher education. (Clowse, 1981)

- Title VIII of the NDEA served to amend the Vocational Education Act (the George-Barden Act) of 1946 to authorize grants to states to assist them in training individuals for employment as "highly skilled technicians in occupations requiring scientific knowledge in field necessary for the national defense" (CLPW, 1958, p. 7). The purpose of this provision was to meet the needs of national defense by increasing funds allocated for the training of technicians in the areas of science and technology. The states would receive funds on the same basis of allocation as specified in the George-Barden Act. (Clowse, 1981)
- Title IX provided for the creation of a Science Information Service "to provide for more effective dissemination of scientific information...and to provide for the development of new or

> improved methods, including mechanized systems, for making this information available, and to establish an advisory body called the Science Information Council." Both organizations created by this title were to be established and supervised by the NSF (CLPW, 1958, p. 21).

Federal funds from the NDEA program were distributed to the states on the basis of school population, and for the acquisition of educational materials for specific subjects mentioned above, the NDEA provided funds had to be matched by local school expenditures. Later the program was enhanced to include education materials for the instruction of history, civics, geography, English, language arts, and the humanities (Dent, 1981).

The NDEA also aroused some controversy: By associating the NDEA funds with national defense needs, Congress partially responded to many people who had feared that with federal funds would come excessive government control over schools. Though eventually people would find that these fears were unfounded, for several years acceptance of NDEA funds was withheld by some school systems. Another aspect of the NDEA that caused considerable consternation was a provision in the act that required faculties of schools and institutions of higher education applying for funds were required to sign a patriotic loyalty oath before the dispersal of funds could be approved. Several universities contested the constitutionality of this provision and urged Congress to amend the act to discontinue this requirement. "Despite these various objections, however, most schools welcomed financial aid from NDEA...it was

the first legislation for substantial federal aid to education to be passed in many years" (Dent, 1981). Congress finally relented, and in 1962 repealed the loyalty oath provision (Clowse, 1981).

In 1958, Congress also passed a law to require the NSF to manage the federal research programs on weather modifications. This legislation and the National Defense Education Act of 1958 had the result of enlarging the NSF's attempts to carry out its directive to diffuse scientific information among scientists in the U.S. and friendly countries. Supplemented by an executive order in 1959, the NSF dismantled its small information office and created a significantly expanded office of Science Information Service (Lomask, 1975).

Section VI:
THE EMERGENCE OF TECHNOLOGY IN EDUCATION AS MEDIA AND AUDIOVISUAL COMMUNICATIONS

Instructional strategies and methodologies developed during and after World War II evolved into the first, and one of the earliest views of technology in education, as *media and audiovisual communications.* It grew out of the visual instruction movement during the late nineteenth century and the audiovisual movement (introduced in Section I) that began in the 1930s, both as alternate methods to books and lectures to deliver information. This movement continued to evolve following the war, and converged with the new communications movement— eventually becoming *media and audiovisual communications,* representing the tools and technologies to assist in the delivery of instruction in a more effective and efficient way to learners.

The Communications Movement and Models of Learning

During World War II, the visual instruction movement reached its maturity. When the war demanded rapid, effective training for both the armed services and wartime industries, visual materials were intensively used— aided by the procedural and research data that had been compiled by civilian educators and instructional designers. Following the war, visual instruction began to lose its

distinct identity as a movement in American education and leaders of the movement became uneasy about the adequacy of the visual instruction label as the newer technologies such as audio recordings and radio entered into the equation. An impetus to this uneasiness came about in 1947 when the National Education Association's Department of Visual Instruction (DVI) became the Department of Audiovisual Instruction (DAVI), signifying a changing of perspective. It was apparent that visual instruction was to begin moving toward a convergence with the broad mainstream of educational technology as it began to be replaced with a number of communications models of the instruction process (Saettler, 1990).

Previously, during the 1920s and 1930s, mass communications theory began to emerge as media developed. This was a result of the need to systematically study and understand the impact communications— their content and functioning— had upon the mass society and what influences they might have on individuals and particular kinds of people. However, following the introduction of audio recordings and radio, communications had little influence on the theories and practices of education-related technology until after the war (Saettler, 1990).

The growth of instructional radio occurred primarily during the decade of 1925-1935— during which the first courses in radio education were established at colleges and universities across the country. However, by the late 1930s and the advent of World War II, the growth period of educational radio had begun to decline (Saettler,1968).

> The advent of stringent federal regulation, the rise of national commercial networks, and their use of inexperienced faculty were the chief factors promoting their failure....However, there was another consideration....Since the licensing authority had accepted the philosophy of commercial radio, no place was left for educational stations which had to withdraw when costly commercial standards were applied to their operations. Regardless of the explanations offered, it is clear that educators were generally apathetic toward educational broadcasting. (Saettler, 1968, p. 295)

Meanwhile, as educational radio declined, instructional television brought about a general expansion of instructional technology. By the 1950s, television favorably impacted the communications movement and took center stage as a medium in education (Saettler, 1968). Molnar (1969) attributes the following statement to Edward R. Murrow: "This instrument [television] can teach, it can illuminate, yes it can even inspire. But it can only do so to the extent that humans are determined to use it to these ends. Otherwise it is merely lights and wires in a box" (p. 59).

The first non-experimental educational television station was launched by Iowa State University in 1950 (Newby et al., 2000). Following World War II, instructional television was initiated on commercial stations because educational stations were preoccupied with problems of financing, staffing, and developing programs for adult instructional use. In 1952, the Federal Communications

Commission (FCC) set aside 242 television channels for public educational television stations, spurring a growing interest in the use of television for education. By the late fifties, instructional television was beginning to receive serious attention from educators and educational broadcasters; and, during the 1960s courses geared to this medium were being taught by either open or closed circuit television, on educational or commercial stations, and in educational institutions (Saettler, 1968).

In 1958, Congress passed the NDEA Act. Though the principal aims of the NDEA were to provide federal funds for the promotion of science, mathematics, and foreign language instruction; improved testing and high school counseling, and to finance loans and scholarships for under-financed college students— another objective of the act was the distribution of funds to extend the use of audiovisual materials in teaching and to expand vocational training. This led to large increases, across the country, in purchases of audiovisual equipment and related materials (Dent, 1981).

During the postwar period and through the early years of the Cold War, the NDEA Act played a key role in the emergence of instructional technology and its wide spread application in the nation's schools and institutions of higher education. The role and leadership of states increased in advancing the use of audiovisual media, which experienced steady growth following the war— reflecting the growth of teacher education requirements and the budgeting of considerable sums for the purchase of audiovisual materials and equipment (Saettler, 1990).

In higher education, a trend was established whereby the audiovisual center became a resource center or centralized administrative organization for educational media services, as well as research for the study of media in the teaching-learning process. Much of the impetus in this effort was stimulated by appropriations from the National Defense Education Act (NDEA) and by support from private foundations such as the Ford Foundation (Saettler, 1968).

As instructional media use increased after the passage of the NDEA, the field continued to change and mature. Media specialists became important members of the educational community, interest grew in new forms of media technology; and media itself came to be viewed not in isolation, but as one part of a larger instructional technology process. "As instructional design developed into a field of study, media science matured in ways that increasingly acknowledged its link to instructional design and communications" (Newby et al, 2000, p. 250).

During the 1950s, the educational media field began to shift its focus from hardware to the role of media in learning. The instructional theories or models of the postwar time period initially focused on the communications process, and the authors of these models indicated that in planning for instruction it was necessary to consider all of the elements of the communications process and not just focus on the medium, as many in the audiovisual field had a tendency to do (Heinich et al., 1989). "These models helped to move audiovisual specialists to consider all of the components involved in the communications process. As a result, audiovisual studies began to be conceptualized as something broader

than just media. A convergence of audiovisual sciences, communications theories, learning theories, and instructional design began" (Newby et al., 2000, p. 249). Saettler (1990) writes:

> The concrete-abstract continuums of visual instruction began to be replaced with a number of communications models of the instructional process....By the early 1950s, the 'audiovisual instruction' had begun to be replaced by 'audiovisual communications.' Emphasis began to shift from the 'things' of the instructional situation to the complete communications process involved in transmitting information from a source (a teacher) to a receiver (the learner). (p. 167)

Molnar (1969) argues that the promise of educational technology brings benefits to both the teacher and the learner:

> The promise of educational media rests upon the premise that technology can provide a mechanical or electronic advantage which will permit educators to teach more students for less while maintaining or even improving the quality of education. The objective has not been to replace the teacher with a machine but to free the teacher from the routine administrative functions, the monitoring of drill and practice and the simple presentation of factual information. Once freed from these chores it was hoped that the teacher would have more time to interact with students on an individual basis and to devote more time to higher order conceptual and affective learning. (p. 53)

Systematic studies were undertaken to determine how the attributes or features of various media affected learning. In the process, various theories or models of communications were developed that incorporated the role of media, helping to move audiovisual specialists to consider all components in the communications process as they were being applied to education. As a result, audiovisual studies began to be conceptualized as something more than just media (Newby et al., 2000).

By the end of the 1950s, the aforementioned convergence had failed to take root and gain widespread acceptance in education. Despite the significant implications of communications theory and research, and the fact educational circumstances of the time were favorable to the application of mass media or a technology of mass media, in practice little use was made of the convergence of communications and the audiovisual movement. Saettler (1990) states:

> Aside from the usual resistance of educational institutions and teachers to new ways or means of communicating, the primary reason that educational technology did not incorporate communications within its conceptual framework to any great degree is that behaviorism began to exert its influence in the early 1960s, just about the time that communication was beginning to have some impact on educational technology. (p. 277)

Perspectives On the Beginnings of the Science of Instruction

According to Saettler (1968), modern day instructional technology finds its definition and earliest roots involved with a consideration of at least two concepts: "the physical science, or media, concept and the behavioral science concept. Although often functionally interrelated, each is an outgrowth of different theoretical notions, and each viewpoint holds important implications for learning and instruction" (p. 1).

The view of educational technology, during its early stages as visual instruction (and later as audiovisual communications), had traditionally been primarily concerned with a *physical science concept*— the use of specific media and as a small, specialized movement almost completely separated from the mainstream of educational technology. This concept usually involved the application of physical science and technology, such as film projectors, audio and video recorders, and television for group presentations of instructional materials. The concept viewed media as tools or aids to instruction and tended to be more concerned with the effects of the various instructional devices and procedures, vs. concern for the differences among learners or the selection of instructional materials (Saettler, 1968).

The use of audiovisual media had been little influenced by theory-oriented research and generally ignored psychological theory, stressing group presentation of materials without explicit regard for individual differences in learning ability. Whereas, a "technology of instruction" was oriented toward

theory, the psychological principles, and empirical data was based on the total teaching-learning processes. This issue provided yet another impetus, during the late 1940s, for reassessing the state of the visual movement: concern revolved around visual instruction's relationships to the educational technology and instructional theory (Saettler,1968).

> From the earliest days of the visual instruction movement the predominant theoretical rationale justifying the visual approach to instruction was based on the concept that visual materials would serve as an antidote for verbalism. The traditional rationale has identified devices, machines, or media, use of particular senses (primarily visual), and characteristics of instructional aids or teaching materials on the basis of their levels of concreteness or abstractness. (Saettler, 1990, p. 140)

During the postwar period, "both audiovisualists and educators generally developed an increased sensitivity to the applicability of scientific theories of learning to practical problems of instruction. Moreover, there evolved an increased sophistication concerning the function and role of the media and/or communications specialist within the total context of instructional technology" (Saettler, p. 180).

The physical science (media) concept predated the second concept, the *behavioral science concept*, by several decades: This concept was of more recent origin, from the World War I era and the impetus the war gave to psychology in the areas of intelligence tests and statistical measures. "Ironically,

even though behaviorism developed in the early decades of this [twentieth] century, it did not exert any great influence on educational technology until about the time its dominance in American psychology was beginning to wane in the 1960s. Behaviorism began to make an impact on educational technology in the early 1960s, with B. F. Skinner's concepts of reinforcement and with applications in teaching machines and programmed instruction" (Saettler, 1990, p. 286). Behaviorist-influenced "systems approaches to solving educational problems originated in military and industrial training but later emerged in university research and development projects. K-12 practices began to reflect systems approaches when university personnel began advocating them in their work with schools" (p. 6).

Robert Glaser, B. F. Skinner, and Edward Thorndike were among the noted *behaviorists* during the interwar years. Thorndike was an educator whose theories and methods, according to Saettler (1968), produced or fostered a modern science and technology of instruction and, along with John Dewey, dominated much of the thought and practice of American education during the first half of the 20th century. Thorndike, an educational psychologist, fashioned the first scientific learning theory and established empirical investigation as a basis for a science of instruction. In fact, it was Thorndike who, in 1902, offered the first course in educational measurements at Columbia University and became the first to apply the methods of quantitative research to instructional problems (p. 47-8). "Behaviorist theories held sway initially and cognitive theories gained influence later" (Roblyer and Edwards, p. 2000, p. 6-7).

Behaviorists stressed that educational practice should be more dependent on the methods of science as developed by behavioral scientists in broad areas of psychology, anthropology, sociology, and in specialized areas of learning, group processes, language, and communications. The term *behavioral science* first began to be widely accepted in the 1950s when the Ford Foundation supported the Behavioral Science Program with several million dollars (Saettler, 1968).

The behavioral science concept, and the behaviorist impact on educational technology, provided the impetus for the beginning of the instructional design movement and the advent of a systematic approach to instruction (Saettler, 1990). This approach added another dimension to the existing media-and-audiovisual-communications view of technology in education. "The traditional theoretical framework of educational technology had emphasized the stimuli or messages to the learner; behaviorism shifted the learning emphasis onto the behavior of the learner and its reinforcement. Thus, the primary purpose of media became reinforcement rather than merely presentation" (Saettler, 1990, p. 286).

Following the behaviorists came the *information processing* theories of Richard Atkinson and David Ausubel. Robert Gagne built upon both behavioral and cognitive theories in playing a key role in the development of instructional systems design (Roblyer and Edwards, p. 2000). Systems approaches to solving educational problems shifted to the belief that both human (teachers) and non-human resources (media) could be integrated as parts of a system— the

analysis, design, development, and delivery of instruction— for addressing the needs of learners. From this perspective, educational technology was not seen just as a medium for the diffusion of knowledge, but as a systematic approach to designing, developing, and delivering instruction matched to carefully identified learner needs (Heinich et al., 1996). Resources for delivering instruction were identified only after detailed and careful analysis of learning goals, objectives, and tasks, and the appropriate instructional strategies that were deemed as being required to teach them (Roblyer and Edwards, p. 2000).

Section VII:
CONCLUSION

In this study I attempted to demonstrate that the organizations, educational and political issues, and legislation described in the first three sections represented early, crucial elements in federal intervention in educational matters and the emergence of the formative patterns of instructional technology in American educational practice: What were the significant historical events that prompted federal intervention, in terms of research sponsorship and funding of education? What role did instructional technology and media play during periods of national crises in terms of military training and industrial manpower preparedness? What roles did the wartime preparedness, industry workforce training, training in the sciences, and federal legislation play in the development of modern instructional methodologies?

During the late 1940s and the 1950s, the impetus for much of the federal government's role in education, the evolution of instructional technologies and media, and university-based research was in reaction to world events, national defense needs, and concern for the country's economic and scientific competitiveness. Therefore, in subsequent sections of the study, federal interventions in education are described in terms of the increasingly broader

definitions of what the nation's defense and public welfare might encompass, and the potential roles that education and instructional technologies would be called upon to assume: What events prompted the National Science Foundation (NSF) Act of 1950, the National Defense Education Act (NDEA) of 1958? What were the influences and outcomes from the aforementioned and subsequent federal legislation that impacted science and math education, and advances in the utilization of new instructional technologies, materials, and teaching aids in the classroom and scientific and technical training programs? How did instructional technology—as *visual instruction,* and later as *audiovisual communications*—in education evolve in the United States?

Federal Interventions in Time of Crises and National Embarrassments

Throughout our nation's history there have been significant events, legislation, and other evidence of a gradual and significant federal involvement in education. The national welfare, defense of the nation, and racial desegregation, among others, are issues that have provided legislators and presidents with rationale for federal intervention and financial aid. The Morrill Land-Grant Act of 1862 is an early example: this legislation was passed during the outbreak of the Civil War, and is generally regarded as the first overt involvement in education by the federal government in the history of the United States.

Federal interventions in scientific research and educational matters—particularly in higher education—began to accelerate prior to World War II as education was called upon to support the national agendas of wartime

preparedness, manpower training, and later competition with the Soviet Union and reclaiming global leadership in science and technology. Following the war, most Americans anticipated a period of relative peace, and had expectations of economic improvement and increased prosperity. Instead, the decade following the war proved to be one of uncertainty and was characterized by crises both at home and abroad. Federal education legislation during this time frame was fixated on education as a response to a Cold War emergency (the launching of Sputnik) and in reaction to forces of social and technological change working in America.

On the international stage, Sputnik sparked concern in the nation regarding its science, technology, and educational leadership. There was fear in Congress and in the Eisenhower administration that the nation had lost the space race and academic superiority to the Soviets. In particular, the Naval Research laboratory's failed attempt to launch a Vanguard rocket carrying an American satellite, two months following the first Sputnik launch, reinforced the resolve for legislation that would increase the prowess of American science, technology, and education.

The national embarrassment of Sputnik and the Vanguard failures and worries about America's faltering technological leadership and competitiveness during the Cold War added another dimension to the on-going, and often complex and acrimonious, debate in education among advocates of schooling for social development and advocates of schooling for intellectual excellence.

"The latter tend to prevail during periods of heightened international competition" (Kaestle and Smith, 1982, p. 393).

The expansion in the science training role of the National Science Foundation and passage of the NDEA in 1958 represented the first critical milestones in federal education-related efforts that attempted to find solutions to those events, needs, and concerns by directly funding the nation's schools and universities. Emerging from the period marked by the end of World War II, Sputnik and the passage of the NDEA came a vigorous re-assessment of education, new developments in the area of instructional methodology, and early efforts to explore the potential role for technology in America's classrooms— all in the name of national defense and security. Of significance is that fact the NDEA promoted federal interest in, and direct support for, science and mathematics education at the elementary and secondary levels (as well as higher education). As previously noted in this study, it was not until the mid- to late-nineteenth century that America's institutions of higher education moved from curricula that stressed classical education, to curricula that began to place more stress on the sciences, engineering, math, and graduate level studies.

The NDEA, in particular, was for the American people, a call to arms because of the seemingly poor preparation children were receiving in America's schools to play the leading role in world affairs. This act was passed to provide substantial finance assistance to students, schools, and states to ensure a future supply of trained people to meet the national defense needs of the U. S. in the Cold War. The Russians, it seemed by the launch of the Sputnik, were

surpassing the U. S. in knowledge of science, mathematics, and the ability to bring new technology to the global marketplace.

On the home front, school desegregation and the emergence of the Civil Rights Movement occupied the attention of politicians, educators, and the nation as a whole. Beginning with *Brown v. Board of Education of Topeka (1954)* and a plethora of later cases; and later the Civil Rights Act of 1964, federal judicial and legislative interventions brought about the first significant steps toward integrating the nation's schools. Of equal importance to the nation's minorities, this federal intervention made it increasingly possible for racial minorities and historically Black colleges and universities to benefit from the aforementioned federal education legislation.

However, as Urban and Wagoner (2000) explain, implementing the integration of schools proved far more difficult than most proponents had envisioned:

> There were several reasons for this difficulty. First, the federal courts had no agency to enforce their mandates. Second, the office of the president, particularly under the Eisenhower administration, failed to act decisively on behalf of the *Brown* mandate. Third, Congress through its seniority and committee system, was controlled by southern legislators pledged either to the ideology of "massive resistance" to *Brown* or to a studied inaction that amounted to the same thing. (p. 321)

Setting the Precedent for Federal Aid to Education

While the nation had what originally appeared to be a joint, independently-run private / public higher education system, its development came to be dominated by the federal government in terms of fundamental initiatives and guidelines as a result of World War II, the Cold War, and the national welfare in general. Previously, the great initiative that impacted higher education in particular was the Morrill Land-Grant Act of 1862. With World War II came the decision to have the federal government to rely on universities for basic and applied research and the GI Bill of Rights of 1944. "These three initiatives taken together, more than all other policy initiatives, have impacted the development of the American 'system' of higher education. To the extent that it is a 'system', it is a federally influenced system: *e pluribus unum*" (Kerr, p. 27).

The Cold War brought the National Defense Education Act of 1958. Although the NDEA and subsequent legislation of the 1960s marked an expansion of the federal government's categorical aid to education, they can hardly be considered radical. The federal government's periodic assertion that good education was in the national interest, the sustained precedent of the Smith-Hughes Act (and subsequent vocational legislation), and the Congressional habit to intervene in interest of manpower problems during the Great Depression, World War II, and the Civil Rights era of the 1960s— all contributing to the context within which the NDEA and the Great Society programs were created and evolved. And, similarly, the *Brown v. Board of*

Education (1954) marked a new incursion by the federal judiciary to ensure equal educational opportunities for all students, regardless of race.

For the nation, therefore, the tone and tenor for future federal involvement with schooling had been set. Fass (1986) describes this circumstance:

> Since the 1954 Supreme Court decision in *Brown v. Board of Education,* and especially since the 1960s, Americans have become accustomed to active federal participation in education. We often assume that the recent past emerged from a kind of *tabula rasa,* a long prehistory of federal quiescence in which educational matters rested exclusively and naturally in the domain of the states and local school districts, where the silence of the Constitution seemed to leave the matter. In fact, American history is dotted with instances of federal activity affecting education. Usually, however, these were simple legislative acts....Rarely did the federal government actively design a set of programs or policies, which reach broadly and deeply into the realm of education. The one important exception was the New Deal. The reform activities initiated by Franklin Roosevelt in the 1930s to cope with the devastations of the Depression were unprecedented in many ways. Not the least of these was the significant educational dimension of federal intervention, which was carved out of the jigsaw pattern of economic relief. The federal activity was not only fundamentally new but had significant implications for defining a new federal responsibility in educational matters which anticipated our more recent experiences...fundamentally altered beliefs

about the role of the federal government in the area of education and raised, without completely defining, a new ideal of education as an entitlement. (p. 22-23)

At first blush, it seems that there is a logical connection between national crises and the establishing of national educational policy. According to Kaestle and Smith (1982), wars, both hot and cold, "threaten and unite a nation, creating reasons for large-scale mobilization of talent and resources that tend to outweigh traditional resistance to centralized control of education" (p. 391). "All nations, in war and in peace, have used schools to inculcate nationalism. Whether schools could aid world peace by advocating peace and international government is a moot point; in this, as in so many matters, schools are more reflective of society than instrumental in causing its problems or solutions" (p. 392).

Establishing a national educational policy would prove to be difficult and frustrating for the federal government. Among the many challenges facing the federal government in its efforts to upgrade and improve the nation's schools and universities there were two potential inhibitors— the lack of a centralized school system in this country and the prevalence of racial and gender discrimination:

- The fragmented, decentralized nature of U.S. education had the potential to restrict the spread of new technology, especially to small or remote school districts, private schools, and minority

groups— where its effect would be greatest in guaranteeing a minimum level of education.

- Wide-spread segregation in the nations school systems and higher education, and the prevailing notions of gender bias, contributed, in part, to compromising the effectiveness of educational legislation in reaching and positively impacting women, racial minorities, and historically Black colleges and universities.

The NDEA was unprecedented in many respects, but in reality the total amount of federal aid that was appropriated to education was not large: "total allocations did not equal either the school milk and lunch programs or the federal aid to impacted areas programs" (Kaestle and Smith, 1982, p. 394). "The long-lasting effect of the legislation, however, was in the precedent that had been set. Rather than continuing the trend of single-purpose legislation, the passage of this act legitimized broad-based federal aid to education for the first time. The full scope of the federal efforts was not felt until midway through the next decade, when President Lyndon Johnson piloted through Congress a more comprehensive and wider-ranging educational aid law" (Urban and Wagoner, 2000, p. 296-7). The NDEA, nevertheless, had put the federal government firmly on the side of educational aid for specific purposes (Kaestle and Smith, 1982).

The NDEA—coupled with initiatives from business and industry, the Ford Foundation, the National Science Foundation, and the Carnegie Corporation—began to funnel funds to the nation's schools, adult learning environments, and

employment training programs for the construction of new learning facilities, purchasing equipment, and integrating modern electronic and mechanical aids into the process of education. Together, the NDEA and the aforementioned organizations represented important elements of a national agenda to upgrade and expand the scope of math, engineering, and science learning in America's schools— with the goal of re-establishing and maintaining excellence in America's schools. Although the NDEA no longer exists as an independent statute, its impact remains today (Russo, 2001).

Science for National Prestige and Security

America's responses to Sputnik and its Cold War technological achievements bolstered the credibility of research as a source of protection against ostensibly hostile nations and were central to shaping federal research policymaking during the late 1950s and early 1960s. However, these responses also led to a fragmentation of research policymaking and did little to improve the coordination of critical research.

Sputnik played an important symbolic role in prompting the creation of several new federal organizations devoted to scientific research and development: Within the context of the nation's hysteria over Sputnik and in the interest of national security, the National Aeronautic and Space Administration (NASA) was created a year after the launch of Sputnik to replace NACA. Established in 1915, NACA was established to foster aviation progress in the U. S. and had been moving into space-related areas of research and engineering

during the 1950s. NASA solved the problem of promoting civilian space research by consolidating all space exploration projects under an single administration and provided a focal point for United States' efforts to compete with and eventually win against the Soviets in the space race. The Defense Department was, therefore, to restrict its efforts to secret programs with direct military application.

Next came the creation, within the Defense Department of the Advanced Research Projects Agency (ARPA), in response to the Department's need for high-level attention to promising longer-term research projects and to explore advanced technologies. Since its creation, ARPA has contributed to various important technological innovations in areas from computers to materials science. It has no labs of it own, but instead supports university and industry research, paying these organizations to push the envelope of high-risk, high payoff technological ventures. The agency's list of significant developments include: Stealth aircraft, cruise missiles, robotics, satellite, artificial intelligence, and the ARPA-Net, the forerunner to the Internet.

The rhetoric of the Cold War and the national embarrassment of Sputnik meant an orientation was established toward science for national prestige and security. Historical junctures viewed as crises motivated the change.

The Promise of Instructional Technology and Media

In his comprehensive historical survey of educational technology, The Evolution of American Educational Technology (1990), Saettler writes: "It is clear

that educational technology is essentially the product of a great historical stream consisting of trial and error, long practice and imitation, and sporadic manifestations of unusual individual creativity and persuasion" (p. 4). He further notes that the earliest reference that he can confirm regarding the use of the term *education technology* was in an interview with W. W. Charters in 1948; the earliest known reference he finds for the term *instructional technology* was in a 1963 forward by James Finn for a technology development project sponsored by the National Education Association.

Instructional technology such as audiovisual media existed prior to World War II to facilitate learning. Yet, it was this war and the federal government's postwar education intervention through legislation (such as the NDEA and its direct financial aid to education) that helped to support use of media technology and accelerate the pace of the development of the first systematic applications of media for instructional purposes.

Several important factors brought about this development and utilization of instructional technology during the war: (a) the establishment of industrial and military training programs which produced unprecedented demands for effective instructional technologies, (b) the emergence of federal and military policies that encouraged the broad use of instructional media and production of a wide variety of instructional materials, leveraging pre-war scientific research into a technology of instruction; and, (c) the allocation of almost unlimited financial resources for the implementation of instructional technology to meet wartime needs.

Since the advent of the visual education movement, the use of media had been little influenced by theory-oriented research and generally ignored psychological theory. Instead, initiatives to implement media tended to stress group presentation of materials without explicit regard for individual differences in learning ability. Likewise, the various media movements, and society in general, became fascinated with each introduction of new media technology. The use of visual aids became disconnected from educational theory. The existence of a relationship between increased utilization of audiovisual media and the emergence of communications and, later, behaviorist theory that espoused sensory experiences as being essential to learning, were found to be fragmentary and fragile at best.

Audiovisual media was viewed as tools or aids to instruction and tended to be more concerned with the effects of the various instructional devices and procedures vs. concern for the differences among learners or the selection of instructional materials (Saettler, 1968). Saettler (1990) adds:

> From the earliest days of the visual instruction movement the predominant theoretical rationale justifying the visual approach to instruction was based on the concept that visual materials would serve as an antidote for verbalism. The traditional rationale has identified devices, machines, or media, use of particular senses (primarily visual), and characteristics of instructional aids or teaching materials on the basis of their levels of concreteness or abstractness. (p. 140)

It would take several decades, until the 1950s, for the emphasis in audiovisual instruction "to shift from the 'things' of the instructional situation to the complete communications process involved in transmitting information from a source (a teacher) to a receiver (the learner)" (Saettler, 1990, p. 167).

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