The Technocratic Momentum after 1945, the Development of Teaching Machines, and Sobering Results

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Abstract • This article investigates the development of new teaching ideologies in the context of the technocratic ideology of the Cold War. These ideologies did not simply vanish after 1989. The catchwords were "programmed instruction" and "teaching machines", accompanied by the promise that all students would make efficient learning progress. Although Eastern and Western states fought the Cold War over political ideologies, their teaching ideologies (perhaps surprisingly) converged. This may explain why neither the apparent failure of these educational ideologies nor the end of the Cold War led to the modification of the ideologies themselves, but rather to the modification of devices serving the ideologies.

Keywords • behaviorism, Burrhus Skinner, cognition psychology, Cold War, Jerome Bruner, programmed instruction, teaching machines, Sputnik

Walter Heller, the economic advisor to the president of the United States, said in his keynote address to the plenary session of the first conference about education held by the Organization for Economic Co-operation and Development (OECD) in October 1961 that educational issues were of the utmost importance and therefore should not be left entirely to the professional stakeholders in the educational field. "May I say that, in this context, the fight for education is too important to be left solely to the educators."[1]

The notion of fighting for education expressed in this speech is not misleading. It refers to the first national law on education that the US Congress ever passed, that is, the National Defense Education Act of 1958, which was implemented in direct response to the Sputnik satellite launched by the Soviet Union on 4 October 1957. The alleged technological lead that the Soviets had won over the United States had triggered a fundamental national crisis that would prove to have far-reaching consequences for education and daily life. For the first time in US history, education became a national issue after having previously been a local

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issue. This transcendence expresses a more widespread understanding of problems as the result of deficits in the education system. This reaction originated in the late eighteenth century and was usually related to social problems.[2] During the Cold War, however, it was used to address the lack of technological competence, which was alleged to have a considerable impact on economic and military development. Whereas the process of "educationalization" around 1800 was based on questions regarding civic progress and uncertainty,[3] during the Cold War it fostered school subjects such as mathematics and the sciences in the global martial contest for world domination. The medical historian Thomas Bonner found widespread support when he wrote, in 1958, that, "Science and education have now become the main battleground of the Cold War. It is upon education that the fate of our way of life depends. It means that the outcome of a third world war may be decided in the classroom."[4]

This educationalization of the Cold War was of course by no means limited to the Western world. In the Soviet Union in 1958 the president, Nikita Khrushchev, launched an educational reform in secondary education in order to "revive technical and vocational emphasis."[5] Although the importance of the state's educational ambitions for the armed forces was rarely explicit, such ambitions were frequently expressed in military language. It is no coincidence that in the United States one of the leaders of this educationalization of the Cold War was Hyman Rickover, a vice admiral of the United States Navy and "father of the Nuclear Navy,"[6] who took an interest in education during the Cold War. "Education is Our First Line of Defense—Make it Strong" was the title of the first chapter of Rickover's book *Education and Freedom*, published in 1959 eighteen months after the launching of Sputnik.[7]

Rickover's commitment to educational questions at the end of the 1950s was not an exception within educational history but part of a broader cultural shift that had begun[8] in the early 1950s and later began to dominate global policy in education via transnational organizations such as the OECD. It included an alliance between economists, high-ranking military officers, scientists, and psychologists including, initially, behavioral psychologists and, later, cognitive psychologists (who were often considered to be the heirs of behavioral psychologists). Philip Coombs, who also gave a keynote speech alongside Walter Heller at the OECD conference on education in October 1961, was an economist who became the head of the UNESCO International Institute for Educational Planning in 1963. Coombs held the position until 1968, when he published his best-selling *The World Educational Crisis*.[9] The head of the OECD committee who addressed questions concerning education at that time was Alexander King, a British chemist who was assisted by James Ronald Gass, a British social scientist who, according to the Norwegian economist and

deputy undersecretary of state in the Ministry of Education and Church Affairs Kjell Eide, did "not know much about education."[10]

The aim of this article is to show that, during the Cold War in the 1950s, a fundamental educational shift affected the curricula of the countries involved, and that specific organizations (primarily the OEEC and its successor OECD, but also the UNESCO International Institute for Educational Planning) provided the organizational framework for this educationalized ideology—an ideology which continues to exert its influence on nation-states to this day. The different strategies connected with this educationalization of the Cold War were partially compatible, but not mutually coordinated. They were strongly influenced by specific modes of successful problem-solving strategies developed during the Second World War in institutions such as the Massachusetts Institute of Technology, Harvard University, and the Manhattan Project. In these settings it was not only politicians, scientists, and engineers who were involved in cooperative teamwork, but also psychologists, who developed methods of testing individual abilities, strategies in applied social psychology, and programs of instruction and training. The two stars in educational reforms since the late 1950s, Torsten Husén in Europe and Jerome Bruner in the United States, had both been military psychologists during the Second World War. By virtue of their participation in these war programs these psychologists were able to understand problems in the language of science, which defines relations in a causal way and uses notions such as input, output, and rational control system.[11] When, in the late 1950s, these former military psychologists were requested to help to reform education, they translated the complex and non-causal cultural system of education into a technological system that could be "steered".[12] Against this background, it is not surprising that Bruner, at an education conference sponsored by the US Air Force in Woods Hole, Massachusetts (after Sputnik, in 1959), noted that by reforming education "the entire array of possible alternatives that might be created by using existing or newly developed technologies … from scratch" and that "the goals of education … expressed in terms of the human functions and tasks to be performed … can be as exactly and objectively specified as can the human functions and tasks in the Atlas Weapon System."[13]

This (largely Western) technocratic culture (of which this article deals exclusively with the last) includes the following aspects:

1. At the level of governance this new strategy challenged the democratic idea of local school boards. Locally elected laymen were now meant to implement the theories of central experts. The general assumption of the expert-driven democracy was "that democracy is best, in which people participate least."[14]

2. These experts based their educational vision on the human capital theory (the expansion of education as *investment*[15]) and the vision of useful knowledge, including languages, sciences, and mathematics (curricular reform).[16]
3. The experts based their education policy decisions on the results of cognitive psychology tests in schools and comparative statistics.[17]
4. It was thought that this new ideology would spread across the world via transnational organizations such as UNESCO or the OECD and national institutions such as the Max Planck Institute for Human Development and Education (founded in 1963).[18]
5. Teaching of school subjects should become efficient and individual; the catchword was "programmed instruction", and its central instrument was the teaching machine.

The following exploration reflects the development of new teaching ideologies in the context of the overall technocratic ideology of the Cold War, ideologies that persisted after the fall of the Iron Curtain in 1989.[19] This article explores the way in which the new teaching ideology had become possible in the context of the Cold War, and how it found expression in teaching machines and in programmed instruction (often in combination with cybernetics). The third part will show how (after Sputnik and the educationalization of the Cold War) these new teaching methods were supported and how this support affected unprecedented research activities. The final section shows how the failure of this ideology did not lead to an intelligent modification of the ideology but to the modification of the devices serving the ideology.

The New Science of Learning, Military Anxiety, and Education in the 1950s

When the Cold War was educationalized after the shock of Sputnik in 1957, a limited amount of relevant and suitable (new) theories of learning and education were available. In 1953, when McCarthyism was at its peak, the behaviorist and former military psychologist B. Skinner published his landmark book, *Science and Human Behavior*.[20] During the Second World War Skinner had trained pigeons for use in steering Pelican missiles, and in his book he transferred his insights into pigeon training ("operant conditioning") to the human sphere. A year later his article "The Science of Learning and the Art of Teaching"[21] transferred learning theory developed with the pigeons ("Science of Learning") to education ("Art of Teaching").

Learning is understood as behavior, and desired behavior is caused by the "reinforcement" of provoked "effects" of specific, prepared conditions.[22] The advantage of this "positive reinforcement" technique is that

(for the first time, Skinner argues) it builds on positive feedback and not on aversive feedback. Whereas the old pedagogy had been based on the child's fear of being punished by the rod, the movement called "progressive education" had only seemingly moderated this brutal practice, for "anyone who visits the lower grades of the average school today will observe that a change has been made, not from aversive to positive control, but from one form of aversive stimulation to another."[23] In the old system, whether traditional or progressive, the teacher cannot escape mistreating the learner:

> The child at his desk, filling in his work book, is behaving primarily to escape from the threat of a series of minor aversive events: the teacher's displeasure, the criticism or ridicule of his classmates, an ignominious showing in a competition, low marks, a trip to the office "to be talked to" by the principal, or a word to the parent who may still resort to the birch rod.[24]

Wrong reinforcement is one of the problems of the "old" system(s), of which Skinner lists another three. First he addresses the time span between fulfillment of the task by the learner and the reinforcement by another. "Many seconds or minutes intervene between the child's response and the teacher's reinforcement … it is surprising that this system has any effect whatsoever."[25] Immediate reinforcement is one of the necessities, a "skillful program which moves forward through a series of progressive approximations to the final complex behavior desired" is another,[26] and the "frequency of reinforcement" is the third. The result is that "The condition in the average school is a matter of widespread national concern. Modern children simply do not learn arithmetic quickly or well."[27] Instead of being dedicated to clearly defined progressions of learning targets, the modern teacher is caught up in unclear expectations brought about by progressive philosophy, according to which, "Skills are minimized in favor of vague achievements, educating for democracy, educating the whole child, educating for life, and so on."[28] When Skinner published his propaganda article about more effective ways of teaching in 1954, John Dewey had been dead for two years. Dewey was the epitome of progressive education,[29] and was accused of having introduced an inefficient and possibly misguided way of teaching in the United States.

In the view of the new, science-based paradigm in education, American teachers had been seduced by the false ideals of progressive education instead of becoming committed to a modern technological worldview. Indeed, the ideals of education advocated by the American teachers as they had been formulated in 1961 by the National Education Association and the American Association of School Administrators were health, worthy home membership, vocational competence, effective citizenship, worthy use of leisure, ethical character, self-realization, human relation-

ships, economic efficiency and civic responsibility. However, they did not include the mastery of school subjects.[30]

After Sputnik, these ideals were condemned as inappropriate or even dangerous, and they were interpreted as educational practices that weakened the strength of the nation and thus paved the way for the dominance of Soviet communism. After Sputnik, in December 1957, *Time* magazine reported on education in the United States. In the article, Vice Admiral Hyman Rickover was asked about the efficiency and purposefulness of the American school system. Angrily he said that "If the local school continued to teach such pleasant subjects as 'Life adjustment' and 'How to know when you are really in love,' instead of French and physics, its diploma would be, for all the world to see, inferior."[31] It is in this context that Rickover postulated, for the first time, national standards and a system of incentives:

> In some fashion we must devise a way to introduce uniform standards into American education. It would be best to set up a private agency, a Council of Scholars, financed by our colleges and universities as a joint undertaking—or perhaps by Foundations. This council would set a national standard for the high school diploma, as well as for the scholastic competence of teachers. High schools accepting this standard would receive official accreditation, somewhat on the order of the accreditation given medical schools and hospitals.[32]

Stakeholders at the intersection of the sciences, the military, and the economy asked for fundamental change, involving more sciences in the curriculum and more science-based modes of teaching. The former president of the United States Herbert Hoover declared after Sputnik that

> The trouble is that we are turning out annually from our institutions of higher education perhaps fewer than half as many scientists and engineers as we did seven years ago. The greatest enemies of all mankind, the Communists, are turning out twice or possibly three times as many as we do. Our higher institutions of learning have the capacity to train the recruits we need. The harsh fact is that the high schools are not preparing youngsters for the entrance requirements which must be maintained by our institutions training scientists and engineers.[33]

Skinner did not wait long, and published an article as early as 1958 in which he propagated his ideas of teaching machines, defining his ideas on operant conditioning.

Teaching Machines and Programmed Learning

Skinner started advocating his teaching machines in 1954, the same year that he transferred his insights from pigeon training to education. He pro-

duced a film in which he demonstrated the effects of his new teaching method.[34] In the film, he praises the teaching machine as "a device which creates vastly improved conditions for effective studying."[35] The machine looks like this:

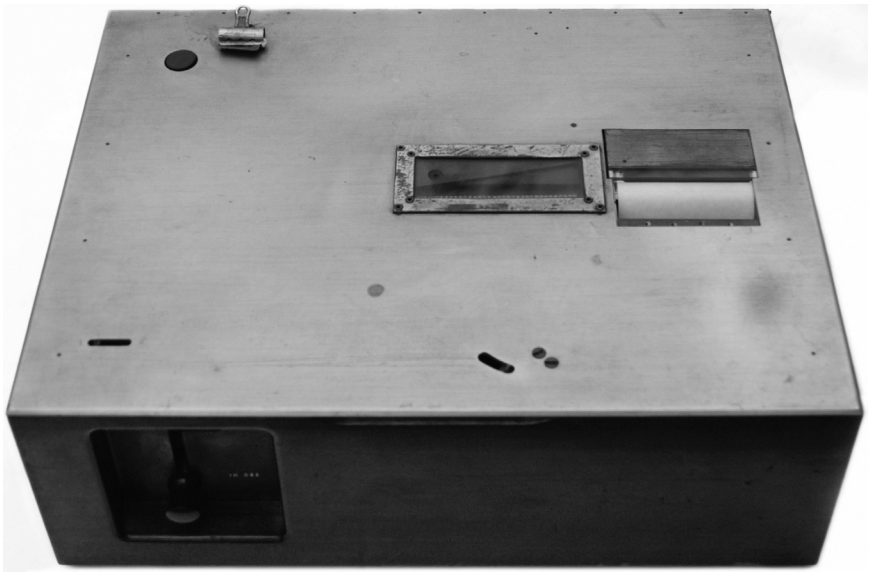


Figure 1. Skinner teaching machine.

In the film, Skinner goes on to explain the function of the teaching machine with the same rationale developed in his article, "The Science of Learning and the Art of Teaching": "With the machine you have just seen in use, the student sees a bit of text, or rather printed material, in a window." This bit could be a "sentence or two, or an equation in arithmetic." However, this bit is not complete; some "small part is missing, and the student must supply it by writing on an exposed strip of paper." According to the created problem the student's response "may be an answer to a question or the solution of a problem, but generally it is simply a symbol or word, which completes the material he has just read." The great advantage of this kind of learning, says Skinner, is that as "soon as the student has written his response, he operates the machine and learns immediately whether he is right or wrong. This is a great improvement over the system in which papers are corrected by a teacher, where the student must wait perhaps till another day to learn whether or not what he has written is right."[36]

Skinner[37] sees three fundamental advantages to the machine: immediacy, individuality, and perfectibility:

1. *Immediacy:* Immediate feedback has two effects: (1) "It leads most rapidly to the formation of correct behavior. The student quickly learns to be right" and (2) "The student is free of uncertainty or anxiety about his success or failure." Skinner says this makes "work … pleasurable." Coercion is no longer needed, for a "classroom in which machines are being used is usually the scene of intense concentration."
2. *Individuality:* The machine allows the student "to move at his own pace." Therefore, it solves the problem of traditional teaching "in which a whole class is forced to move forward together, the bright student wastes time waiting for others to catch up, and the slow student, who may not be inferior in any other respect, is forced to go too fast."
3. *Perfectibility:* A third feature of this propagated machine teaching is that "each student follows a carefully constructed program." This program leads "from the initial stage, where he is wholly unfamiliar with the subject, to a final stage in which he is competent." The student progresses "by taking a large number of very small steps, arranged in a coherent order. Each step is so small that he is almost certain to take it correctly."

The presence of small steps increases the chance of success, and success in turn motivates the student to continue ("positive reinforcement"). Skinner promises that this setting is not only better in terms of motivation but also in terms of efficiency. "A conservative estimate seems to be that with these machines, the average grade or high school student can cover about twice as much material with the same amount of time and effort as with traditional classroom techniques."[38]

In 1958, in the wake of Sputnik, the National Defense Education Act had set aside seventy million dollars annually for subsequent years "for the acquisition of teaching equipment (suitable for use in providing education in science, mathematics, or modern foreign languages),"[39] and Skinner was supported in the further development of this teaching machine.

To legitimate his teaching ideology, Skinner published an article about teaching machines in the journal *Science* in October 1958.[40] Not surprisingly, the article starts with a comment on the need for more education and for more effective education. "There are more people in the world than ever before, and a far greater part of them want an education. The demand cannot be met simply by building more schools and training more teachers. Education must become more efficient."[41] The growing size of the classes, says Skinner, may render the student "more and more a mere passive receiver of instruction."[42] Skinner mentions earlier attempts to design teaching machines by Sidney Pressey, a psychology professor at Ohio State University, but reminds us that in those days learning theories

had not been well developed. This had changed in the meantime, Skinner argues. "The learning process is now much better understood. Much of what we know has come from studying the behavior of lower organisms, but the results hold surprisingly well for human subjects."[43] However, what works with regard to "the behavior of lower organisms often cannot be arranged by hand; rather elaborate apparatus is needed. The human organism requires even more subtle instrumentation."[44]

In the article Skinner repeats his main argument from his text of 1953, criticizing the "old" way of teaching, criticizing John Dewey for not having had a real alternative to the old drill school, and propagating his teaching machine for effective learning (a "science of behavior"[45]) in mathematics, foreign languages, and high school physics. Here, Skinner admits that the "machine itself, of course, does not teach." However, it "brings the student into contact with the person who composed the material it presents. It is a labor-saving device because it can bring one programmer into contact with an indefinite number of students. This may suggest mass production, but the effect upon each student is surprisingly like that of a private tutor."[46] The reference person for the student is no longer the teacher but the programmer. It is of no surprise that stakeholders in the late 1950s supported efforts to develop the teaching machine, for it complemented another idea on instructing with minimum emphasis on teachers, again developed by the intersection of army and psychology, namely, the idea of "programmed learning" developed by the air force around 1955.

Programmed Learning and the Anxieties of the Cold War

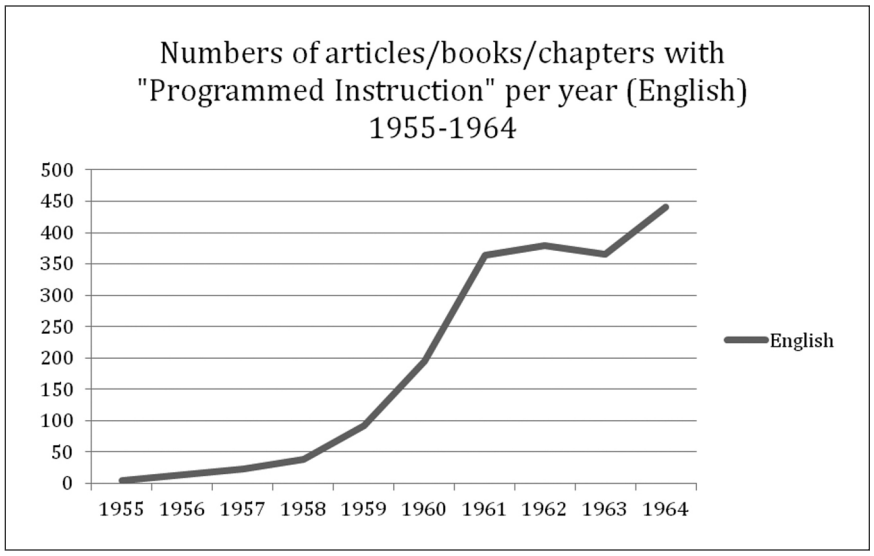
In 1955, a year after Skinner had launched the idea of a teaching machine that promised to instruct students more efficiently than the old ways of teaching, two psychologists (Guy Besnard and Leslie Briggs), an air force lieutenant (George Mursch), and a member of the technical staff at Hughes Aircraft (Elbert Walker) published a brochure entitled *Development of the Subject-Matter Trainer,*[47] in which the idea of programmed instruction was explained for the first time. According to the authors, an ideal "device" should "provide opportunity for effective individual and group study of the adjustment and check procedures to be learned."[48] In accordance with Skinner's ideas, students should "receive automatic guidance and information as to the correctness or incorrectness of each response made" and that this would "[free] the instructor to work with students performing on the equipment." If the device was "versatile enough" to offer the students "practice in a great variety of learning problems," it should be capable of being used "regardless of the student's previous degree of knowledge of the problem at hand."[49]

A couple of months later, Besnard, Briggs, and Walker published another twelve-page brochure, *The Improved Subject-Matter Trainer.*[50] Here again, the idea of programmed instruction was favored, and the "device" was developed "to permit students to practice and learn technical subject matter under conditions of reinforced practice with minimum aid of the instructor." Six modes of operation had been designed, five learning modes and one test mode, through which the student could learn effectively.[51]

Between 1955 and 1957 the notion of "programmed learning" was used mostly in air force contexts or in training for medical assistants. However, after Sputnik (in October 1957) the idea became a global one. The Instructional Service of the National Education Association, contracted to the US Department of Education to promote the National Defense Education Act, and organized propaganda initiatives in which people like Wilbur Lang Schramm, a professor of English who had served in the Second World War in the Office of War Information (where he became familiar with behaviorism), served as propagandists.

In 1962 Schramm published a seventy-four-page booklet called *Programmed Instruction: Today and Tomorrow.*[52] The publisher was the Fund for the Advancement of Education, an initiative of the Ford Foundation, which in 1968 became the co-sponsor of the Center of Educational Research and Innovation (CERI) at the OECD and later nurtured PISA. The purpose of the booklet was to popularize Skinner's idea of programmed instruction. In his half-page introduction, Schramm promised what every reformer in education had always promised, that is, to break with tradition and begin completely anew. "Programmed instruction" was of "revolutionary significance" for the education system, for it served to free schools and every individual learner from the "bonds of the past."[53] The first chapter outlined the general idea. "Programmed instruction" replaces the teacher's role from the student's point of view and induces the learner to specific desired ways of behavior. Programmed instruction can be executed by textbooks, but also by teaching machines. Schramm emphasized that the program consists of a series of statements where the student has to fill in a gap in the text or answer a question or tick a multiple-choice option. The pupil should immediately receive a response to his behavior. To give pupils a sense of success, the program should be formulated such that each learning step is so small that the learner selects the right answers most of the time.[54] The large number of publications addressing the subject demonstrates the success of this propaganda in the nervous culture of the Cold War. In English-language publications, the notion of "programmed instruction" was used in twenty-three different articles or chapters in 1957 and in 379 different articles or chapters in 1962.[55]

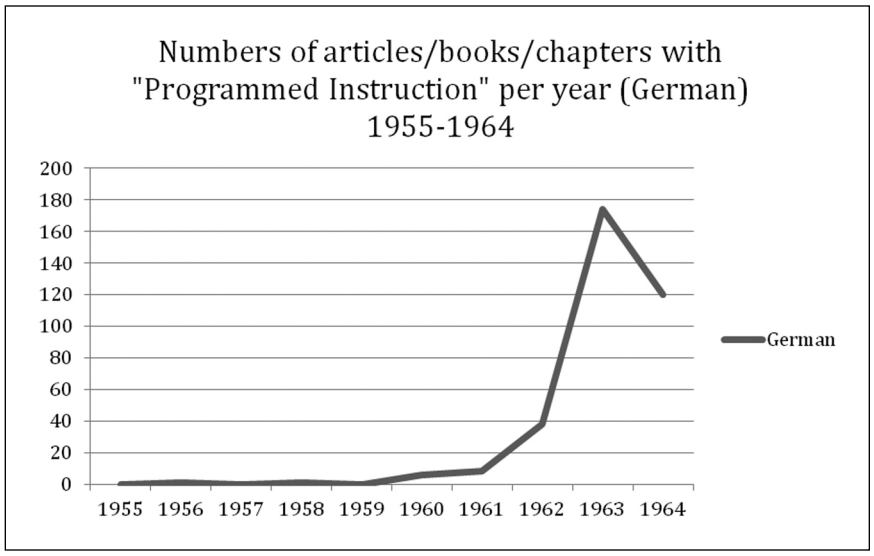
After 1958, the two ideas of the teaching machine and programmed learning were often mentioned together and not infrequently combined



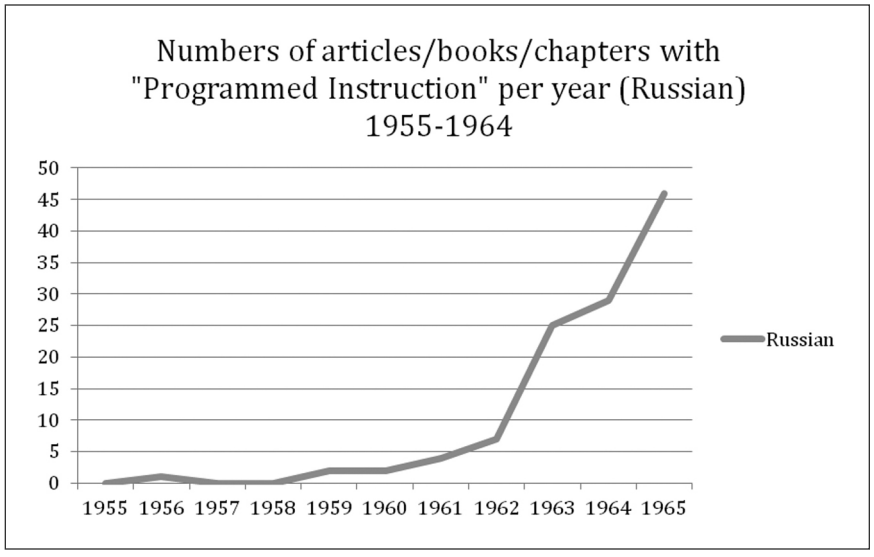
with cybernetics. In Germany, for instance, where the first evidence of discussions about American language laboratories and teaching machines appeared in 1960[56] and 1961,[57] a symposium was held in 1963 in Nürtingen about *Lehrmaschinen in kybernetischer und pädagogischer Sicht* (Teaching Machines from a Cybernetic and Educational Point of View).[58] The same year, an international conference took place in Berlin called *Programmed Instruction and Teaching Machines,* which included a panel on "cybernetics in relation to programmed instruction" organized by the editor of the Nürtingen symposium.[59] In 1964, the *Lexicon of Programmed Instruction* (*Wörterbuch Programmierter Unterricht*) was published with the subtitle *Short Terminology List of Cybernetic Education* (*Kleine Terminologie der kybernetischen Pädagogik*).[60]

Not least due to specific translations, such as Schramm's *Programmed Instruction: Today and Tomorrow* or Robert Mager's *Preparing Objectives for Programmed Instruction* (*Lernziele und Programmierter Unterricht*), the idea of teaching machines and programmed instruction became popular in Europe. In Germany the number of publications with either programmed instruction or teaching machine in the title rose from six in 1960 to over 170 in 1963.

The "enemies" behind the Iron Curtain pursued similar explorations. They too started to investigate programmed instruction and teaching machines, as Hartmut Vogt reported in 1965 in a booklet entitled *Programmed Instruction and Teaching Machines in Academies and Professional Schools in the Soviet Union (Programmierter Unterricht und Lehrmaschinen an Hoch- und Fachschulen der Sowjetunion)*.[61] As early as 1962, the journal *Questions of Psychology* (*Вопросы психологии*) reported on the *Implementation of Some Psy-*



chological Principles in Teaching Machines in the USA (*Реализация некоторых психологических принципов в обучающих машинах в США*).[62] Programmed instruction, based in part on findings from animal psychology, was not affected by the deep political and ideological differences between the West and the East; both sides found it relevant. Moreover, it served the interests of two political leaders who were striving toward global dominance, as the illustrations for publications in the Soviet Union shows:



The Unteachable Reformers

After 1960 several teaching machines and even more textbooks were produced, based on programmed instruction. At the same time language laboratories became popular. Schools invested a lot of money in laboratories to make learning easier than before. Extremely complex efforts were undertaken to "program" knowledge in an infallible way. The idea that both the human mind and the facts of the subject matter were prearranged in an analog way had already been advanced by some eighteenth-century philosophers and reinforced at the Woods Hole conference in 1959, with the support of the air force, the RAND cooperation, and the National Academy of Sciences, under the leadership of Jerome Bruner. The general psychological idea underlying the reform was that "intellectual activity" (the cognitive process) is uniform in principle, regardless of a person's age or situation. The conviction was that "intellectual activity anywhere is the same, whether at the frontier of knowledge or in a third grade classroom."[63] However, not only the human intellect, but also academic and school disciplines were uniform. To learn a discipline at school, the participants at the Woods Hole conference claimed, was basically to learn its "structure". This learning of structure was claimed to be the "heart of the educational process,"[64] which meant that every discipline had a general "idea" or "basic or underlying principle" that needed to be learned by the student. The experts should make decisions concerning curricular content. "The decision as to what should be taught … is a decision that can best be reached with the aid of those with a high degree of vision and competence"[65] in the academic disciplines and was not a decision to be made by elected school boards.

However, the challenges encountered when constructing ideal programs that served the individual's capacities were severe and, after ten years, led to disillusionment. Textbooks dispensed with the idea of gap texts to be filled in from the late 1970s. Those teaching machines that were developed (and sold), such as Brigg's Subject Matter Trainer, PLATO, Socrates, CLASS-System, Promentaboy, MIN/MAX III, Unitutor, Mitsi 2023, Geromat or Robbimat,[66] have disappeared and are largely unknown to modern historians of education, and language laboratories have been removed from schools and colleges.

However, out of sight is not out of mind. The general idea that education is a technological system that should be steered like a technical system has not disappeared. When the discussions about more efficiency in schooling started to label traditional policy as "input-steering" and to compare it with the allegedly more efficient "output-" or "outcome-steering", this technocratic thinking gave rise to a dichotomy. Experts (the former programmers) define standards in subject matter, while schools are "free" (autonomous) in their choice of methods to achieve these standards. To

ensure compliance from the schools, incentives serve as motivation in the same way that Skinner used bread with his hungry pigeons, rewarding them after they had been trained to play a sort of table tennis, as he proudly recounted in 1954.[67]

The shift in educational policy from "input" to "output" was possible with the shift from behaviorism to cognitive psychology. Whereas behaviorism aimed to create desired behavior as defined by experts, cognitive psychology measures desired competencies as defined by experts. Both systems try to minimize the role of teachers in both their public role and in their daily interaction, and both systems view the democratic process as one that is potentially opposed to so-called experts. Both systems view the teacher as a coach, who implements defaults defined by experts. It is no coincidence that, in 1963, when programmed instruction and teaching machines were attracting the attention of education policymakers, the secretary of the Committee for Scientific and Technical Personnel, Alexander King, was lambasting criticism by national delegates who accused him of integrating so-called experts without asking the members. King told them they were simply not familiar enough with the issues to evaluate the committee's work.[68] Chester Finn, a tireless promoter of standards in American schools, described the local school boards in the United States as "living fossils of an earlier age."[69] Those in power did not adequately consider the right to the Western ideals of participation and self-determination.

It is part of this cultural heritage that those who fail do not question either the aspiration or the approach, but rather the technology. How else could we understand the current initiative of Idaho's superintendent Tom Luna[70] who, on the basis of the alleged bad PISA results (output steering), wants to improve school outcomes by using computer-based online learning programs (input steering) and to cover the investment by reducing teachers' salaries?[71] William Pinar reports that a 2011 Idaho state legislature initiative passed a law "requiring all high school students to take online classes in order to graduate."[72] Similar to an initiative in North Carolina, "the state promised to provide all students and their teachers [with] laptops or tablets." However, "to pay for these purchases, the state shifted tens of millions of dollars away from teacher salaries. State bureaucrats also announced a shift in the role of teachers, who, they announced, would no longer be 'lecturers,' standing at the front of classrooms." Here the idea of the teacher as "coach" or "guide" came up again. "Teachers would be 'guides,' their teaching focused only on helping students complete whatever lessons appeared on those computer screens (Richtel 4 January 2012, A1, B4)."[73]

The army-run laboratories during the Second World War had developed an efficient way of solving problems. These problems were not social, concerning questions of equity, justice, or freedom, but military, concerning weapons, survival, and killing. This method of problem solv-

ing was designed to be adapted to the postwar period. In 1944, President Roosevelt asked Vannevar Bush, a trained engineer and initiator of the Manhattan Project, to prepare a report on the question "What can be done, consistent with military security, and with the prior approval of the military authorities, to make known to the world as soon as possible the contributions which have been made during our war effort to scientific knowledge?"[74] Bush's report, entitled *Science: The Endless Frontier*, delivered on 25 July 1945 to President Harry Truman, closely recounted the future fight against disease, defense against aggressors, and the establishment of a welfare state to promote "new knowledge" that "can be obtained only through basic scientific research."[75] Scientific work involved teamwork by experts, as practiced during the Second World War: "Science can be effective in the national welfare only as a member of a team, whether the conditions be peace or war. But without scientific progress no amount of achievement in other directions can insure our health, prosperity, and security as a nation in the modern world."[76] Science education as a program designed to ensure the "renewal of our scientific talent"[77] was of the highest importance for the future. The history of education over the last sixty years is a testament to the success of this commitment.

This technocratic and technological educational culture was activated after Sputnik and implemented as a strategy toward global salvation against the new enemy, the Soviet Union. The problem was that the Soviet Union had a similar agenda, and claimed to be on the path toward freedom, welfare, and justice. Both ideologies and systems relied on reforming education on the basis of principles of central expertise, technological innovation, and supporting psychology. Against this background it is not surprising that the differences between Western and Eastern educational reforms during the Cold War were much smaller than the overall ideological differences would suggest. The technocratic movement, which gained momentum in the laboratories of the Second World War, had no frontier, and still exerts an influence. A broader historical investigation into this transnational discourse of salvation and its materialization in teaching media and devices has still to be carried out.

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Notes

1. ECD, *Policy Conference on Economic Growth and Investment in Education, Washington, DC, 16–20 October 1961* (Paris: OECD Publishing, 1961), 35.

2. Paul Smeyers and Marc Depaepe, *Educational Research: The Educationalization of Social Problems* (Dordrecht: Springer, 2009).
3. Daniel Tröhler, "The Educationalization of the Modern World: Progress, Passion, and the Protestant Promise of Education," in *Languages of Education: Protestant Legacies, National Identities, and Global Aspirations,* ed. D. Tröhler (New York: Routledge, 2011), 21–36.
4. Thomas Bonner, "Sputniks and the Educational Crisis in America," *The Journal for Higher Education* 29 (1958): 178.
5. William Tompson, *Khrushchev: A Political Life* (New York: Palgrave Macmillan, 1995), 192ff.
6. R. Wallace, "A Deluge of Honors for an Exasperating Admiral," *Time,* 8 September 1958, 104–106, 109–116, 118.
7. Hyman Rickover, *Education and Freedom* (New York: E. P. Dutton and Co., 1959). Rickover's "counterpart" in the Soviet Union was the navy admiral Aksel Ivanovich Berg, the head of the Soviet Naval Research Institute from 1947 to 1957, and deputy minister of defense from 1953 to 1957. In 1958, Berg founded the Scientific Council of Complex Problem Cybernetics and published several books and articles on programmed learning and cybernetics, which were translated into English. See *А. И. Берг, Кибернетику на службу коммунизму* (Moscow, 1961) and Aksel Ivanovich Berg, *Cybernetics at the Service of Communism—USSR* (Washington: US Department of Commerce, Office of Technical Services, Joint Publications Research Service, 1962).
8. In historical analyses the notion of "start" is a vulnerable one. "Start" is used to mean, "becoming evident" or "becoming visible," and I am not inclined to say that there were no forerunners.
9. Philip Coombs, *The World Educational Crisis* (New York: Oxford University Press, 1968).
10. Kjell Eide, *30 Years of Educational Collaboration in the OECD* (Oslo: Royal Ministry of Education and Research, 1990), 9.
11. John Rudolph, *Scientists in the Classroom: The Cold War Reconstruction of American Science Education* (New York: Palgrave Macmillan, 2002).
12. This idea reflects a broader attempt to overcome, often with the catchword of cybernetics, the traditional separation between two human cultures, that is, a hard (technology) and a soft (literature, philosophy) culture. "It is the thesis of this book that society can only be understood through a study of the messages and the communication facilities which belong to it; and that in the future development of these messages and communication facilities, messages between man and machines, between machines and man, and between machine and machine, are destined to play an ever-increasing part." See Norbert Wiener, *The Human Use of Human Beings* (Boston: Houghton Mifflin, 1950), 16. This idea became popular in the Soviet Union not least in the context of teacher education; see Samuil Braynes, Anatoliy Napalkov, and Vladislav Svechinskiy, *Problems of Neurocybernetics* (Moscow, 1959); Victor Glushkov, *About General Aspect of Cybernetics: Transcript of Lectures, Read at the Seminar of Teacher Training* (Kiev, 1960); Берг, *Кибернетику.*
13. Jerome Bruner, cited in Rudolph, *Scientists in the Classroom,* 94, 99.
14. Joseph Schmupeter, cited in Nils Gilman, *Mandarins of the Future: Moderniza-*

tion Theory in Cold War America (Baltimore: Johns Hopkins University Press, 2003), 48.
15. Burton Weisbrod, "Education and Investment in Human Capital," *Journal of Political Economy* 70 (1962): 106–123.
16. OECD, Harold Stoke, Hans Löwbeer, and Jean Capelle, *Modernizing Our Schools: Curriculum Improvement and Educational Development* (Paris: OECD, 1966).
17. Francis Keppel, *The Necessary Revolution in American Education* (New York: Harper and Row, 1966).
18. Daniel Tröhler, "Change Management in the Governance of Schooling: The Rise of Experts, Planners, and Statistics in the Early OECD," *Teachers College Record* (forthcoming).
19. Daniel Tröhler, "Harmonizing the Educational Globe: World Polity, Cultural Features, and the Challenges to Educational Research," *Studies in Philosophy and Education* 29 (2010): 7–29.
20. B. Skinner, *Science and Human Behavior* (New York: Macmillan, 1953).
21. B. Skinner, "The Science of Learning and the Art of Teaching," in *Programmed Learning,* ed. W. Smith and J. Moore (Princeton: D. Van Nostrand Company [1954], 1966), 34–48.
22. Skinner, "The Science of Learning," 19.
23. Ibid., 24.
24. Idem.
25. Ibid., 24f.
26. Ibid., 25.
27. Ibid., 26.
28. Ibid., 27.
29. It is of no importance whether John Dewey's alleged "fatherhood" of progressive education is right or not, for he was believed to be at the origin of this movement.
30. Educational Policies Commission, *The Central Purpose of American Education* (Washington, DC: Educational Policies Commission, 1961).
31. Hyman Rickover, "Education. What Price Life Adjustment?" *Time*, 2 December 1957, LXX (23).
32. Rickover, "Education: What Price Life Adjustment?"
33. Idem.
34. B. Skinner, *Teaching Machines and Programmed Learning* (film), 1954. http://www.youtube.com/watch?v=jTH3ob1IRFo&feature=related.
35. I thank Viktoria Boretska and Caroline Galiatsos for transcribing the film about teaching machines, which is available at http://www.youtube.com/watch?v=jTH3ob1IRFo&feature=related.
36. Skinner, *Teaching Machines and Programmed Learning,* film narration.
37. Idem.
38. Idem.
39. US Congress, National Defense Education Act 1958, section 301.
40. B. Skinner, "Teaching Machines," *Science* 128 (24 October 1958): 969–977.
41. Ibid., 969.
42. Idem.
43. Ibid., 970.

44. Idem.
45. Ibid., 976.
46. Ibid., 971.
47. Guy Besnard, Leslie Briggs, George Mursch, and Elbert Walker, *Development of the Subject-Matter Trainer (AFPTRC, Armament Systems Personnel Research Laboratory* (Tech. memo, ASPRL-TM-55-7, March 1955).
48. Idem.
49. Idem.
50. Guy Besnard, Leslie Briggs, George Mursch, and Elbert Walker, *The Improved Subject-Matter Trainer (AFPTRC, Armament Systems Personnel Research Laboratory* (Tech. memo, ASPRL-TM-55-11, April 1955).
51. "Each of the practice modes, while providing knowledge of the correctness or incorrectness of each response the student makes, gives varying amounts of assistance to the student, depending upon his own speed of learning and previous knowledge of the subject matter.… The test mode of operation, usable in both classroom and laboratory, provides for testing students following learning sessions with the device. Two types of automatic scoring during practice are also provided." http://oai.dtic.mil/oai/oai?verb=getRecord&metadataPrefix=html&identifier=AD0487936.
52. Wilbur Schramm, *Programmed Instruction: Today and Tomorrow* (New York: Society for the Advancement of Education, 1961).
53. Schramm, *Programmed Instruction,* 5.
54. Ibid., 6.
55. I thank Franziska Sophie Hirt, Viktoria Boretska, and Ekaterina Belousova for their help when putting together these bibliographies.
56. Reinhold Freudenstein, "Stand und Entwicklung der Language Laboratories in den Vereinigten Staaten," *Die neueren Sprachen* 9 (1960): 384–388.
57. Wolfgang Fischer, "Die amerikanische Lehrmaschine," *Die Neue Sammlung* 1 (1961): 368–383.
58. Helmar G. Frank, ed., *Lehrmaschinen in kybernetischer und pädagogischer Sicht (Referate der ersten deutschen Lehrmaschinentagung Nürtinger Symposium 1963).* (Stuttgart: Ernst Klett; Munich: Oldenburg, 1963).
59. Helmar G. Frank, "Kybernetik und Lehrmaschinen," in *Lehrmaschinen,* Helmar G. Frank, ed., 13–27.
60. *Wörterbuch Programmierter Unterricht: kleine Terminologie der kybernetischen Pädagogik* (Munich: Manz, 1964).
61. Harmut Vogt, *Programmierter Unterricht und Lehrmaschinen an Hoch- und Fachschulen der Sowjetunion: Studie zum Bildungswettlauf zwischen Ost und West* (Munich: Manz, 1965).
62. Бирилко Ю.И., Сабурова Г.Г. "Реализация некоторых психологических принципов в обучающих машинах в США "// Вопросы психологии 4 (1962). Birilko, Y. I, and G. G. Saburova, "Implementation of Some Psychological Principles in Teaching Machines in the USA," *Questions of Psychology* 4 (1962).
63. Jerome Bruner, *The Process of Education* (Cambridge, MA: Harvard University Press, 1960), 16.
64. Bruner, *The Process of Education,* 17.
65. Ibid., 19.

66. See C. Thomas, *Überblick zur historischen Entwicklung von computerunterstutzten Lehr- und Lernsystemen* (Bakkalaureatsarbeit, Technische Universität Dresden, 2006) (elearn.inf.tu-dresden.de/history/ba.pdf).
67. Skinner, "The Science of Learning," 20.
68. OECD Archives, *Committee for Scientific and Technical Personnel, Record of the 7th Session held at the Château de la Muette, Paris, 26–28 June 1963*, STP/M(63)2 (Paris: OECD Archives), 9f.
69. Chester E. Finn, *We Must Take Charge of Our Schools and Our Future* (New York: Free Press, 1991), 32.
70. In 2012 presidential candidate Mitt Romney named Luna to his nineteen-member education policy advisory group: http://www.idahopress.com/news/state/mitt-romney-taps-idaho-superintendent-of-public-instruction-tom-luna/article_1e2a801e-a630-11e1-90c1-001a4bcf887a.html.
71. Tom Luna's ideas are available at: http://educationidaho.blogspot.ch/2012/01/superintendent-luna-provides-update-on.html.
72. William Pinar, "The End of Public Education in the United States," Unpublished paper presented at the University of Luxembourg, 18 September 2012. The paper will be published in William Pinar, *Curriculum Studies in the United States: Present Circumstances, Intellectual Histories* (New York: Palgrave Pivot, forthcoming).
73. Pinar, "The End of Public Education," 19. Idaho is no exception; the faith in programming learning for the sake of a better economy; Idaho governor C. L. Otter doesn't understand the opposition against the superintendent's initiative, commenting that "putting technology into students' hands" was the "only way to prepare them for the workforce" (quoted in Pinar, 20). In Mooresville, North Carolina, "Apple has already plundered Mooresville's public budget." For each student a "MacBook Air was leased from Apple for $215 a year, including warranty, for a total of $1 million; an additional $100,000 a year was allocated for software." Technology saves money in terms of on-site workforce: "Sixty-five jobs were eliminated, including thirty-seven teaching positions, which resulted in larger class sizes—but district officials insisted that instruction was now more efficient due to the technology" (Pinar, 17).
74. Vannevar Bush, *Science: The Endless Frontier: A Report to the President by Vannevar Bush, Director of the Office of Scientific Research and Development, July 1945* (Washington, DC: United States Government Printing Office, 1945), http://www.nsf.gov/od/lpa/nsf50/vbush1945.htm (accessed 15 June 2013).
75. Bush, *Science: The Endless Frontier,* Summary section.
76. Ibid.
77. Bush, Chapter 4.