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Making the Computer Fit for School: Efforts to Develop a State-Mandated Educational Computer in Sweden and East Germany (1980s–1990s)

Rosalía Guerrero Cantarell
Zurich University of Teacher Education

Carmen Flury
Zurich University of Teacher Education

ABSTRACT
As a result of the computerization of various workplaces and the increased presence of microcomputers in society, several countries around the globe took steps in the 1980s to introduce computers into schools. In certain countries, such as East Germany (GDR) and Sweden, this meant developing a purpose-built computer centrally to raise pupils' level of competence in informatics. As part of this process, the microcomputer became the epitome of educational technology. In this article, we investigate the process by which the microcomputer became an educational technology in the minds of the politicians and pedagogues involved in the projects. We argue that the national projects that the GDR and Sweden embarked upon express the dominant views of the respective state authorities in relation to the ideal relationship between computer technology, society, and education. Through a historical comparison by contrast of contexts, this article shows the sociotechnical imaginaries that prompted the two countries to initiate a strategy to bring computer technology into schools.

RÉSUMÉ
En raison de l'informatisation des divers lieux de travail et de la présence accrue de micro-ordinateurs dans la société, plusieurs pays du monde ont pris des mesures dans les années 1980 pour introduire les ordinateurs dans les écoles. Dans certains pays, comme l'Allemagne de l'Est (RDA) et la Suède par exemple, cela impliquait le développement centralisé d'un ordinateur spécialement conçu pour augmenter le niveau de compétence en informatique des élèves. Dans le cadre de ce processus, le micro-ordinateur est devenu le modèle de la technologie éducative.

Dans cet article, nous étudions le processus par lequel le micro-ordinateur est devenu une technologie éducative dans l'esprit des politiciens et des pédagogues impliqués dans les projets. Nous soutenons que les projets nationaux lancés par la RDA et par la Suède expriment les

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points de vue dominants des autorités respectives de ces États concernant la relation idéale entre la technologie informatique, la société et l'éducation. À travers une comparaison historique par *contraste de contextes*, cet article décrit les *imaginaires sociotechniques* qui ont incité les deux pays à initier une stratégie d'introduction à l'informatique dans les écoles.

> "Electronics and computer technology will spread even more, and it will be as natural for future schoolchildren to calculate with computers as it was for us to use a ruler."[1]

> "Behind this is the task of not only producing computers, and quite a lot of them, but above all, we must learn how to use them. This is necessary if we want to harness this progress. Just as when writing was invented, everyone had to learn to read and write to use it, so too, in order to use it, we learn the language of the machine. That's why we learn informatics now!"[2]

The quotations above, from a Swedish national newspaper and a German Democratic Republic (GDR) magazine for youth respectively, suggest that computers were envisioned in the popular discourse as a device that would inescapably be a natural part of the future and of the school's reality. These prevailing views were circulated through media and various stakeholder channels, shaping the collective understanding of the role of computers in society and schools. The integration of computers into education required special considerations, because they were seen as a lasting presence, similar to other enduring technologies such as writing or measuring instruments. The perception of computers as useful or even necessary in education became explicit in the late 1970s in Sweden and the 1980s in the GDR. Looking across a broad geographical scope, it is clear that the educational nature of computers has been shaped by many context-bound developments, including the efforts of the information technology industry to penetrate the education market and the initiatives of educators seeking to integrate new technologies into their teaching.

The fact that in the GDR and Sweden computers were seen as a tool for the future of education was not unique to these countries. In the 1980s, several European countries established programs to use computers as educational tools. A recent edited collection examines the incorporation of computers in schools across multiple European countries from 1960 to 2000. It uncovers commonalities such as contrasting perspectives among school management and teachers, as well as the establishment of programs and initiatives to govern computer usage. Nonetheless, it shows that the distinct economic, social, and political circumstances in each country strongly influenced the objectives of computer instruction, the speed of implementation, the extent of computer utilization, the levels of adoption, and the degree of state involvement in the overall process.[3]

Some countries developed computers locally, with software suitable for educational purposes. In the Netherlands, the state subsidized Philips and Music-print products to equip schools before introducing computer courses in secondary schools. Denmark and Finland used domestically manufactured computers in schools: Piccoline and Mikromikko, respectively. The United Kingdom government promoted microcomputers as inherently educational. The development of the BBC Computer Literacy series went hand in hand with the manufacture and distribution of the BBC Microcomputer. Other countries designed and produced computers for school use, including the ICON in Canada, the Smaky in French-speaking Switzerland, the Elwro 800 Junior in Poland, and an unfinished school computer in Australia.[4] However, the most comprehensive projects, with substantial state subsidies to finance technology development and implementation, aimed at producing a purpose-built computer for school use, with a view to widespread use throughout each country, took place in the GDR and Sweden.

This article examines the perception of computers as an educational technology. In our study, we posit that the state played a crucial role in providing schools with suitable hardware and software, aligning with their envisioned futures. We regard the state as encompassing various actors working within an institutional framework, including politicians, educators, and technicians. Thus, this article focuses on how the state viewed technology's role in education and society's future. Specifically, it explores the sociotechnical imaginaries that shaped the development of computers as educational technology in Sweden and the GDR and assesses the resulting implications.

Moreover, we employ a comparative approach to demonstrate that the process of making the computer educational was not arbitrary. There were deliberate strategies behind it. By analyzing the seemingly similar strategies of the GDR and Swedish states, we are able to contrast their goals, views, expectations, and courses of action — and thus reveal striking differences in the sociotechnical imaginaries that underpinned their endeavours.

While on the surface there appears to be similarities in the development of dedicated school computers among several countries around the world, the different cultural and political sensitivities behind these efforts remain largely hidden. A comparison of the two cases of Sweden and the GDR when combined with the conceptual lens of sociotechnical imaginaries allows us to uncover these important differences in country-specific approaches to establishing the computer as an educational technology in their respective national school systems.

Computers began to populate schools and many other sectors of society around the world in the 1980s. However, as Roldán Vera and Fuchs remind us, in the case of pedagogical knowledge, simple narratives of contagion or diffusion do not explain the adoption of knowledge or technologies in local contexts. Instead, to problematize the diffusion of knowledge, or in this case, the use of computers in education, it is necessary to examine the processes of translation, appropriation, and adaptation in local contexts.[5] Conducting a comparative analysis of two countries that adopted a similar approach to incorporating computers in education provides a comprehensive understanding of the mechanisms involved in the translation, appropriation, and adaptation of a universal technology within specific local contexts.

Computers were not the first devices to cause a stir in the education system. Various technologies have created expectations for change. However, historians have demonstrated that schools have not significantly changed their teaching and learning practices in response. Educational scholars such as Larry Cuban and Robert A. Reiser have identified trends in the literature on educational technologies in which high expectations were placed on devices such as radio, film, television, and computers. However, these technologies did not live up to their promise to revolutionize education, and the visions of the future that they once inspired were never realized.[6]

Some case studies show different attempts to use technology to improve education, including Audrey Watters's example of teaching machines (re)invented by B. F. Skinner. Watters's study shows that despite the efforts of entrepreneurs to promote the machines, they ultimately failed to gain widespread acceptance by manufacturers and educators. Other examples include attempts to teach global citizenship through technology and the One Laptop per Child project.[7] Taken together, the studies suggest a pattern of unsuccessful attempts to revolutionize education through new technologies.

The fundamental role of the state in discursively shaping computer technology as educational through the development and endorsement of a specific computer was not unique to countries where educational computers were commissioned.[8] Neil Selwyn's study of the British BBC Micro examines the process by which computers became educational tools in the United Kingdom, where the state did not commission them. Selwyn examines the political, cultural, and industrial contexts and finds that the government, the information technology industry, and the media all embraced the discourse of the computer as an educational tool for different reasons and for their own purposes. In Selwyn's view, uncovering the economic, political, and commercial forces behind this process helps us to understand today's use, or lack of use, of computers in education.[9] The present article is close to Selwyn's study in that we also examine the formation of discourses about the computer as an educational tool.

However, our study differs in important ways. We focus on the political side of the school computer projects. As Selwyn noted, various actors have played a role in establishing computers as educational tools, including businesses, teachers, and users. However, we argue that in the early 1980s, governments had a significant influence in making computers an educational technology through national initiatives and institutionalized structures that were granted considerable resources.[10] Thus, although there were other sociotechnical imaginaries in the GDR and Swedish societies, those propagated by the state are worthy of closer examination.

Theoretical Framework, Method, and Sources

This article is framed within the concept of sociotechnical imaginaries, which Sheila Jasanoff defines as "collectively held, institutionally stabilized, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology."[11] In an earlier definition, Jasanoff and Kim mention that the imagined social order is reflected in the design and fulfillment of nation-specific scientific and/or technological projects.[12] Although Jasanoff admits that sociotechnical imaginaries are not limited to nation-states, we return to this definition to focus on the specifics of the cases we examine.

The explicit motivations of a state to develop a school computer reveal a collectively imagined form of social life and social order. Thus, a computer developed within one nation-state and used in its educational system is an element of a larger vision of the mutually interdependent relationship between technology and society, or a piece of evidence of a sociotechnical imaginary.

The school computer is, in this article, regarded as an educational technology, here defined as a device that is inserted in a social context, incorporates the needs of human and non-human actors,[13] and aims to aid teaching and learning processes. We assume that for educational technology to be accepted, it must align with beliefs about its educational purpose and value. This entails that there was a shared belief in the potential of computers as an educational technology to enhance the education process and to contribute to the fulfilment of a sociotechnical imaginary.

The history of the introduction of computers in schools is inherently transnational since it involves the adoption, in various local contexts, of a technology that was initially produced primarily in countries such as the United States. Adopting an unfamiliar device that carries potential risks into an education system that values its local nature raises questions about the various justifications and meanings behind this process. Thomas S. Popkewitz suggests that a comparative, transnational history approach requires an understanding of the different epistemological systems under study.[14] We adhere to this idea, and to approach these systems, we investigate sociotechnical imaginaries in the GDR and Sweden to better understand how the local interpretation of a global phenomenon like computerization occurred in the 1980s.

Moreover, the contrasting economic and socio-political structures of these countries make them appropriate for a comparative study. Sweden, a market-oriented social democracy, and the GDR, a communist state, were at different stages in terms of computerizing the classroom and had distinctive educational systems. Despite these differences, both countries chose a similar path.

Thus, methodologically, this article is based on a comparison between Sweden and the GDR, where we look for common and contrasting rationales, concerns, and developments in two systems that followed a similar policy strategy of equipping schools with computers, but were politically and economically very different.

Inspired by the contrast of context approach described by Skocpol and Somers, we highlight the contextual particularities of the development of a school computer and pay attention to the similarities and differences of the features surrounding this experience.[15] In this way, the sociotechnical imaginaries that constituted the backdrop to their projects become more visible.

This article draws on sources from the Federal Archives in Germany and the Swedish National Archives to examine the perceptions of each state, and its motivations and expectations pertaining to the school computer. Official documents produced by government authorities, including minutes and reports from the committees overseeing the school computer projects, as well as materials from educational authorities and expert groups appointed by the government, provide insights into these perspectives. These official documents were complemented with newspaper and popular magazine articles, published reports, school curricula, and published interviews with relevant actors.

Contextualizing the Case Studies: Economic, Political, and Industrial Policy Background

The formulation of Sweden's industrial and educational policies is intrinsically linked to the development of the welfare state. The socio-democratic government's goals revolved around achieving a consensus-seeking modern democracy, which was closely tied to the development of Sweden's economy, industrial production, and educational system. The government's vision aimed at establishing a knowledge-intensive society, fostering a sense of optimism for the future. As the welfare state expanded, Sweden encountered the need to rationalize work across diverse sectors and to establish mechanisms to facilitate the growth of the public sector. Consequently, the state began collecting larger amounts of data from the population, leading to concerns and activism within civil society and politically engaged groups. This, in turn, created a rising demand for general education in computer technology. For these reasons, in the modern Swedish welfare state, computer education became an essential requirement.[16]

The GDR, in comparison, operated as a self-proclaimed socialist state whose primary source of legitimacy was the welfare of its citizens. The Socialist Union Party (SED) claimed to prioritize the well-being of the people by ensuring social security, full employment, safety, and educational opportunities. In the context of state socialism, the fusion between the state and society was assumed, although social aspects were in practice often subordinate to economic priorities. Consequently, the intertwining of economic and social policies was intended to drive social development. This perspective had significant implications for the relationship between technology and education. Within this context, workers were regarded as the masters of production and therefore also had to be the masters of new technology. Active involvement in shaping the future computerized society was declared as essential for workers. To achieve this objective, education played a crucial role, providing the necessary skills and knowledge for workers to master the new computer technology. The goal was to empower individuals to actively participate in and contribute collectively to the advancement of a computerized socialist society.[17]

In the 1960s and 1970s, there was a change in the orientation of industrial policy towards increased support for microelectronics and computer industries in several European countries. This can be illustrated by the establishment of microelectronic programs in several countries intended to develop knowledge and skills to boost national industries.[18]

The GDR's socialist leadership launched the Microelectronics Program in 1977, encompassing significant investments to develop a domestic computer industry.[19]

This was part of a broader economic strategy to computerize the socialist economy so as to keep up with global competition: computer-aided design and manufacturing, industrial robots, and office computers were meant to modernize production, boost productivity, and facilitate planning and administration in the command economy.[20]

The start of the domestic production of microcomputers in the GDR in the mid-1980s fuelled hopes and expectations for a widely computerized socialist society.[21] Consequently, educational efforts to introduce the prospective and current workforce to computer technology were expanded to reach broader population segments. However, the limited production capacity, due to a shortage of electronic components and skilled personnel, meant that computer technology remained scarce in the GDR.[22] The imposition of the COCOM[23] embargo by the Western Bloc had a significant impact on socialist states, because it restricted the legal import of specialized technological equipment and state-of-the-art computing technology from Western capitalist countries.[24] This limitation hindered the availability of advanced computing resources for these countries. Conversely, the socialist combine Robotron played a crucial role in addressing the demand for microcomputers within the GDR. Initially, its focus was on fulfilling the needs of industry and education, with private consumers gaining access to home computers in retail stores at a later stage.

The few available devices were almost exclusively distributed to companies for use in production and administration, state and political organizations, research facilities, and educational institutions.[25] Thus, microcomputers were rarely found in private homes in the GDR, and more often than not, they would be private imports of Western models such as a Commodore 64, rather than a domestically produced KC 85. Consequently, the GDR microcomputers were renamed from home computers (German: *Heimcomputer*) to “small computers” (German: *Kleincomputer*).[26]

In Sweden, meanwhile, from the 1970s onwards, the industrial policy of the government placed significant emphasis on providing financial support, including subsidies and grants, to businesses operating within the computer and electronic sectors. The state granted development funding to the newly established Datasaab AB, LM Ericsson, Luxor Industri AB, Sonab AB, and Telub AB, through the Board for Technical Development (*Styrelse för Teknisk Utveckling*—STU).[27] The strategy was to strengthen the home market by developing sub-sectors of electronics. The STU stressed the need for training and competence in computer technology as a prerequisite to achieving expansion in the field of electronics.[28]

In the late 1970s, governmental committees were established in Sweden to investigate various aspects of computerization. Their findings indicated that investing in the domestic computer and electronic industries would foster technology diffusion within the business sector.[29] The National Microelectronics Program, launched in the mid-1980s, included the areas of microelectronics, systems engineering, and information technology.[30] Information technology was considered a growing sector, the economic significance of which rested both on the manufacture of products and the use of these products.[31] Computer use in Sweden had increased since the 1960s and more significantly since the late 1970s. While most Swedish households did not own computers in the 1980s, household computers were more common than in the

GDR. The most common way for individuals to encounter computers was through work, as almost one in every four workers used computers. Around 3 per cent of the population was believed to have computer equipment at home.[32]

In summary, the governments of both the GDR and Sweden supported the microelectronics and computer industries. However, the GDR faced far greater economic and developmental constraints than Sweden. In addition, the GDR's socialist leadership prioritized the computerization of the manufacturing industry and higher education to the detriment of the computer as a consumer good.

Computer Education in the Curriculum

The entry of computers into general education and schooling presupposes that these devices were recognized as having meaningful pedagogical potential and that education policy-makers and educators widely supported this belief.[33] The pedagogical potential of computers and their acceptance by education professionals, however, depended on how their nature and their function were conceived.

The function of computers in education can be divided into two essential categories. Firstly, computers were introduced into schools as subject matter — an object of learning. Under the designations of computer education, informatics instruction, or ICT literacy, the aim was for learners to master the new technology for application outside the school system, in the workplace and in their personal life. Secondly, computers were introduced into schools as a tool of instruction and a means of learning (Computer Assisted Instruction [CAI] and Computer Assisted Learning [CAL]) — that is, as an educational technology in the narrower sense. Learning *with* computer technology was aimed at increasing the efficiency of school-based learning but also at imparting new skills, such as "algorithmic thinking" and problem-solving, which were thought to be specific skills that could be best acquired with the help of computer technology.[34]

Discussions surrounding the curriculum changes that introduced computer instruction in schools dealt with this distinction between ICT literacy and CAI/CAL. American schools were a standard reference, because the first trials started there. In the 1980s, teaching *about* computers dominated in the United States, following the drill and practice model.[35] In the GDR, computer instruction mostly entailed mastering the computer, whereas Swedish educators placed greater emphasis on the societal implications of computerization.

In November 1985, the Socialist Union Party (SED) leaders in East Germany decided upon various measures in the field of education and training in response to the development of informatics and information processing technology.[36] Against the background of the SED's plan for the rapid development and widespread use of computer technology, profound changes in the production process, the content and nature of work, and the role of those involved in this process were anticipated. Computer education was perceived as necessary to prepare the people in the GDR for their future working life. Consequently, a mandatory, basic computer education course was introduced into general education in the second half of the 1980s, as part of the subject Introduction to Socialist Production.[37] Inserting the course into this specific subject was an adamant expression of the defining sociotechnical imaginary of the computer as a seminal technology of economic and industrial modernization, as propagated by the SED leadership. New information processing and automation technology were meant to boost productivity, so as to raise the living standards of the people in the GDR and relieve the burden of repetitive or physically demanding work on the socialist workforce. The computer education course was thus not only concerned with teaching pupils how to use a computer, but also inculcating the idea of a prosperous, computerized future for the socialist economy and society.

In the GDR, a decision was made to introduce mandatory computer education courses in vocational and general education and to develop a purpose-specific, educational computer (*Bildungscomputer*). While the development of the school computer took several years, educational policy-makers drew up curricular changes to include computer education in general and basic vocational education at a speedier pace. The thirty-hour computer course introduced in grade 9 within the subject Introduction to Socialist Production included a guide to the operation of microcomputers, their function in measuring and controlling production, the fundamentals of programming in BASIC, and the use of ready-made software for data and text processing.[38] In vocational education, computer instruction also included basic graphic design and a general introduction to process automation and computer-aided manufacturing.[39] The professional use of standard software for text processing, databases, and spreadsheet programs was particularly important. The basic premise of pedagogues in preparing the new curricula was: "No computer education without at the same time imparting computer familiarity."[40] In other words, computer classes had to include hands-on use of the computer for programming exercises and for running software to solve various problems.

In Sweden, the period 1950 to 1980 was characterized by the implementation of the notion of "One School for All" as a basic premise of educational reform. The development of the welfare state in Sweden, which presupposed democratic and egalitarian education, was reflected in the comprehensivization of education. In 1962, the various schools were integrated into a nine-year comprehensive school, followed by the integration of secondary schools, including vocational schools, into the "*gymnasieskola*."[41] It was within this framework of standardization and equal access that computers in education started to be discussed.

The formal introduction of computer education in Swedish schools was preceded by the implementation of national initiatives to investigate the potential benefits of using computer technology in schools.[42] The final report of one of these initiatives, *Computers in Education* (DIS), became the action plan for introducing computers into schools. A curriculum change was made based on this report that entailed mandatory computing modules from grade 9 onwards. The new curriculum came into force in 1982. "Computer knowledge" (*datalära*) would be included in social and natural science oriented subjects, as well as mathematics, in both lower and upper secondary school. In the theoretical tracks of upper secondary school, computer knowledge would be included in "work-life orientation" and other suitable subjects, depending on the track. The main aim of computer instruction was "to provide pupils with an adequate understanding of computers so that they are willing to, dare, and can take a stance on the use of computers in society."[43] Access to equipment was not a prerequisite for instruction in lower secondary school. In upper secondary school, the instruction would deepen the knowledge imparted at lower levels and would introduce the computer as a tool for problem resolution. To this end, pupils needed to work with a programming language and have access to computer equipment.[44]

The interest in computer-assisted instruction (CAI) was present from the 1970s and throughout the 1980s. An expert committee appointed by the Swedish Ministry of Industry to investigate necessary economic policy measures to foster the computing area urged educational authorities and teachers to investigate the possibilities of CAI, which they thought would be particularly useful in improving the education of pupils with disabilities.[45] The use of CAI was the focus of another national initiative, the PRINCESS project (*Project for Research on Interactive Computer-based Education Systems*), which ran from 1973 to 1977. It concluded that computers could be used to manage individualized teaching as a calculation and learning aid. Moreover, the National Board of Education (NBE) released an action plan for the use of computers in schools in 1980, which reinforced the desire to develop CAI further.[46] These ideas became the basis of the school computer project, which required the computer to be suitable for teaching the computing subject, subject-related computer uses, and CAI.[47]

Despite both the GDR and Sweden implementing curricular changes to incorporate computer education, there existed a fundamental distinction between their approaches. The GDR education policy-makers placed greater emphasis on the practical use of computers in the workplace, accentuating the teaching of computer functions and their various applications across potential work contexts. In contrast, Sweden evinced a more overt inclination towards utilizing computers as an instructional tool and imparting knowledge aimed at familiarizing the learner with the social effects of computerization, while concurrently delineating their role as a citizen.

In the 1980s, the use of computers as an instructional tool (CAI) was not a priority in the political agenda of the GDR. While there were discussions among educators about computer-aided instruction in various subjects, it was not part of the government's policies. Research and debate on the use of computers in education in the GDR were limited and theoretical, and the use of computers as an educational technology in subjects other than computer education was not considered until the 1990s.[48]

The Need for a School Computer

The conception of purpose-built, government-mandated computers was driven by a perceived need for appropriate technology within schools and a desire to cultivate industrial expertise.

In the GDR, the project to develop an educational computer started in 1986. The decision stated that "research must be undertaken to clarify the pedagogical and technical requirements regarding such a computer and other peripheral devices. It must be adapted to the different environments in which schools operate and accommodate the various needs and demands in basic and vocational education, as well as initial and further teacher training."[49] By the end of the 1980s, all educational facilities were to be gradually equipped with the new educational computers. Since they were to be used both in vocational and general education, the computer needed to cater to a wide variety of educational needs, according to the different curricula yet to be introduced. A modular configuration was envisaged so that schools and educators could upgrade the basic unit with optional add-on modules if required.[50]

In the GDR, the first school started teaching an experimental mandatory computer education course in 1986.[51] A syllabus for the mandatory computer education course was introduced in 1989, but only in schools equipped with a sufficient number of computers and trained teaching staff.[52] Until the advent of the *Bildungscomputer* (BIC), classrooms were equipped with different types of KC 85 microcomputers—the first generation of domestically produced microcomputers in the GDR.[53] However, the first teaching experiences soon revealed that the KC 85, which had initially been developed with different purposes in mind, such as leisure and home computing, was not suitable for use in classrooms.[54] The computers simply did not offer enough computing power to fulfill the ambitious goals of the new curricula in informatics and computing. Moreover, intense use of the computers and inadequate technology resulted in the frequent breakdown of computer equipment.[55] Since the GDR's computer industry was already at the limits of its capacity, teachers were faced with very long repair times of up to a year, without any access to temporary replacements.

In essence, East German educators had to work with what was at their disposal in terms of quantity and quality. Equipping schools with computers was not a matter of what was most suitable for instruction but rather what was available. The lack of homogenous computer equipment posed a problem in relation to efficiency on several levels: during classroom instruction, everything had to be explained multiple times in order for pupils to familiarize themselves with the various systems in use; this proved more problematic in teacher training and software development, because there were numerous computer systems with which teachers needed to familiarize themselves and for which various types of school software had to be developed. It was hoped that a purpose-built school computer would solve these problems, since teacher training and instructional materials could be aligned to a single specified set of hardware used in all educational settings.

While in the GDR, it was the problems faced by schools in adopting the use of computer technologies that drove the state to develop a school computer, in Sweden, the idea to do so originated in industrial policy. Two phenomena occurred in parallel in Sweden. The industrial policy of state support for industries related to new technologies coincided with the first pilot projects investigating the potential of computers in education. Thus, the Swedish government decided to entrust the Board for Technical Development (STU) with organizing a procurement project to create a school computer.[56] Technology procurement projects in Sweden were aimed at stimulating the development and marketing of new technology, using existing market actors. The STU created the TUDIS project (*Teknikupphandling Datorn i skolan— Technology Procurement of the Computer in School*) in co-operation with several municipalities. The initiation of a procurement project highlights the state's commitment to fostering technological advancements and reinforces its perspective that technology serves as a catalyst for economic progress.

The planning of TUDIS started in 1981 with the formation of two groups: the reference group made up of representatives from STU, the Swedish Association of Local Authorities, the State Office, and the National Board of Education, and the project group. For the formation of the latter project group, municipalities with previous experience in the use of computers in schools were called upon to nominate the most experienced educational staff. The project group, led by a STU representative and supported by experienced teachers from selected municipalities, was in charge of establishing the technical and pedagogical specifications of the school computer and coordinating the project in a way that promoted "good teaching about computers, their use and their consequences for society in general."[57]

In the late 1970s and early 1980s, Swedish upper secondary schools acquired computer equipment with their own resources. Educational material companies were then influential in selling computer equipment to schools. These leveraged their familiarity with the educational sector to establish deals with hardware and software companies. These companies provided schools with equipment, instructional materials, and computer services, albeit in a rudimentary manner during the initial stages. The two dominant educational material companies in the Swedish market were Liber and Esselte. In the early 1980s, the most common computers in Swedish schools were manufactured by Swedish companies such as Luxor, Vic-datorer, and Esselte. The latter had models specifically developed for upper secondary and secondary schools.[58]

Both in Sweden and in the GDR, the desirability of standardized computer instruction was a central argument for developing a national school computer. In Sweden, standardization would contribute to the democratization of education, an essential pillar of the Swedish social democratic program. Policy-makers stressed the need for a computer with a range of uses that could be adapted to various subjects. In the GDR, on the other hand, it was hoped that the widespread use of the same computer across the country would increase both the efficiency of schooling, teacher training, and the economical use of scarce resources.

In the GDR, there existed a clear belief that computer technology possessed the potential to enhance teaching efficiency across various levels of education. The realization of this potential necessitated the establishment of a clear mission that ensured the development of computers aligned with the specific demands of schools to train students for their future professional lives. In this regard, state intervention was deemed essential, given that the market could not be relied upon to cater exclusively to the demands that solely educational practitioners and politicians in the field of education and labour were aware of.

In addition, the situation in the GDR, characterized by scarce resources, a variety of different computer models—all of which were considered inappropriate for use in schools—and a high incidence of breakdowns and inadequate maintenance, was considered unsustainable. It was, therefore, imperative to standardize access to computer technology and to ensure that any investment in providing such access met the real needs of educational institutions. Implementation of school computers also aimed to address the issues of insufficient access, technological obsolescence, heterogeneity, and inadequate maintenance of existing equipment. The envisioned future involved transcending the state of technological backwardness and endowing the population with cutting-edge computer technology to prepare them for a labour market characterized by the pervasive use of computerized technologies across various sectors.

In Sweden, by comparison, the computer that would be created thanks to the TUDIS project would first and foremost help the computer industry to enter a new era. However, the pedagogical premises were also taken care of. Before the launch of TUDIS, the National Board of Education had formulated a document containing explicit directives. In addition, pilot projects had been executed to showcase the advantages of utilizing computer technology in educational settings. These preliminary efforts served as the foundation for the development of a product which prioritized pedagogical principles. Consequently, the school computer initiative was underpinned by the requirements of the schools and the promotion of democratic ideals.

The School Computer's Pedagogical Potential: Establishing the Specifications

Since the technological imaginary that guided the GDR project stressed the efficient use of computers to facilitate learning and to prepare pupils for the labour market, it was essential for pedagogues and policy-makers in the GDR that computer technology for use in education would be designed to match pedagogical requirements, considering curricular contents and goals. The need to develop a purpose-built educational computer for schools thus seemed evident.[59] Based on the curricular goals and content for computer instruction in the GDR, the Ministry of National Education and the State Secretariat for Vocational Education and Training compiled a pedagogical-technical catalogue of requirements for the BIC. However, these needed to be aggressively negotiated with the Robotron combine representatives in Dresden tasked with developing and producing the hardware — the educational computer itself.[60] In the young computer industry of the GDR, material and human resources were scarce, which made it difficult for Robotron to meet the demands of educational researchers and policy-makers.[61] Eventually, the parties settled on a set of basic criteria and technical requirements, taking into account economic, ergonomic, and pedagogical considerations.

In Sweden, the specifications for the school computer were set in the opposite way. The TUDIS group did not have to conform to the companies' capabilities, but the companies had to create technology that met the conditions imposed by the authorities. When crafting the final specifications, the TUDIS group considered the results of the national pilot projects carried out in the late 1970s and early 1980s, as well as the needs identified within the municipalities of the project group's members. Moreover, before the final document was agreed upon, the TUDIS project was presented to the industrial sector, mainly computer and educational material companies. These companies heard about the general features of the school computer, such as functionality, pedagogical goals, user-friendliness, and high accessibility.[62]

The project group reiterated that the specifications should be based on pedagogical and teaching requirements, and that the computer needed to be functional.[63] Moreover, teaching aids should teach pupils about the reality outside of school and stimulate them to use computers actively and independently.[64] The TUDIS group demanded that the school computer be delivered with teaching material for computing, natural sciences, economics, administration, social sciences, technology, and text- and word-processing.[65] General specifications established by the TUDIS project group in Sweden were closely related to the new curricular goals. The project group stated that "the products should meet the educational needs for hardware and software for the subject of computing, subject-related computer use and the use of the computer as a learning tool" and that they should meet the different needs for, for example, "primary and secondary memory … resolution, character width on the screen, and [should have] a software system and programming language that allow wide access to good software." The basic specifications were sent to computer and teaching aids companies in mid-May of 1982. They comprised the following.

Figure 1
Key Parameters Set by the TUDIS Project Group for the Development of the School Computer[66]

- modular and upgradeable operative system
- interpretative programming language that allowed for structured programming
- easily expandable primary memory
- access to graphic representations, with a target resolution of 500 x 500 pixels and colour graphics as a desirable option
- possibility to connect to external computer systems
- ergonomic and easy-to-read keyboard in Swedish layout standard
- connection of at least fifteen workstations to one another
- short power on and power off times
- possibility to upgrade to a more qualified multi-user construction
- ergonomic screen

In the GDR, the primary goal of pedagogues when developing the BIC was to allow for a higher quality and practice-oriented computer education. Pedagogical considerations focused primarily on fulfilling the curricular goals (which included knowledge of microcomputer operation, the microcomputer's role in production measurement and control, BASIC programming, and the utilization of data and text processing software), and vocational schools were to prepare pupils for the hardware and

Figure 2
Key Parameters Set by Pedagogues and Education Policy-makers for the Development of the BIC[67]

– state-of-the-art BASIC version
– compatibility with software for the PC 1715
– graphics, both monochrome and in colour
– keyboard layout with umlauts ö/ü/ä and the possibility of switching to Cyrillic layout
– floppy disk drive
– option to connect various devices and peripherals
– option to connect computers in a local network
– robust and ergonomic design
– price ceiling of 10,000 marks to ensure affordability for schools

software used in workplaces.[68] The hardware of the BIC, particularly in vocational schools, was to be closely modelled on what was commonly used in workplaces in the GDR, namely the PC 1715. To ensure software compatibility, workstation applications developed for the PC 1715 were also designed to run on the new BIC. For use in general schooling, the computer needed to support an up-to-date and user-friendly version of BASIC and needed to be easily connectable to the "student experimental device" (*Schüler-Experimentier-Gerät*). A series of coupling modules had been developed so that the microcomputers could be used for experiments in electronics and automation, as part of the basic computer education course.[69]

The processes of defining the specifications for the school computer were different in the GDR and Sweden, mainly because the GDR had to go through an additional round of negotiations with the only company capable of manufacturing the machine. In both cases, however, the specifications were determined on the basis of the curriculum goals that had been set earlier on. The GDR emphasized the need for the computer to be state of the art and similar to the system most commonly used in the labour market, while in Sweden the emphasis was on software development. The basic requirements arrived at in both countries were similar, with priority given to functionality, ergonomics, and response time. However, the desirable characteristics and the choices made during the production process were more closely linked to the particular contexts of each country and their specific sociotechnical imaginaries.

Imaginaries Confront Contingencies

In the face of rapid technological development, pedagogues in the GDR insisted that the computer had to be designed to ensure that it would meet the requirements of both general schooling and basic vocational education over a longer period. Their demands for a state-of-the-art computer that could keep up with international standards can be understood as an expression of pedagogues' dissatisfaction with the computer technology available at the time in the GDR compared to Western computers, but also of the confidence that the domestic industry was essentially capable of producing the desired high-quality computers. Demanding advanced technology was the first step towards producing it. Ultimately, at least the more computer-enthusiastic pedagogues in the GDR hoped that the new BIC would allow for a future-oriented computer education.

While the introduction of computers in GDR schools initially focused on computer science and computer education, teachers' expectations grew rapidly in the face of SED propaganda, which never tired of emphasizing the almost inexhaustible potential of computer technology. It was expected that the computers could also be used in clubs and extracurricular activities as well as in the classroom in a variety of subjects.[70] The desired possibility of switching to a Cyrillic keyboard, for example, would allow the BIC to be used in Russian language instruction.

However, the price proved to be an obstacle to meeting all expectations. Robotron struggled to develop a computer that would fulfill all the demands and criteria while staying within the financial limits set by the state authorities. For example, Robotron could only equip the BIC with a twelve-inch monochrome monitor instead of a colour monitor, as GDR pedagogues had emphatically demanded.[71] Since the BIC was designed specifically for educational use, the production volume was relatively small compared to other computers that Robotron manufactured for professional use. Moreover, the ministry for electronics had decided not to authorize the device as a home computer, further limiting the BIC sales market.[72] Concerned for its financial viability, the Robotron combine thus demanded a purchase guarantee from state authorities for education.[73]

In Sweden, expectations also increased and became more specific. The circulation of news about the TUDIS project led groups close to school practice to make their wishes known to those responsible for the project. Some of these wishes were included in the list of specifications, increasingly limiting the manufacturers' room for manoeuvring. School consultants from the NBE, for instance, requested the implementation of the BASIC-dialect, COMAL, and the working group for electronic data processing applications in economics within the NBE requested the CP/M (Control Program/Monitor) operating system, arguing that it had become standard in microcomputers.[74] The TUDIS group considered that by adding the wishes of those groups closest to educational practice, schools would benefit from functional and efficient computers developed under democratic principles.

Moreover, the tendering process brought certain technical issues to the attention of the TUDIS group. Out of the sixteen bids received, the project group considered three. One of them stood out: Svenska Datorer AB (SDAB), a new joint venture firm formed from Management Computer International (MCI) and AB Olesen & Lindgren, was the only company that offered a 16-bit computer. At the time, all computers in the market were 8-bit, but since MCI was developing a 16-bit microprocessor for Philips, MCI decided to include this in their offer to the TUDIS group. At this point, the project group assessed their priorities and realized that this needed to be a requirement of the school computer. The TUDIS group awarded SDAB the project once they presented a joint proposal together with Esselte.[75] The contract to produce the Compis computer was signed in December 1982.[76] However, in 1983, Esselte's subcontractor, AB Teleindustrier,[77] took over the manufacturing of Compis due to SDAB's financial difficulties.[78] By then, manufacturers realized that price constraints were unsurmountable and chose the least costly 16-bit microprocessor available (Intel 80286), which had an integrated CP/M operating system. This decision made the final product less flexible, compared to MS-DOS (Microsoft Disk Operating System), which was then becoming the standard.[79] The first computers were ready for testing in October 1983, but they did not function well enough, delaying production until March 1984.[80]

According to the prevailing sociotechnical imaginaries in the GDR and Sweden, pupils would learn computing with the help of a technically advanced machine, capable of adapting to a range of school contexts, and that was also durable, user-friendly, and accessible. However, many of these characteristics could not be guaranteed due to external situations and events that were unforeseen.[81] Both in the GDR and Sweden, difficulties arose due to delays and imported parts being more expensive than expected. In both cases, the decisions taken to reduce costs had decisive and long-lasting effects.

The School Computer Arrives in the Classroom

The production process of the GDR's new Robotron A5105 Bildungscomputer (BIC) began in January 1987 and was completed in October 1988, when the first fifty computers were delivered to schools for testing.[82] In July 1989, serial production of the BIC finally began, and soon afterwards, the equipment of educational institutions on a broader scale started.[83] In several ways, the BIC was a significant improvement in comparison with the KC-series microcomputers. Despite compromises in computer capacity and features, the ministry of education claimed that the newly developed school computer would, from a technological point of view, meet the "advanced international standard."[84]

In Sweden, meanwhile, Compis faced an unexpected obstacle before entering the classroom. In 1984, while the Compis was in serial production, the state approved a stimulus grant for purchasing hardware and software in lower secondary and upper secondary education. The NBE prepared a list of specifications for the equipment and software eligible for subsidies. Equipment from fifteen suppliers was approved, not limited to Esselte's Compis. In order to receive the funds, municipalities needed to contribute half of the equipment cost and organize training courses for teachers.[85] Following this development, the Compis developers found themselves in a baffling situation, because they did not expect to have competitors in the school market.[86] The setting of specifications for the equipment eligible for subsidies followed a different logic. The reports highlighted compatibility and price, rather than the pedagogical aspects of computer use; the 1985 report mentioned that five out of six computers were IBM-compatible, whereas one (Compis) could work with its own software and, to some extent, with software developed for IBM-compatible computers.[87]

After several complications along the way and delays in production, a trial was carried out in fifteen schools. When the trial ended, the participating schools' verdict was mixed. Schools began to buy equipment at a faster pace, but by then Compis was not the only option. Many schools continued to choose Compis due to the lower price; however, after 1987, this price difference was minimal. In 1988, TeleNova was bought up by the computer company Svenska Viktor AB, and by 1988, Compis was discontinued.[88] A total of 25,000 Compis computers were produced, and 11,000 were sold in Sweden.

In the GDR, pedagogues did not regard the BIC as the promising and future-oriented device educators had anticipated and hoped for. Despite being a step forward, it was considered an already outdated piece of technology from the start. The Academy of Pedagogical Sciences in the GDR had emphatically emphasized that the school computer needed to be a 16-bit device, since the pedagogues had argued that 8-bit computers, such as the BIC, had no chance of success internationally, not even in the educational market sector. They warned that the GDR's development of a purpose-specific educational computer would have both a locally and temporally limited impact.[89] Instead, they recommended that the recently developed IBM-compatible 16-bit computer EC 1834 be modified for use in schools and other educational institutions.[90] Nevertheless, their concerns remained unheard. It was decided that a 16-bit school computer would be too expensive and that the limited technical capacity of the BIC would be sufficient to familiarize pupils with the new technology.[91]

However, with the fall of the Berlin Wall and the sudden availability of more modern Western computing technology, the BIC became a slow seller. Not just its hardware, but also its price, hampered its competitiveness, making it difficult to compete with Western computers. At least as significant, however, was the symbolic value of Western computers that trumped the GDR's BIC. Western computer technology had become, and was advertised as, the epitome of hope for a better future: powerful, modern, and seemingly future-proof. Many East German schools thus preferred to wait for Western computers to become available and decided not to purchase the BIC.[92] Less than a year after its launch, production of the BIC ceased.[93] The remaining devices were rebranded as a consumer product under the name, ALBA PC 1505 to be distributed in the GDR and Western countries. Unsurprisingly, they found little success.[94]

The Compis and BIC computers were discontinued only a few years after they were first envisaged. One plausible explanation is the obsolescence of both systems, whose production was not in line with market standards. However, it was not only that these computers had features that were already outdated at the time of their release. Equally relevant was the fact that the sociotechnical imaginaries in both countries were changing. In Sweden, the three-year campaign illustrated a shift in the state's vision away from the pedagogical needs of education and towards faster computerization of schools. The new specifications were less ambitious than those that guided the development of Compis, but they were good enough for policy-makers. The industrial policy goals of creating expertise in the computer industry had already been achieved, so the Compis developers could continue to contribute to improving the industry in other contexts. In the GDR, by contrast, the fall of the Berlin Wall brought about a shift in the sociotechnical imaginary that dominated the public discourse as the authoritarian leadership's imaginary dissolved with its fall from power. Technology was no longer imagined primarily as a tool for advancing the socialist society and unleashing human potential to achieve the collective goal of social progress in some distant future. Instead, with access to Western computer technology, it became associated with a vision of modernity, immediate and tangible progress, and the promise of individual self-realization.

* * *

A close look at two national projects concerned with the development of a school computer has shown how the device was shaped into an educational technology within the two different economic and political contexts of Sweden and the GDR. Our study reveals the desires, concerns, and preoccupations within the two countries' speculative futures at an early stage of integrating computer technology into schools, when the microcomputer was still an unstable and undomesticated technology in education.

In the process of planning, designing, and developing the school computer, the GDR and Swedish authorities articulated their visions of desirable futures of social progress that they believed could be achieved through technology and education. Accordingly, the school computer was expected to have an impact not only on educational systems, but also on the economy as a whole through its industrial and economic policy implications. School computer projects were therefore part of a utopian vision of the future constructed by state authorities, which, as we also noted, were challenged by economic, technological, and time-bound constraints. The idea and materiality of the educational microcomputer therefore had to be balanced between the hopes and desires for the future and the constraints and affordances of the present.

When the GDR and Sweden decided to develop a school computer — in 1986 in the GDR and 1981 in Sweden — both countries had economic and industrial policy programs that envisaged the computerization of society as a means of increasing competitiveness and stimulating the economy. In parallel, curriculum changes were implemented in both countries, introducing computer instruction in both general and vocational education.

However, the different sociotechnical imaginaries at work in the GDR and Sweden were expressed in the different ways computer education was integrated into the curricula. The fact that, in the GDR, computer education was part of the subject Introduction to Socialist Production shows that the aim of teaching computer education was mainly to prepare pupils for their jobs in a computerized and efficient socialist industry. In terms of content, the emphasis was on programming and learning how to use a computer to automate and rationalize various tasks in industrial production. In Sweden, on the other hand, "computer knowledge" was taught in mathematics and social sciences. Although programming was often taught within mathematics, the exact content was left to the discretion of teachers, depending on their training and interests. The most important aim, however, was to familiarize students with computers and reduce their fear of them, so that they could judge and influence their use in their roles as citizens and workers. Thus, in both the GDR and Sweden, the computer was seen as a technology that facilitated a collective vision of a desirable future to be constructed through education: one that emphasized economic progress and one that emphasized democratic participation.

These visions were further developed through the specifications of the school computers. For the GDR authorities, the motivation for a locally developed computer was to produce a high-quality system that could respond to the specific needs of their national curriculum, that is, a computer that could emulate workplace situations in a didactic way. While GDR educators were also interested in having a more flexible computer that could be used in a wider range of educational settings, the limited technical and human resources and the inability of the state-owned computer manufacturer, Robotron, to meet the high technical standards without exceeding the financial limits, led the decision-makers to focus on the economic core of their technical imaginary and to frame the computer primarily in terms of improving economic growth. In Sweden, the development of the school computer as part of a technology procurement project meant that politicians were freer to decide what kind of computer schools needed. When the government turned to the TUDIS project group, composed mainly of pedagogues, to realize its objective, the specifications reflected their local experience and included the guidelines outlined by the pilot projects carried out by the NBE. Therefore, the sociotechnical imaginary in Sweden was more in tune with the needs of the schools, in contrast to the GDR's, which more clearly addressed the needs of the labour market.

The history of the BIC and Compis computers could undoubtedly have been studied as failed technology projects or even as failed educational technologies, much like teaching machines or other technological devices that have passed through classrooms. However, by examining the sociotechnical imaginaries behind the planning and production of these systems, we are prompted to look beyond a technological deterministic narrative that merely highlights local technological and economic fiascos, perhaps followed by the emergence of new and better technologies. In contrast to such narratives, our analysis focuses on the process by which microcomputers became successfully established as educational technologies. As we have shown, the development of the BIC in the GDR and the Compis in Sweden played a significant role in that process. The commercial failure of the BIC and the Compis was decisively influenced by events in global and local contexts: from the fall of the Berlin Wall and the positioning of IBM personal computers in the school market in many countries, to the technical and economic constraints of the GDR, or the change of strategy in Sweden, which favoured a more rapid computerization of schools. Moreover, despite the short life of these school computer projects, the industrial endeavour and the formulation of a pedagogical framework within which computers were given a place in the classroom, decision-makers in the GDR and Sweden contributed to giving computers a central role in education, as a means of fulfilling national visions of technological, economic, and social progress.

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