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ARTICLE

Science Education in the USA During the Cold War

From Neglect to a National Security Issue

Felipe Sanches Lopez[1,2] · **Cristiano Rodrigues de Mattos**[1,2]

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Abstract

Several countries have implemented educational changes in recent years, most of which generally happen suddenly and abruptly to appease sectors of society that benefit economically. Most educational change watchword is innovation, fulfilling more a propaganda space than a fundamental educational transformation. One of the foremost educational innovations in science education was the Physical Science Study Committee (PSSC), a physics education project aimed at improving science education in the USA during the Cold War. In this period, teacher training was critical to the science education imbroglio in which the country found itself, primarily due to the long period the government made little educational investment. The reactions came with the creation of multiple committees, including the PSSC, when the nation faced a shortage of qualified teachers and a crisis in training scientists. In this investigation, we seek to understand the relationship between economic policies and science education in the USA by analysing the administration's economic reports through document analysis methodology. The findings show that science education had three different levels of priority throughout the period: the first, when it was deemed irrelevant; the second, when it started to be seen as imperative for economic and technological development; and the third, when science education was considered essential for national security. This historical case study shows the lasting impacts of treating education as unimportant, even for a short period, and the enormous inertia to move the complex economic and political network between society's superstructure and infrastructure activities.

✉ Felipe Sanches Lopez
felipe.sanches.lopez@usp.br

Cristiano Rodrigues de Mattos
crmattos@usp.br

1 Science Teaching Interunit Graduate Program, University of São Paulo, São Paulo, Brazil

2 Institute of Physics, University of São Paulo, Rua Do Matão, 1371, Cidade Universitária, São Paulo CEP 05508-090, Brazil

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1 Introduction

Educational changes have recently taken place in several countries worldwide (e.g. Australian Education Ministers, 2008; Strengthening Career and Technical Education for the 21st Century Act, 2018; Decreto de Reforma Educativa, 2019)[1]. The reforms appear to have specific international interests, with the explicit support of international institutions such as the Organization for Economic Cooperation and Development (OECD), the World Bank, the World Trade Organization, and some large corporations, such as Pearson (Saltman & Means, 2018). Some sectors of society may understand that this is good for the educational system; nevertheless, those economic and private institutions supporting educational reforms contribute to the aligning of the educational system with the interests of the capital (Saltman & Means, 2018), serving as echo chambers to reinforce the capitalist economic system without any criticism (Robinson, 2016).

To grasp elements of the relationship between the state and educational reforms and the common political and economic power dispute around education and science, we explored a historical period where this struggle was prominent and simultaneously held consequences for science education. We investigated the implementation of the PSSC, the first significant reform that occurred amidst the Cold War in the United States and was adopted in several countries worldwide (Haber-Schaim, 1967; Rudolph, 2002). In Latin America, for example, these reforms influenced the physics curriculum for decades (Matthews, 2015).

One of our primary motivations for examining the curricular changes influenced by economic and political factors within a country stemmed from the top-down curriculum reform implemented in Brazil in recent years. The country has been going through a period of political instability over the past years, aggravated after the 2016 coup d'état that disposed of Dilma Rousseff from Brazil's presidency (Bin, 2021). Following the coup, the new government initiated a fresh political agenda, swiftly impacting the educational system with a rapid high school reform that commenced with a provisional measure enacted in the same year (Brazil, 2016), which Congress converted into permanent law in just 6 months. The same rushed process drove the implementation of the National Learning Standards (BNCC, from the Portuguese acronym), which were approved 1 year later (Tarlau & Moeller, 2020), bringing severe consequences for education in general, particularly for science education.

In the last 30 years, some public policies have developed educational system reforms that counter specific values, such as education as a public good or the cast of empowerment educational activities for the impoverished classes (Saltman & Means, 2018). As a result, worldwide educational reform has extended the idea that the educational system serves to develop innovations driven by economic growth plans, leading school institutions to be seen as production agencies (e.g. Young, 2007; Hanushek & Woessmann, 2007, 2020; Scott, 2011; Gopinathan, 2007; Sahlberg, 2006, Sims, 2013). The globalisation and standardisation of education, as supported by those economic agencies, become evident in the *Programme for International Student Assessment* (PISA) as a programme to globalise and standardise education (Osborne et al., 2017; Sjøberg, 2021) that has been used as a measure of the quality of education in different countries throughout the human capital theory (e.g. de la Maisonneuve, Égert & Turner, 2022; Angrist et al., 2021; Giménez, 2015).

[1] The Australian educational change began in 2008, but it was only in 2014 that the curriculum was approved. See more in https://www.acara.edu.au/curriculum/history-of-the-australian-curriculum.

Educational innovation has become increasingly used in political discourse during political, economic, and social insecurity. The novelty is enticing, but it usually means that the same aims are achieved more efficiently rather than critically rethinking goals (Burbules, 2016).

The expression "educational innovation" has a variety of meanings in the literature[2] that can range from processes centred on specific methodological improvements for each teacher to more extensive changes affecting educational policy implementation. However, some consider educational innovation as the means to improve institutions' status (Fullan, 2007).

Uncritical discourse about innovation can obscure many issues, including a failure to implement practices that promote it. Educational innovations, for example, are viewed as adjustment mechanisms in institutions with the power to execute them. On the other hand, other educational system players generally do not meet their specific demands in such innovations (Messina, 2001). Instead, top-down educational reforms are often government initiatives that require the mobilisation of multiple political spheres and significant financial support (Krasilchik, 2000; Smith, 2016).

After the 2nd World War (WWII), the imperative for scientific research and development became the angular stone to victorious nations maintaining scientific hegemony. The USA and the Soviet Union made efforts not to allow German science research and development to fall into each other's hands through the forced immigration of German scientists and engineers. Beyond that, the USA was committed to reconstructing destroyed Europe's infrastructure during WWII and the continent's scientific basis (Krige, 2006). The USA's commitment went beyond Europe since Truman's Point Four programme, proposed in his Inaugural Speech in 1949 (Truman, 1949), clearly stated that the USA needed to help underdeveloped allied countries with benefits brought by technological advancements.

When considering this USA's historical moment, a complex approach is necessary to comprehend the historical conditions influencing the creation of educational innovations, like those recent curriculum reform initiatives made worldwide. As science education is our primary interest, in this text, we focused on US administration economic documents to understand how science education was addressed during the Cold War's early years. These documents provide political and economic information to grasp the conditions exemplary science education institutional innovations which were created during the 1950s, particularly the Physical Science Study Committee (PSSC) and its educational products, one of the most relevant consequences of science educational innovation in the USA. PSSC was created when the USA was going through a crisis, experiencing a shortage in training scientists and, at the same time, the lack of enough science teachers to deal with the problem.

This research investigated how the federal government conceived science education from an economic perspective. To accomplish that, we analysed US Economic Reports from 1950 to 1960 to understand how economic policies impacted educational policies during the Cold War.

From the analysis, we proposed three periods expressing different levels of priority to science education through the decade: (i) science education was not seen as relevant, (ii) science education was seen as imperative for economic and technological development, and (iii) science education was considered essential for national security.

[2] See Méndez (1991) and Tavares (2019) for the most used, but most of time the "term 'education innovation' is similar. Not simply an empty signifier, with a vague, uncertain meaning, the phrase usually refers to ways to make education faster and cheaper, more flexible, efficient and cost-effective." (Mintz, 2021).

2 Contextualising the Problem

The dropping of the atomic bombs on Hiroshima and Nagasaki was, among others, the US strategic choice to demonstrate the power it garnered via its massive expenditure on scientific research. (Bernstein, 1995). After these events, science's role in the arms race became obvious.

Bush (1945/1960) pointed out the US government's concern with scientific development, responding to four questions posed by then-President Franklin D. Roosevelt in November 1944 that can be summarised as such: (i) how to show the world the scientific advances made by the country during the war?; (ii) how to organise a development programme to combat disease?; (iii) what could be done, at that moment, to support scientific research in the future?; and (iv) would it be possible to create a programme to discover and develop scientific talent in young people?

The questions made clear that the president's interest, already in 1944, was in the country's scientific growth potential and how science would develop, particularly considering the training of new scientists.

There are different versions of the origin of the Cold War, with the more orthodox views considering its beginning with the Truman Doctrine in March 1947 (Harbutt, 2002; Lewkowicz, 2018). Meanwhile, others indicate that the origins of the Cold War can be traced to tensions that began in 1941 (McCauley, 2021), the same year the USA got directly involved in World War II. Whichever we assume to be its origin, the immediate years following the end of WWII did not present a period of stability for the USA, due to the fear of either the post-war recession (Norton, 1977) or the Red Scare (Goulden, 1976; Patterson, 1998).

Among the enduring legacy of WWII, the scientific and technological ones profoundly and permanently impacted the economy and quotidian life in diverse countries after 1945. Technologies developed and implemented during the war impacted not only industries (Davies & Stammers, 1975) but also American life as a whole (Baldwin, 2016; Colomina, 2007). Although civilians acquired access to wartime medical advancements, the advances in military technology led to the creation of increasingly more potent weapons that sustained tensions between the USA and the Soviet Union, fundamentally changing how people lived in the world. Then, WWII's scientific and technological legacy became a double-edged sword, shaping a modern way of life while also expressing Cold War tensions (Burton, 2020).

Amid the troubled sociohistorical context of the Cold War, there was the fear, especially in the USA, that the "enemy" was infiltrating governmental institutions (known as the "Red Scare") and battlefronts in foreign lands, such as in the Korean War (Gaddis, 2005; Hobsbawm, 2011). In this context, the US government established the National Science Foundation (NSF) in 1950 to define and promote national policies for basic research and science education (National Science Foundation Act, 1950).

The NSF was the federal agency that provided critical institutional foundations for the American curricular reforms that began in the 1950s (Rudolph, 2002). Thus, it is essential to understand the scientific and educational policies proposed and promoted by this agency to determine how PSSC developed. According to Alan Waterman[3] (Bush, 1945/1960), Bush's study was essential for creating the National Science Foundation and curricular changes throughout the 1950s and implemented in the 1960s.

[3] In 1960 the National Science Foundation's 10th anniversary edition of Science: the Endless Frontier was published. In this period Alan Waterman was the director of the NSF.

As it is possible to identify in Bush's response (1945/1960), the changes were already being studied and proposed in 1944 but were only really implemented when the creation of the PSSC in 1956, more than 10 years later.

Rudolph (2002) provides an in-depth analysis of PSSC's origins by understanding the curriculum materials as the materialisation of different interests. As the author demonstrates, the scientists who undertook the curriculum reforms were not guided by fear of the Soviet Union surpassing the USA in technology, but that fear was one of the reasons that gave them a free hand for conducting the reforms, mixed with the belief that science was ideologically pure (Lopez & Mattos, 2023).

Therefore, within this context, we investigated the economic reports of the American administration to identify the meanings science education had for administration throughout the period studied.

3 Methodology

3.1 Sources

We investigated the meanings science education had to the US government throughout the 1950s by analysing the Economic Reports of the President from the digital library FRASER[4] during that period.

The Economic Report of the President is a requirement established by the Employment Act of 1946 (1946), and it must be submitted annually to Congress by January 20th. Beyond the possibility of additional reports, this legislation also mandates the creation of the Council of Economic Advisors. The Council was to provide the president with the economic data needed to make decisions and plan for the economy's future.

Between January 1950 and January 1953, Harry Truman was the president of the USA. During this period, his economic team published the reports in two parts, except for January 1953, when the government published only one report due to the change of government, totalling seven reports. The Reports published in January were called "Economic Reports of the President", while those published in the middle of the year were called "Midyear Economic Report of the President".

President Dwight Eisenhower's administration started in 1953; the first report was submitted in January 1954. From the beginning, the Eisenhower administration provided only one annual report, also totalling seven. Considering the entire decade, we analysed the fourteen reports by the two administrations.

The Economic Report and the Midyear Economic Reports produced by Truman's administration were composed of two parts. The first was a personal directive signed by President Truman, which proposed to Congress parameters on which they could base their legislative proposals. This first part was based on the data advisors provided that composed the second part of the documents. Thus, President Truman authored the first part, while the economic advisors, who constituted the Council of Economic Advisors, were responsible for the second.

[4] A digital library of USA's economical documents, available at https://fraser.stlouisfed.org/

3.2 Document Analysis

We used document analysis as proposed by Bowen (2009) and Minayo et al., (2011) to analyse the corpus. The method has three main stages: (i) selection, (ii) preparatory, and (iii) consolidation. We started the document selection stage after defining the scope of the project and its goals.

The Economic Reports' choice over other documents merely provides economic indicators because they serve as a point of convergence between economics and politics. These documents provide more specific information about each area of interest's financial planning and how the legislators managed public policies to attain particular objectives.

The preparatory stage is the second step of document analysis, when the document's historical context is analysed. As a result, we relied on secondary sources to comprehend the broader context of the Reports' production (Gaddis, 2005; Harbutt, 2002; Hobsbawm, 2011; Leuchtenburg, 1973). At this step, it was also required to study the authors, the text's validity and reliability, its nature, and key concepts. To identify those last ones, we performed a simple textual analysis (Burrows, 2004) to locate and count the number of times each concept's word appeared in the text. In addition, verifying the frequency of each word, we produced a word cloud that gave us a visual representation of the text's most discussed themes.

Lastly, the consolidation stage consisted of categorising the document by describing the characteristics of the text, such as the number of words and the constitution of its parts; raising the information brought in the text by inference, and, finally, interpreting the document, when all the information gathered about it is related to extracting deeper information.

3.3 Triangulation

Although using one type of document is considered enough in interpretative research, triangulation guards against overconfidence in the data provided by the documents (Bowen, 2009). In our case, triangulation serves to confirm the information provided by the federal government to Congress. Thus, following Bowen (2009), triangulation should provide convergence or corroboration of data by using multiple sources and methodologies.

For convergence, we used two primary documents to triangulate the Economic Reports data: the United States Government Budget and the Statutes at Large. Moreover, for corroboration, we used Rudolph's (2002) work that provides an overview of the creation of PSSC, analysing the US school science educational context during the 1950s.

When information about the expenditure on science, education, or schools was provided in the Economic Reports, we cross-checked under the section "Education and general research" from the corresponding year and the next ones, where the budget was more precise due to not being a projection. In the Statutes at Large, a collection of laws enacted by a specific Congress; we looked it through from the same period of the Economic Reports to check the convergence of data between these two types of sources. Due to the research's goal, we searched for terms related to education, such as "education", "school", "science", "teachers", and "research", in the sections "List of Public Laws", and, after collecting the necessary legislations, we read them on the sections "Public Laws".

In other cases, specific documents such as the NSF Annual Report from 1956 were required to understand what actions the agency took when stated in the Economic Reports from that same year.

4 Results

Through the document analysis of the Economic Reports, we divided the period from 1950 to 1960 into three distinct parts, each with its level of priority regarding science training: (i) as a “non-priority”, (ii) as “economic progress”, and (iii) as a “matter of national security”.

4.1 Science Training as a Non-priority

The last year of the 1940s began with the US administration’s proposal, dubbed Peacetime Economics, that the economy should be oriented toward domestic growth, with incentives for sectors including health and education (USA, 1950a). However, with the outbreak of the Korean War in June 1950, this decision was reverted, and the first level of priority for science training emerged, which lasted until the end of Truman’s administration.

This war prompted the country’s economy to revert to a resource-conservation system (USA, 1950b), in which military spending was the primary focus of public resources, while other competitive sectors were less prioritised. The Economic Reports of the President usually emphasised priority for the army’s needs, rarely mentioning science or education, and not once mentioning science education, science training, or related terms.

Although resources were scarce, especially for schools, the Truman administration turned its attention to scientific research and development, including creating the Science Advisory Committee within the Office of Defense Mobilization to improve credibility in the scientific research field (Rudolph, 2002).

As the following two excerpts demonstrate, there was a need for a programme that would regulate actions to support public construction:

> The more successful we are in this twofold task [increase production and allocate products in proper sectors], the less difficult it will be to meet promptly the increased military demand for goods and services, both for ourselves and for the free nations associated with us—without impairing the civilian economy or weakening the industrial potential upon which our military potential depends (USA, 1950b, p. 4).
>
> This [governmental credits for construction] requires a compulsory allocation program, not only to assure adequate military supply, but also to prevent price and cost increases […] The program should therefore provide for limitation of nonessential use. This would reduce the total demand to match the supply (USA, 1950b, p. 47).

The government’s emphasis on the military industry indicates a return to a wartime economy. The absence of the words “education” and “science” in the documents reveals that these sectors were not a primary concern, but in the 1952s document, this disregard becomes explicit: “Total construction expenditures for schools, although at record levels, must be held below the real need.” (USA, 1952a, p. 12).

In fact, according to the original 1950 legislation and the US budget (school facilities in areas affected by Federal Activity, 1950; USA, 1952b; USA, 1953a; USA, 1954a), the allocated amount to the construction of schools in areas affected by Federal in the first year it was implemented, 1950, was $3 million and grew to $92 million[5] in 1952. The construction of schools was an important issue, but it was only one aspect of education.

In a later passage, the Economic Report presents a contradiction in the statement:

[5] The amounts correspond to approx. $33 million and $1 billion in 2023 USA dollars, respectively.

> In education, health, and social security programs, we must continue to be highly selective, deferring improvements and extensions not clearly necessary now in support of the total defense effort. *Education of children, however, cannot be postponed, nor should health standards be allowed to fall.* I recommend a program of general Federal aid to help meet teaching and other school operating costs, and a more adequate program of Federal aid for school construction and operation in critical defense areas (USA, 1952a, p. 19, emphasis added).

Although this seemingly important addition of urgency for education, nothing changed in the legislative aspect. The same law for federal aid for school construction was extended every year and nothing more.

The three listed objectives in the Economic Report from 1951 (USA, 1951a, p. 1-3) show the primary goal of Truman's administration mid-war: (i) achieve rapid growth in the country's military force and help with the growth in the allied countries, (ii) expand the production capacity for military supplements, and (iii) expand the fundamental economic force.

The document also lists five principles to guide people's actions: "all of us must plan", "all of us must serve", "sacrifices must be shared fairly", "we must develop all our resources wisely", and "we must work with our allies in the common cause" (USA, 1951a, p. 7-11).

Science, technology, and education became apparent as future demands, perhaps due to dealing with a longer-than-expected conflict. A passage from the 1951 Midyear Economic Report is an exception to the typical reports' emphasis on the army's needs. It is a warning for the shortage of professionals such as doctors, scientists, and engineers:

> Shortages in scientific and health professions, and of workers trained in skills required by some of the defense industries, exist and will increase. Thus, although it would be inappropriate to recommend now manpower policies for a general manpower shortage, it is important to take such actions as are feasible to meet the specialised problems of skill shortages and shortages within particular labor market areas. The situation is particularly critical where both types coincide. (…) Since we are faced with an emergency which may last for many years, it obviously is necessary to begin now the education and training of professional and scientific personnel in those physical and social sciences in which the supply will be most seriously short two or more years from now. These include virtually all of the major health professions (…) many types of scientists and engineers (USA, 1951b, pp. 112–113).

These passages were made as a warning by the economic advisors in their section of the Report, but Truman's address to Congress does not mention the matter, indicating that the government did not consider it a priority.

The Midyear Economic Report from July 1952 (USA, 1952c) does not present relevant information for the analysis. By the time the Report reached Congress on July 19th, the Congress was adjourned until January 3rd, 1953.[6] The same is true for the Economic Report of January 1953 (USA, 1953b), the last report produced by Truman's administration, which consists of an overview of the economic indexes from Truman's presidency.

[6] The session dates of Congress are available at https://history.house.gov/Institution/Session-Dates/80-89/

4.2 Science Training for Economic Progress

During the second period, beginning in 1954 and ending with the launch of Sputnik I in 1957, the reports began to include, for the first time, science and education as well as scientific training. Basic science research became the government's top priority in the first year of this period. National Science Foundation (NSF) got new responsibilities via Executive Order 10521, such as keeping constant contact with the Ministry of Education to establish training for future scientists:

> […] the security and welfare of the United States depend increasingly upon the advancement of knowledge in the sciences; […] useful applications of science to defense, humanitarian, and other purposes in the nation require a strong foundation in basic scientific knowledge and trained scientific manpower; […] the administration of Federal scientific research programs affecting institutions of learning must be consistent with the preservation of the strength, vitality, and independence of higher education in the United States; […] in order to conserve fiscal and manpower resources, it is necessary that Federal scientific research be administered with all practicable efficiency and economy; […] the National Science Foundation has been established by law for the purpose, among others, of developing and encouraging the pursuit of an appropriate and effective national policy for the promotion of basic research and education in the sciences (USA, 1954c, p. 1499).

In this excerpt from the Executive Order, scientific knowledge is regarded as essential for security and welfare. This justification does not appear in the Economic Reports, where the primary justification was a direct connection between scientific and economic development, as seen in the following excerpt: "A fundamental condition of economic progress is a growing fund of scientific and technological knowledge." (USA, 1954b, p. 6).

The following year, the document's justification continues to be the need for economic growth: "Among the activities essential to economic progress and in which there is a large public interest is the field of education, extending from education for literacy to the highest reaches of theoretical inquiry." (USA, 1955, p. 4)

At first glance, it appears to be a straightforward policy shift by the new president's administration. However, we must first consider a critical study developed around mid-1952 and funded by the NSF and the National Research Council (Kaiser, 2006). DeWitt's (1955) research, entitled "Soviet Professional Manpower: Its Education, Training, and Supply", details the Soviet educational system of the period and criticism of any aspects that slightly differentiated it from the American system, e.g. a central curriculum. DeWitt was part of a group at Harvard University called the Russian Research Center, funded by the Central Intelligence Agency (CIA) (Kaiser, 2006).

One of the most significant impact points following the release of DeWitt's research (1955) was the Soviet Union's workforce training. Although the author made it clear in his analysis that the raw figures, without interpretation, did not indicate that the USA was falling behind in workforce training, the press accounts were utterly different. As early as 1954, with the preliminary results of DeWitt's research (DeWitt, 1954), *The New York Times* and *The Washington Post* articles alerted the population to the American labour shortage (Kaiser, 2006). Besides, Allen Dulles, then director of the CIA, utilised the research findings to persuade

Congress to support measures to overcome the training of the Soviet labour force (Clowse, 1981).

Faced with the dilemma imposed by the public release of DeWitt's research, Eisenhower formed various committees to accessorise him to deal with what became an internal and geopolitical problem. One of the first committees formed in mid-1956 was the National Committee for the Development of Scientists and Engineers, created to address the shortage of qualified scientific personnel and to appease public opinion (Kaiser, 2006), as Eisenhower (1956) specified the committee's duties:

1. Aid the federal government in identifying issues related to the development of skilled scientists and engineers.
2. Invite people and private organisations to help the Federal Government to tackle the lack of skilled Scientists and Engineers.
3. Supply information to interested parts on ways to overcome the obstacles for training Scientists and Engineers.
4. Inform the general public about the problems and solutions to gather support.
5. Provide the President, from time to time, with a report of progress.

(Eisenhower, 1956, April 3rd, *Letter to Dr. Bevis* [Personal communication]).

According to PSSC's founder, Jerrold Zacharias (*apud* Goldstein, 1992, p. 151), one should not mind the committee created because "they didn't recommend anything". Suggesting that this committee's main goal was to deal with public opinion about the educational system.

Despite the lack of recommendations, Rudolph (2002) attributes the prioritisation of science education to various reports coming from the Soviet Union about its efficient scientific training programs, which, due to fear of losing technological hegemony, made science education become the US government's main topic of concern.

The 1956 Economic Report (USA, 1956) has a chapter entitled "Building for Future Prosperity". It is the first time science teaching is explicitly quoted as applicable to national security: "the future improvement of our level of living, no less than our military security, is heavily dependent on research in the basic sciences and technology" (USA, 1956, p. 86).

The report also mentions an "experimental program of supplementary training for teachers in science, mathematics, and engineering, which the National Science Foundation has under way …" (USA, 1956, p. 86). This programme is the Academic Year Institutes, announced in NSF's 6th Annual Report (NSF, 1956, p. 68) as a "new and extended science-teacher-training plan". The Academic Year Institutes was an extended version of the Summer Institutes for Science Teachers, launched in 1953 to improve the quality of science teaching (NSF, 1956).

Interestingly, the report mentioning NSF's programme for science teaching improvement was precisely the first one released after DeWitt's (1955) work became publicly known. Rudolph (2002) confirms that these reports on the structure and efficiency of the Soviet educational system were one of the reasons for the federal government putting the educational system on top of their priorities.

As with the Midyear Economic Report of 1952 (USA, 1952c) released in a presidential election year, the Economic Report of 1957 (USA, 1957) also does not offer relevant information and consists of a review of the economic aspects of Eisenhower's term.

4.3 Science Training as National Security

Following the launch of Sputnik I, a new period began with the level of priority for science training being raised to a matter of national security and the search for the USA's hegemonic predominance:

> The security and well-being of our people depend upon timely and adequate investment not only in physical structures, equipment, and weapons, but also in knowledge and skills. (…) If we allow a gap to develop and persist in favor of the communist bloc, our influence in the struggle for peace may be seriously diminished. (…) Our aim is to assure the continuing superiority of the free world's military and economic defenses, and to retain the confidence of uncommitted peoples (USA, 1958, p. 60).

However, just a month after the Soviet satellite launch, President Eisenhower anticipated a speech justifying that "I could not possibly deal with this subject in just one address" (Eisenhower, 1957a, p. 1). In this speech, titled "Science in National Security", Eisenhower discusses the positive and negative aspects of the country's national security sector and the achievements made possible by investing $5 billion[7] in science and engineering. In addition, Eisenhower briefly cites science education to emphasise the shortcomings of the American education system:

> According to my scientific friends, one of our greatest, and most glaring, deficiencies is the failure of us in this country to give high enough priority to scientific education and to the place of science in our national life.
> Of course, these scientists properly assume that we shall continue to acquire the most modern weapons in adequate numbers as fast as they are produced; but their conviction does expose one great future danger that no amount of money or resources currently devoted to it can meet. Education requires time, incentive and skilled teachers (Eisenhower, 1957a, p. 5).

In a complementary speech at National Education Week[8] called "Our Future Security" (Eisenhower, 1957b), the president returns to the subject and delves into measures for the following years.

Besides the Soviet Union training scientists at higher rates than in the USA, due to Sputnik's launch, its training was no longer seen as worse in quality, thus becoming a real threat, particularly the number of hours devoted to science in the Soviet educational system, as is quoted:

> when a Russian [child] graduates from high school he has had five years of physics, four years of chemistry, one year of astronomy, five years of biology, ten years of mathematics through trigonometry, and five years of a foreign language (Eisenhower, 1957b).

Eisenhower then asked US citizens to participate in the National Education Week to analyse the country's educational system while considering the differences between the

[7] The equivalent of 53.2 billion 2023 USA dollars.

[8] The week that precedes Thanksgiving, dedicated to celebrating public education and reflecting upon the nation's education future. More information in https://www.nea.org/resource-library/american-education-week-november-15-19-2021

American and the Soviet curricula when making decisions. He hoped people would make better decisions regarding the future curricula that would train future scientists.

A national examination system for high school students, a system of incentives for high-performing students to pursue a career in science, programs to encourage high-quality math and science teaching, providing more laboratories, and measures such as grants to increase the training of qualified teachers were among the proposals to try to solve the problem (Eisenhower, 1957b).

The Economic Report of 1959 (USA, 1959) does not present much information about investments in education and science. We attribute this to these two points: first, since 1958, some legislations being recycled yearly[9] to allow federal aid for schools were unbounded by time so that the federal government could financially help schools without congressional approval. Second, the National Defense Education Act of 1958 (1958) determined specific rules for financing research, scholarships, and others. Therefore, scientific research and education were not needed in the agenda proposed in the Economic Reports as passed legislations were already implementing them.

As it occurred in 1952 (USA, 1952c) and 1957 (USA, 1957), the Economic Report of 1960 (USA, 1960) does not present relevant information for this work.

5 Final Considerations

As Bush's (1945/1960) text shows, the USA had been aware of the impending scarcity of scientists and engineers since 1945. However, the Economic Reports show that in the early 1950s, training young scientists was not a priority, owing to the Korean War, when the military sector was the principal beneficiary of resource allocation. Therefore, it is only possible to notice a significant change in the economic reports from 1954 onwards regarding the perspective of science training. One can attribute the change in science training trend to President Dwight D. Eisenhower's election and the end of the Korean War in 1953, though we have to consider the CIA's close funding ties to the Russian Research Center, which may indicate that the intelligence agency already knew DeWitt's (1955) research results. The data on the country's scientific workforce shortfall was public knowledge in the same year that the change in understanding happened, according to DeWitt's (1954) publication, even though it was published in the middle of the year and the report is dated January 1954.

The first trend, science training as a non-priority, determined a gap in training new scientists and engineers and drove the country into a science education conundrum. The training of new scientific cadres demanded the training of new science teachers, but the few scientists prevented them from participating in the teachers' training while they carried out their research. We may generalise the statistics to suggest that this trend began before 1950 because the government preserved the primary economic characteristics of the wartime economy before that year. From a conservative perspective, we can say that the first understanding was in effect from 1945 to 1953, given that the government primarily directed resources to the military sector throughout WWII.

[9] The original legislations are school facilities in areas affected by Federal Activity (1950) and Educational agencies affected by Federal Activities (1950), and they were extended by the following laws: Amendment to 64 Stat. 1101 (1953), Amendment to 64 Stat. 967 (1954), Amendment to 64 Stat. 967 and 64 Stat. 1101(1955), Extension of 64 Stat. 967 and 64 Stat. 1101 (1956), and Extension of 64 Stat. 967 (1957).

One of the consensus for the problems of scientific training was the poor quality of high school teachers (Rudolph, 2002). The first idea that comes to mind to solve this is that if investments in teacher training had taken place in 1945, considering that teacher training takes approximately 5 years, by 1950, the first teachers resulting from federal incentives would have graduated already in the first year of the 1950s, making the gap ever so smaller over the next few years. The training of scientists would still take some time but might not have caused the blow of investing only when the information that the country was lagging behind the Soviets was made public, and it could also have prevented mass panic. However, this is a simplistic view of how teacher training works, as it is impossible to guarantee that all teachers will work at schools due to a lack of financial incentives or school resources to hire new teachers. Indeed, attempts to resolve this were made, even if not by governmental agencies. In 1945, General Electric proposed a summer school for high school teachers intending to improve science education (Rudolph, 2002).

The desired change demanded changes in other activities that comprise the educational system. More teachers teaching the same content might not have changed anything. Likewise, the same number of teachers using new materials would not be the solution.

The investigation regarding the understanding of science education in the early Cold War period reveals motivations for creating PSSC; one is the attempt to break the loop generated by a shortage of well-trained teachers. The committee was formed near the conclusion of the “economic progress” period when the new scientists’ training shortfall was already known.

One aspect that made it more challenging to change the situation was the understanding that the Federal Government should not influence the educational system. Instead, each state should be responsible for its curriculum, which made it impossible to take a more coherent action toward a common goal. This shows that public opinion plays an essential role in changes, and further investigation into how they accomplished this is still necessary.

The importance of science teacher education to a country’s economic and technological progress is highlighted in this historical scenario. Similarly, we learn that a lack of investment in this area might have difficult-to-overcome consequences, given that high-quality teacher training takes time.

However, many factors influenced the pressing need for reform in science education. For instance, Rudolph (2002) pointed out that the PSSC creation materialises different interests. On the one hand, reports such as DeWitt’s (1955) and others developed fear in the US government that the country’s hegemony in technology and science was at risk. However, the scientist’s significant concerns were more in line with how society perceived government funding and control of research. The fear allowed scientists to advocate for the curriculum changes crucial to altering the country’s scientific education for the ensuing years.

In light of our findings, it has become evident that we need to delve further into the origins of the PSSC since it can be seen as a significant educational movement that transcends its historical period and continues to influence physics education in various countries (Haber-Schaim, 1967; Gil Pérez, 1994; Rudolph, 2002). The Physics Project didactic materials (PSSC, 1960) produced by the committee played a pivotal role in reshaping physics education globally, particularly in Latin America (Matthews, 2015). Notably, in Brazil, during the 1960s, the implementation of the PSSC educational project coincided with US administration support to the 1964 military coup (Schoultz, 2003) and had a long-lasting influence on scientific education in the country, inspiring national projects and, until today, a physics curriculum ideal (Pena & Freire, 2003; Queiroz & Hosoume, 2016).

Facing the recent educational coup consequences in Brazil, it is possible to identify different political and economic forces that have been at play regarding education and curricular reforms. These forces rearranged, for instance, science education and science teacher formation, disregarding Brazilian social and economic regional differences and not less the geopolitical tensions. This results in an educational policy that fits with a specific perspective of human capital that supports a hurried educational formation for low-cost and abundant labour. However, disregarding the need for a solid science education disregards the possibility of producing autonomously scientific and technological knowledge. The USA in the 1950s woke up to the science education problem rather quickly, reacting based on a considerable investment in training science teachers. Unfortunately, in Brazil in recent years, this educational policy has been relegated to the level of inaction. Hopefully, the late political changes will allow us to understand the urgent need for more and better science teachers in Brazil.

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