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ORIGINAL ARTICLES

Automating Teacher Work? A History of the Politics of Automation and Artificial Intelligence in Education

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Abstract

The debate on automation in education is also a debate on teachers' work. Throughout history, promises of labor-saving and efficient automation technologies have been repeatedly promoted, while research at the same time has rather argued that automations will always depend on extensive human labor. In this study, we historicize how automation in education has been related to teachers' work and with what implications. Based on Sweden's long history of educational technology, we have drawn on digital and archival materials published from 1957 to the present. By contrasting the policy elements on automation and artificial intelligence (AI) across the past several decades, we show how debates and technologies are dynamically established and naturalized over time, which also risk silencing the critical debates on what the politics of automation and AI means for teachers' work and for public education. We conclude not only that the automation debate aligns with familiar 'techno-solutionist' educational technology histories, including forms of resistance on the technological uptake in education and society, but also that the scale and impact of automation are shifting with the technologies for automation and global platform infrastructures integrated into education. Consequently, one of the main questions is how the critical debate on automating teacher work and education is made possible even under such circumstances.

Keywords Automation · Critical AI studies · Teacher work · History of educational technology · Policy assemblage · Platform infrastructures · Digital labor

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Introduction

The recurring debates on the technologies of automation in education are also debates over teachers' work. Teachers' work has repeatedly been the focus of well-intended policy reforms and technological solutions aimed at improving educational processes. An overall question has been about how the labor of teachers could be automated (at least partly) and the tasks and circumstances that are the most appropriate to automate. The policy ideas also addressed the work that teachers need to do for themselves so as to develop and change their mindsets, individualize their teaching, and achieve better results—in line with technologies that are considered efficient, labor-saving, and cost-effective. The often-cited quote from the early 1980s, 'Any teacher who can be replaced by a machine should be' (Clarke 1980: 77), epitomizes the line of thought directed toward the teacher population and is often used to either stress the inadequacies of the teacher workforce and the need for technological upskilling or to open a discussion on automating parts of teachers' work.

Educational technologies became a growing commercial market that expanded steadily during the twentieth century and especially escalated during the 'wave of industrial-electronic futurism' in the late 1950s and 1960s (Good 2021: 70). According to Audrey Watters (2021), the early automation ideas during this time were spurred by ideas of mechanization and programmable teaching machines. They rested on assumptions about societal progress, often with technology-determinist, future-oriented, progressive, and economic motives for education.

The dynamics between machines of automation and teacher work in focus here connect to the theories on how machines form a part of societal powers (Deleuze 1995) that regulate people, work, etc., 'mechanical machines corresponding to sovereign societies' and 'cybernetic machines and computers to control societies' (175). Similarly, as Winner (1980) suggested, automations align with politics, which he exemplifies by stating how skilled workers in the manufacturing industry were replaced both by automated machines and fewer unskilled workers. The official aim was to increase productivity, but the overall reason was to stop the trade union, which had started to gain power. While the labor of teachers differs from such manual workers, teachers can still be said to share many of the challenges of today's digitally automated work, which rearrange and degrade aspects of their work (Selwyn et al. 2021).

Both today and in the past, it might seem difficult to separate automations and teachers, as technologies have long been integrated into education. The rearrangements and division of labor, however, are important distinctions to make. Despite the promises of replacing the work that is cast as routine and tedious with automated machines, research has consistently shown that automated work rarely leads to less work; rather, when machines and humans work together, it increases people's workload and profoundly rearranges how the work is performed and experienced (e.g., Crawford 2021). Notably, semi-automated work also becomes centered on machines, which demand an adaptable and flexible workforce (Crawford 2021: 66). In this sense, the automated work we focus on here, for example, the

early forms of mechanical (or later forms of digital) technologies for automation that makes a process or device function on its own, will always be dependent on a work and labor context.

However, even though they can outperform humans in many ways, today's automations based on digital technologies and artificial intelligence (AI) will also make errors that are inexplicable and hard to trace, and they have less self-knowledge compared to humans, who are quite good at knowing when human errors are likely to occur (Pasquale 2015). This argument relates to research on teachers' work being rearranged by automated technologies such as biometric facial recognition technologies that promise to replace the seemingly mechanical and tedious task of 'taking attendance' but which proved to be more complex and reliant on the teachers' care and judgment (Selwyn 2022).

Based on the above, our study aims to extend critical AI studies into the realm of public education and teacher work by revealing the historical automations and AI assemblages appearing over time. Taken together, the arguments for automating teachers' work seem to share certain specific features that need to be disassembled. First, the debate is not only surrounded by strong discursive claims regarding teachers' work but also imbued with a strong focus on 'techno-solutionism' (Morozov 2013) for such claims, whereas the fact is that solutions other than technological ones might be more important (Prinsloo, Slade, and Khalil 2022). Second, automation is recurrently naturalized and supported by a broad spectrum of policy arguments. At the same time, it is also being denaturalized and problematized by raising concerns over ethical and legal matters. Following this, our two questions are: *How is automation in education related to teacher work, and what are the associated implications? Which parts of teachers' work are inscribed in technologies for automation, and whose labor is implied for automation?*

Analytical Concepts and Methods

We have chosen to focus on how a policy assemblage (Savage 2020) gives shape to debates on automation in education, where assemblages 'represent a gathering together of political imaginations, rationalities, technologies, infrastructures and agents towards steering individuals and groups in particular directions' (328).

We, therefore, draw on the Foucauldian understandings of how powers operate and are gathered contingently over time and through power arrangements (Foucault 1977, 2007), and in combination with conceptualizations from Science and Technology Studies (STS). Our argument is that by historicizing and contrasting elements of the policy assemblage on automation in education, it is possible to analyze how issues and technologies appear, reappear, or disappear over time and across contexts (cf. Pinch and Bijker 1987). Three aspects of the policy assemblage have been analyzed: first, discourses on automation and teachers' work; second, the governing rationalities that act upon teacher populations, and; last, inscriptions of automation technologies. This means that we are interested in how discursive powers set the limits of what is thinkable and desirable around teachers' work and technologies at certain points in time. We are also interested in governing rationalities (or

governmentalities), that is, the forms of power logics that orient people's behavior and conduct via liberal (or neoliberal) 'freedoms'. Lastly, we also focus on how the materializing powers of inscriptions and inscription devices, which make automation technologies imagined or factual, are constituted over time.

We have used the Swedish context as our vantage point, which also provides a context with many international alignments. Our case shows that the technological uptake in education aligns to wider societal and interdisciplinary discussions on automation, labor, public sector marketization, AI, and data politics. It also has similarities to many other mainly western countries that introduced educational technologies (EdTech) early on. For example, over the latest decades, the Swedish EdTech case has gone from mainly state-led initiatives to decentralized and commercial market-regulated activities (Rensfeldt and Player-Koro 2020). Concurrently, the teacher labor market has become more differentiated (e.g., conditioned by employment in public-municipal or private-for-profit school organizations).

Digital and archival materials published from 1957 to date have been selected,[1] which cover government proposals, news and teacher-press debates, and popular science reviews (the material is listed in the end of this article).

Analytically, we have explored the assemblage of automation and teachers' work from the perspective of 'the exceptional' and 'the mundane', which we argue is a relevant analytical framing of the issue of automation in education in Swedish public debates. The exceptional relates to 'extraordinary' examples of hopes and fears associated with AI and automation, including ideas about how AI needs to be tamed and regulated in different ways. The mundane refers to taken-for-granted notions of automation, for example, as part of an 'already installed' digital infrastructure or everyday routines and processes of EdTech use. In our analyses, these two frames are presented separately and are historicized and compared via the contrasting examples from the various decades. Of course, these perspectives are intertwined; nevertheless, we wish to make the point that they both need to be problematized on their own terms. The mundane could benefit from being seen more as exceptional and, therefore, potentially dangerous, while the loud voices of the exceptional—with calls for actions—could be seen as less dramatic and ordinary or perhaps making other issues less visible. This would denaturalize their respective claims and how they work upon people. Our analytical approach has structured the four parts of the findings section where we present the results and make shorter analytical comments; these are then followed up in the concluding discussion.

Related Research

Our analyses relate to three different lines of research. First, the social science research on the relation between and convergence of automation/AI and human labor and the new work relations and divisions of labor (e.g., Crawford 2021; Irani

[1] The digitized material was collected by combining keywords related to our focus: automation and work (e.g., automation, electronic data processing, computer, computing, AI, teaching technology, electronic machines + school, teacher, student, and education and learning).

2015). This includes 'fake automation'—or fauxtomation as Taylor (2018) has coined it—which is when human labor covers up for automation shortcomings. We also make use of the digital labor concept (cf. Scholtz 2013), which refers to the logics of digital platforms and the capitalization on the often voluntary and unpaid digital labor people do on platforms, and which, in the case of teachers, stretches beyond the space and time of official working hours to private and globally distributed platform activities.

The second line of research we align ourselves with is that which raises concerns over the rearranged power dynamics of public education institutions, as private global platform industries become parts of the public sector (e.g., Williamson et al. 2022). In particular, this is affecting and transforming the work of teachers and school staff, who have historically been a gendered and feminized workforce and who are now becoming increasingly involved in digital labor (e.g., Perrotta et al. 2021; Rensfeldt et al. 2018; Selwyn 2021). Despite the promises of labor-saving technologies in the school workplace, the workload might rather increase, as evidenced in Cowan's (1983) historical study on gendered housework technologies.

Last, we align with critical and historical analyses of EdTech (e.g., Watters 2021; Good 2021) in relation to teacher work.

Findings

The Exceptional—The Fully Automated Promised Land

The postwar era was a time for economic growth and educational reforms not only in Sweden but also in many western countries. Peace, improved economies, and a growing population were often provided as the reasons behind the reformation and democratization of education. In 1958, a Swedish Radio broadcast presented the new comprehensive 9-year primary school reform, intended to streamline and modernize schooling. With the sound of a computer, the radio spot introduced the incredible role that these 'mathematical machines' would play in the society of the future (Hultén 2013). The head of the Stockholm University of Education is also heard declaring that:

> New technical aids in and outside of the workplace require new skills from us. It means that we are never 'ready' or never fully trained. We must be prepared to learn something new all the time. Facts and opinions that are true, or regarded as true, today, may tomorrow be obsolete or even bad jokes. (Swedish Radio 1958)

Even though computers were costly, rare, and as big as rooms, they were still expected to radically change learning and knowledge. Visions of automation (a term which, in the 1950s, signified an automated process of 'electronic brains', i.e., computers) generated new debates around the need for changing education (Sandström 2001). The suggested changes were related to extending and advancing education in time and stressing the need of 'learning to learn' due to rapid technological changes in society. Interestingly, this included character-building and shaping people so that they could cope with the anticipated 'explosion of free time' caused by automation

(e.g., the special issue of UNESCO's International Review of Education on automation and education from 1957). In essence, these changes focused on a broad admission to education and the handling of the imagined *effects* of automation (Thorelli 1956). However, new computers were also seen as being capable of replacing teacher labor. In 1957, a Swedish newspaper stated the following: 'There seems to be no limit to what the electronic machines can accomplish. The final thing needed is to let them serve as teachers' (SDS 1957).

Despite these high-flying expectations, it took some time for computers to enter schools. Swedish inquiries and bills about implementing computers in schools emerged during the end of the 1960s (Emanuel 2009). In the 1950s and 1960s, the (imagined) replacement of teachers with EdTech was not described as a problem but instead as a desirable development. There was a shortage of teachers, and child cohorts were growing in numbers. This meant that television, radio, and film, as well as automated systems (computerized and analog), were seen as offering new opportunities to streamline teaching and automate teachers' tasks (Emanuel 2009). The main inscription of automation was the 'teaching machine' with programmed instructions (Holmgren 1970), based on a mix of industry-military ideals for selecting and processing student learning and promising more effective, rationalized processes and an optimization of the education of populations to develop the prosperity of the nation. Torsten Husén (1963), one of Sweden's internationally renowned education social engineers of the postwar time, suggested the following: 'A more sensible use of the human workforce, a transfer of routine tasks to technical aids and study of the possibilities of grouping the students in other ways than the conventional ones' (5).

Husén (1968) described how the educational psychologist Robert Glaser had already attracted considerable attention at a Scandinavian teacher conference in 1961, where he stated that 'any teacher who can be replaced by a machine should be' (Clarke was perhaps not the first to say this). The main problem with the behaviorist-informed EdTech at the time was, however, described as the practical difficulty of adapting to individual needs. Teaching machines were considered too standardized and not providing enough opportunity for individualized learning (Husén 1968); but with the new (imagined) promise of computer-mediated teaching, students could easily be placed on different learning tracks through a computer program. Imaginative parallels were drawn to other 'intelligent forms of teaching support', such as, for example, having an Aristotle of one's own:

> The aim must be to try to give every student the advantage that, in the past, was only reserved for the aristocracy of the world, namely to have an informant. In other words, why not strive to give every student the advantage that Philip of Macedonia gave to his son Alexander, namely an Aristotle. (Husén 1968: 112)

When the automated teaching machine reappeared in policies around 2018, 50 years later, the discourse was very similar, although the technology had taken the material form of adaptive AI-based programs. In particular, teachers were to be provided with data for monitoring and assessing the progress of individual students and let automation handle the real-time adaptive feedback:

> In the field of education, artificial intelligence is used, among other things, in adaptive learning. Intelligent software programs in the computer learn how an individual learns and adapt educational content and feedback to the individual. This can be a support for the teacher and free up valuable time. (Swedish Association of Local Authorities and Regions, SALAR 2018: 21)

Again, public policies express concerns over how teacher work is best used to support student learning, mainly due to teacher shortage and changing educational needs. Even if the automation discourses of the 2010s resemble the ideas of simplifying work and optimizing education, there are differences in terms of focus and scale. One such difference is that automated technology inscriptions have now been made an integrated part of platform data infrastructures, mainly through the Swedish strategy of school digitalization (e.g., Government Office 2017; SALAR 2019) and global education platform market processes. The argument here is also that individually adaptive and data-driven automations will yield more objective and fair outcomes for students. This is not only because inequalities across school forms, geographies, and digital infrastructures are identified as major policy problems but also because the access to teaching resources and teachers is unequally distributed. Thus, even if the teaching machine policy elements presented here show similarities over time, they also expose new concerns over the capacity of public education to distribute learning opportunities fairly and securely. They also intervene in matters of teacher work (e.g., classroom management and teacher performance) that were protected earlier.

Mundane Becomes Exceptional—Resistance and Struggles over Data

In the 1970s, the behaviorist approach to teaching, which computers were seen as supporting, was increasingly being regarded as problematic (Emanuel 2009). As more cognitive approaches gained ground, the role of computers (still more imagined than actual) was at the time considered to be to support and strengthen a more student-centered discourse. This also changed what was seen as a 'teaching technology'. Interestingly, this debate took place at the same time as the first large-scale efforts to implement a computing curriculum in Swedish education were being made (Emanuel 2009), reflecting this emerging debate in society.

During this time, computerization in general had already spurred enormous debates. A key incident was that in the early 1970s, it was revealed that the Swedish Bureau of Statistics had sold citizen data to commercial advertising companies (Söderlind 2009). This created an extensive debate about computers as tools for state surveillance (Lundin 2015). Striking workers stopped the introduction of computer systems, refusing to be micromanaged, and computerization became a political and union problem (Carlsson et al. 1978). Automation was seen as strengthening corporate power at the expense of workers, and it was therefore considered desirable to instead provide people with the agency to influence technological development through education and citizen information (Rahm and Fejes 2017). Arguably, as a result of such debates, Sweden also became the first country in the world to have regulated data politics (Ilshammar 2007).

Concurrently, similar counterarguments regarding the risks of computerization and automation for teachers' work began to emerge. These arguments aimed to protect the 'inner' work of professional teachers and account for the known problems of EdTech. In the news media, an argument restating the need of teachers' social and relational work was presented, claiming that 'teachers will be needed in the future; computers do not dry tears' (Ohlin 1978). The statement was embedded in a wider critique of EdTech economical miscalculations, which had also been repeated in relation to the public education sector, particularly considering costly systems 'getting more expensive than expected and taking longer than planned to develop' (Ohlin 1978).

Similar criticisms around the failures and costliness of investments in EdTech appear once more in the 1980s (both in Sweden and elsewhere) in relation to the malfunctioning and incompatible 'school computer' (Emanuel 2009). This form of criticism re-emerged around the 2020s, when the impact of the growing market of commercial digital platforms was criticized. The Swedish teacher union reports on how working on platforms doubles teachers' work (e.g., when digital work also has to be done manually for securing documentation) instead of facilitating it. The demands put on digital documentation and the detailed control of work tasks and performances are considered to cause stress and work-life problems (The Teacher Union 2018).

Echoing the struggles over data on citizens in the 1970s, several reports and news media revealed issues around data-sharing as a juridical and an ethical challenge. Several follow-ups by The Swedish Authority for Privacy Protection concern vulnerabilities related to issues of sensitive information being openly available in school platform infrastructures—often in relation to changes such as system updates, new platform integrations, or procurements. The teacher trade union media (The School World 2021) reported on how schools must pay platform providers to obtain access to data that they had themselves generated within the platforms, for example, relating to grading or assessment and other important tasks for schools as public-sector institutions. Commonly, renewed licenses or procurements of new platforms meant that access to archived data was associated with problems, where the platform business model charged extra for such functions. Teachers expressed having to work around this and do double the work to compensate for the effects of such procurement.

Yet, another type of resistance to the logics of platforms appeared in the 2020s. News media began reporting on the huge costs and the malfunctioning processes of the school platform procured by the municipality of Stockholm. This led to protests by a group of parents who, based on their programming skills, decided to create their own application to provide better information. However, the parents were questioned and the officials responsible reported the 'incident', which also made the headlines in international press. Wired magazine reported that 'These parents built a school app. Then the city called the cops' (Burgess 2021). The parents called their protest 'a citizen initiative' and portrayed the capacity of the welfare state as threatened and non-efficient. Their protest action aligned with how public institutions were criticized both by public and private policy actors for underutilizing the assets that they already had

available (e.g., large-scale data generated in and around school) and which could make the work processes more effective.

One particular issue frequently referred to as the target for automated technologies in the policies is student attendance. The Ministry of Education (2016b: 245), for instance, states that schools' digital platforms are underused for monitoring data on absenteeism and goes on to criticize schools for not keeping track of absent students: 'There are still many schools that do not know the extent of the absence in their own unit'. However, the inscription devices for monitoring attendance records will probably not solve the core problem or address the deeper knowledge around absenteeism that teachers and other professionals already have. As we describe in the following sections, transferring the issue to automated technologies is a techno-solution that repeats the same mistake.

The first Swedish entity to be fined for violating the European Union's General Data Protection Regulation (GDPR) was a biometric facial recognition technology used for registering school attendance (Data Protection Authority 2019). It might come across as an exceptional case to actually procure technology that operates beyond the law but the ambition to relocate attendance-taking to a biometric inscription device, instead of relying on the work of a teachers' care, attention, and professional judgment, illustrates the dynamics and priorities of automation in education.

What the first example here shows is that there is a new discourse around automation in education, which has to do with avoiding risks and providing 'objectivity' in decisions. Effectively, this also takes away agency from teachers' work. There is a dynamic movement between what is seen as exceptional and mundane, from being interpreted as open and 'automatable', to the legal closure of such issues where legal and ethical policy discourses are established. In the Swedish case, this movement seems to govern teachers and schools in new ways, aiming at being self-aware and act 'GDPR-safe' in relation to EdTech:

> If, in the industrial era, the promise of automation was to displace manual labor, in the information age, it is to pre-empt agency, spontaneity, and risk: to map out possible futures before they happen so objectionable ones can be foreclosed and the desirable ones selected. (Andrejevic 2020: 9)

These double-sided aspects of the assemblage of automated work—from the teaching machine to automation for securement—are a part of the politics of artifacts (Winner 1980). According to Winner, artifacts can be political in two ways: politics can be built in technology or be aligned to a certain type of societal order. Automation in education is no exception. Replacing teachers' work with automated processes is to disregard the responsibilities that are a part of something like taking attendance and which require professional and situated knowledge (Selwyn 2022). At the moment, this is more of an individual data protection issue, but other values might well come to the fore here, which the more societal critique from the 1970s reminds us of.

'The Mundane'—Data Infrastructures, Standards, and Digital Labor

Sweden's latest school digitalization strategy has a strong data infrastructural focus, arguing that 'increased access to data creates opportunities to use information to improve and streamline education and administration' (Government Office 2017: 12). As the Ministry of Enterprise and Innovation put it (2018: 6), 'Access to data is the lifeblood of AI and a crucial part of infrastructure; and value is only created when AI is widely used, both in the private and public sectors'. Clearly, technologies are seen as general techno-solutions for society and education, claiming that 'everything that ranges from automation to artificial intelligence is an opportunity for the school system today' (SALAR 2019: 14). Above all, AI is dependent on the mundane integrations and operations and the technically and discursively driven powers that draw on 'interoperability' to facilitate integrations between systems. This, in turn, promises fast, upscaled data processing and automated exchange, which will also be 'avoiding future lock-ins in technologies and providers' (SALAR 2019: 33).

Since the 2010s, several policy and techno-solutions have been directed toward digitally improving school infrastructures through inscriptions for standardizations and integrations. This suggests that the digital data infrastructure has achieved a form of closure that invites new problematizations. In particular, policies seem to concentrate on the difficulties associated with governing schools in their current decentralized and unevenly distributed form. Therefore, powerful discourses and governing rationalities underpin these infrastructural powers. The problems of government align with two important reforms of public education around the 1990s. The first is the changed school ownership where municipalities took over the operating responsibilities of public education, which was heavily criticized and caused teacher strikes at the time. The second is the school marketization reform that allowed publicly funded, privately-run, for-profit schools to operate alongside public schools. Seen in this context, the idea of a smoothly operating and seamless infrastructure across different school forms and localities is a strong advocate for reorganizing and providing solutions for a criticized welfare sector.

Despite the high hopes of data infrastructure expansion, it is, however, in the policy details that the mundane and messier realities appear. The latest technical standard (Swedish Standards Institute 2020) presented a more fine-grained classification of the work done in schools than earlier and thereby also interfered with schools' work descriptions. This made the work more visible but presumably also more restricted to the associated categories, which will have implications for how teachers' work will be outlined and regulated by the designs and logics of platforms. Another interoperability standard being recommended is Application Programming Interfaces (APIs), which supports automatic data exchange across platform infrastructures but which are mainly established for commercial platforms and third parties to exploit data. Nevertheless, APIs are proposed as a solution for better integration (SALAR 2019) between official agencies and the public and the private school organizations.

Thus, a flurry of activities has been launched where policy actors are 'struggling to make work tasks interpretative and understandable by software systems' (Crawford 2021: 58). In that sense, digitalization and automation are about standardizing and

modularizing work and facilitating the time-coding that comes with digitizing work. These technical powers align with the governing rationalities of productivity directed toward the public sector workforce, again resting on the idea of effectivization and 'speeding up time' (Crawford 2021: 70; Gregg 2018).

Swedish schools have invested in technical infrastructure for a long time, and, during the two latest decades, the platform infrastructure provided by global enterprises, such as Google and Microsoft, has gained a prominent position. The expansion of platform infrastructures, supported by APIs and standards, means that most schools are integrated with third-party platform providers and functionalities. This allows convenient, fast, and often hidden automations for platform users, as providers make use of AI-based integrations in their platform iterations. The work for teachers on platforms commonly includes cross-platform activity determined by the form of APIs. This means that they perform everyday monitoring of platform activities and of the behavior of themselves and others based on the data provided by the systems' prognostics and dashboards. On the website the IT Teacher (2021), it is described how a private school consortium, via a third-party provider, has integrated an advanced AI-integrated program in their school platform, construing an 'early warning system' that monitors school performance and student dropout risk. With this monitoring, the Google platform infrastructure, supported by APIs, connects to the learning goals in different course syllabi from the National Agency of Education. With the newly added automations, teachers should be supported by automated assessments and documentation for follow-ups and grading, including real-time automations of the data generated.

The type of everyday behavioral management and the semi-automations generating diagnostics or prognostics exemplified here is quite exceptional automations. As real-time monitoring of behavior and automated predictions tends to become more common, people will become used to intensified forms of surveillance, which might in turn desensitize those working in schools. To be constantly monitored and learn to be aware of one's results and productivity (Gregg 2018) could probably create looping effects, where people regulate themselves in line with what the system values as productive. Notably, these forms of mundane, ongoing interventions in work rely on people's freedom and self-conduct. Thus, when automations nudge certain behaviors, they 'intervene in what people do while maintaining a sense of individual autonomy and self-control' (Selwyn 2019: 70). This is also the premise of the governing rationalities that regulate people through positive, liberal powers, demonstrating care as a feminine trait (or neoliberal powers for economical self-gain, etc.)

Incremental Automation—Automation Materialized and Domesticized

The automation of Swedish schools has happened gradually and in small and particular steps, characterized by a push-driven logic that was rarely requested by the teachers themselves (Emanuel 2009). That is, automations and computers were, for a long time, not distributed evenly across all schools in Sweden (Commission for Informatics Policy 1985). Initiatives and resources were implemented in a 'patchy' manner, resulting in very varied curricula and heterogeneous experiences

of education for both teachers and students across Sweden (Riis 1991; Nissen and Riis 1985). Work and adult and higher education were both subject to automation first and elementary education followed their lead, and the sudden spurs and local initiatives have continued well into the twenty-first century. The first Swedish one-laptop-per-child project was initiated in the late 1990s, and this project has been successfully rolled out, mainly via municipal governments, and today, Swedish schools effectively demonstrate one computer per student, and a striking 100% of the students use smartphones (The Swedish Internet Foundation 2021).

Sweden in the 1980s, like many other countries at the time, developed a dedicated 'school computer'. The underlying and driving argument was the compensatory role of schooling. The enormous project of procuring a school computer, however, made COMPIS (as the computer was called) effectively outdated by the time it was implemented (Kaiserfeld 1996). Redistribution politics also shifted toward neoliberal ideals of competitive market procurement, which made the COMPIS project even more obsolete. Critical voices had been raised arguing that schools' investments in computers were benefitting computer companies more than students (KRUT, Critical Education Magazine 1985), but the decentralization of schools and local school computer market practices effectively silenced the critics. Therefore, even though students had increasing access to digital devices and platforms over the 1990s and into the 2000s, it was not a uniform and synchronized process to begin with.

In parallel, the concept of the information society and of information technology (IT) was put forward to emphasize the possibility of global knowledge and deepened democracy. Such concepts carried a deliberating potential: 'This frees up the creativity of both teachers and students' and 'the teaching environment can be renewed, pedagogy developed, and learning improved' (The IT Commission 1994: 7). These quotes effectively illustrate how teachers are positioned as becoming liberated and more creative with technology and showing resistance to IT harder. In a notable media event, Bill Gates visited the Swedish National Agency for Education and, with a certain wiseacre air, claimed that IT can create a better school for all (Söderlund 2000). Investments in technology in schools during the 1990s also had a great impact on school administration. According to Ohlsson (2009), this was connected to the fact that municipalities were taking over the leadership of schools: 'Computerization also facilitated the organization of schools as part of the municipal economy–and could thus constitute an instrument for savings' (38).

In the 2020s, a new push for automation is suggested, characterized by two interrelated arguments. One is the need to intensify the strategies and tactics for infrastructural coordination through automated management, and the other, to replace the teacher with automations. The automated management was mainly oriented towards school organizer levels and governmental authorities. The so-called open APIs were considered main inscription devices for promoting success with automated government reporting and to make data accessible and comparable across platforms and regions (SALAR 2019: 39). The renewed interest in replacing teachers is visible in the proposal on digitalization of national assessments, *Equal, Valid and Effective* (Ministry of Education 2016a). It describes not only how teachers will be released from assessment work, but also how a new division of labor is initially needed:

> In our view, teachers do not have to be involved in reporting the results. When the national tests are conducted digitally, it will be possible to have results reported automatically via the digital testing system. Until then, we consider that the education authorities should develop their procedures for the reporting of test results, for example by allowing an administrator or assistant to conduct the reporting. (Ministry of Education 2016a: 45)

The proposed solution is to fully automate testing. However, the work needed to *report* the test results must also be made simpler. In the proposal, assessments are considered to be fairer and more objectively handled if they are automated and separated from teachers. To achieve this, the governing rationality appeals to teachers' desire for more equal outcomes of education for students. The problem with these ideas is that the work of reporting and grading must legally be done by professional teachers. So, presumably, teachers are implied and expected to perhaps voluntarily contribute to the comprehensive labor required. Assessment policy continues to be highly debated. However, discussions mainly revolve around technical, legal, and economical procurement requirements and seldom concern practical or socio-pedagogical teacher work.

The recent policy examples on the replacement of teachers seems to be somewhat of a 'fauxtomation' (Taylor 2018), an automation that needs labor but at the same time also depreciates labor. As Selwyn (2021) has shown, the invisible and precarious work implied in automated education 'often involves ongoing workarounds, "repair work" and temporary solutions' (364), and he suggests that more labor-centric perspective is needed to reveal the new divisions of labor and invisible work that the mundane powers of 'autonomous' machines produce (366).

Even if a semi-automation approach (of not fully replacing the teacher) has mainly been promoted across time, new examples of how teachers ideally should be replaced by automations have appeared. In the OECD report titled 'Pushing the Frontiers with AI' (2021: 58–61), a parallel is made between self-driving cars and adaptive, personalized learning. In their push for more automation, the OECD compares how both drivers and teachers gradually (through, partial, conditional, high, or full automation) (60) can be freed from controls and monitoring by letting the 'autonomous powers' of the machine take over.

In a recent internet article, Grönlund, professor of informatics (n.d.), proposes that automation and 'learning analytics' are key technologies for making teachers 'gradually hand over some routine tasks that today take a lot of work hours, to technology, which can do such things better and faster'. He further states that teachers' relation to technology is the problem: 'So far, it has largely been characterized by the slave's attitude–suspicion and competition'. The metaphor of the slave is certainly problematic in many ways, and the criticism against teachers that is put forward echoes earlier debates. Assumptions that teacher technophobia is an obstacle for school development can be seen as a trope that has been repeated throughout history. Seeing how digital technology is so strongly associated with the future, expressions of criticism against digital technology (at least during highly techno-utopian times) can also be described as monsters in the discourse (Foucault 1996), that is, there exists little or no agency to destabilize the techno-solutionist promises that digitalization would (ideally) fulfill. To accuse someone of being an ignorant and a petty Luddite who

anxiously guards their profession is a tactical discursive choice as they can then also be described as being against the future itself. The fact that Luddites were not against technology per se but were engaged in a class struggle against unfair production systems is again made invisible by this type of reasoning.

Concluding Discussion

The two questions we raised were as follows: (1) how automation in education is related to teacher work and the associated implications and (2) the parts of teachers' work are that inscribed in technologies for automation, including whose labor is implied in the automation.

Based on the contrasting examples from the various decades from 1957 onward, we have tried to describe the dynamic policy assemblage of automation, composed by different powerful and often internationally aligned elements of actors, discourses, and inscriptions (e.g., McCann and Ward 2012). By historicizing continuities and discontinuities of the political, technological, and economical aspects of the assemblage, certain patterns were revealed across time. Like other national policy contexts, computer and AI-based technologies are here depicted as inevitable and disruptive, but, upon closer inspection, the policy assemblage also exhibits local characteristics and returning discourses (Bareis and Katzenbach 2021). Clearly, the automation assemblage rests on arguments known from the techno-solutionist history of EdTech (Watters 2021). Perhaps, more than other computer and digitization ideas, automation is explicitly based on the idea of saving and reducing the cost and time of labor, which implies new arrangements of human and nonhuman labor, as well as a rearrangement of human and teacher labor relations. As such, automation is linked to liberal governing power, with the promise not only of protecting teachers from the threat of an encroachment on their perceived autonomy, but also of liberating them from certain responsibilities, thanks to a seemingly objective AI solution. Once automation is put to work, it seems difficult to form a resistance, making today's incremental normalization of automation so important to approach critically. Our historical analysis and alignment with critical AI studies hopefully can show that the educational focus bring interesting matters to the transdisciplinary discussions on the politics and inscriptions of automation technologies and work, in relation to approaches such as STS or similar, interested in the impact of technology in society.

There are two clear standpoints in the debates and efforts to automate and replace the teacher; both are essentially about whether human factors are problematic or desirable. One side of the argument is about replacing human judgment with automations, creating a more legally secure, impartial, and fair judgment by removing emotions and uncertainties. The other argument is that core parts of teachers' work cannot be automated but also that some automations can free them from mundane routine tasks and make more time for them to do their most important work. When human bias and shortcomings become problems for education, these are often addressed through automation. Conversely, when imagined people-centered skills, such as empathy, creativity, or care, are put forward

as important, then automation of these skills becomes the problem, while automation of the other more mundane tasks is put forward as a solution.

Importantly, there seems to be a silencing of resistance and debate over time. The international scale and heterogeneous character of automations and AI paired alongside a more decentralized school organization and teacher labor further stress this. Both in the 1970s and in the present time, protests over automation took the form of struggles over data generation and access, and the response has been to domesticate and tame automation through education, laws, and ethical guidelines that also govern teachers' digital work. Earlier, resistance appeared both from within education and from societal and trade union debates; recently, however, the resistance seems less and is mainly visible in local initiatives (exemplified by the parent app solution). There are also new policy concerns around AI and automation for counteracting mainly social and digital resource inequalities across a differentiated school system. As argued by Andrejevic (2020), automation comes with promises of cost-effectiveness and objectivity, which however also have created the prominence of a post-political technocracy that diminish debate and instrumentalize important public issues. This can also explain why today's exceptional moments are mainly about shifting responsibilities and creating new divisions of labor when automation fails, rather than questioning if the relevant aspects were dealt with in the first place. We have described how automation is mundane in the sense that it is incremental and continuous and slowly colonizing more and more work. Both the examples of the mundane and the exceptional therefore silence broader critical automation debates on automating teacher work and the students and public education they serve. An alternative, as suggested by Pasquale (2015) is that teachers as a unionized collective in the future gain more influence over shaping the policies on automation and AI in education to better 'protect those they serve' (5).

Over time, discourses and inscriptions of automation have been oriented towards different educational spheres, mainly related to the teaching–learning situations, but nowadays, more intrusive automations appear, through behavioral micro-powers and wider automation management as well as global platform solutions (Williamson et al. 2022). This makes automation both hidden as well as possible to scale up—fast and often cheap—in secret, for example, via APIs and cloud-based services (cf. Perrotta et al. 2021; Williamson et al. 2022). As argued by Crawford (2021), automation technologies are still, however, dependent on the labor of training the algorithms and machine learning systems, meaning that they always depend on the voluntary digital labor and the network effects of people's digital work activities, which are also further necessary for capitalizing on the digital labor (Scholtz 2013). In their broader sense of digital systems and global platform infrastructures, EdTech arguably also goes hand in hand with the pursuit of AI and automated policy governance (Gulson and Witzenberger 2022), which makes education and teacher work controllable across various spheres. However, it is seldom a linear or a simple process but rather a struggle over who has the power to define the overall purposes of public education.

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Declarations

Conflict of Interest The authors declare no competing interests.

References

Andrejevic, M. (2020). *Automated Media.* London and New York: Routledge.

Bareis, J., & Katzenbach, C. (2021). Talking AI into Being: The Narratives and Imaginaries of National AI Strategies and Their Performative Politics. *Science, Technology, & Human Values, 47*(5), 855-881. https://doi.org/10.1177/01622439211030007.

Burgess, M. (2021). These Parents Built a School App. Then the City Called the Cops. Wired, 4 November. https://www.wired.com/story/sweden-stockholm-school-app-open-source/. Accessed 10 September 2022.

Carlsson, J., Ehn, P., Erlander, B., Perby, M. -L., & Sandberg, Å. (1978). Planning and Control from the Perspective of Labour: A Short Presentation of the DEMOS Project. *Accounting, Organizations and Society, 3*(3-4), 249-260.

Clarke, A. C. (1980). Electronic Tutors. *Omni Magazine, 2*(9), 77-78.

Commission for Informatics Policy (1985). *Bred datautbildning: Betänkande*. [A Broad Data Education: Report]. Datadelegationen. Stockholm: Liber.

Cowan, R. S. (1983). *More Work for Mother: The Ironies of Household Technologies from the Open Heart to the Microwave.* New York: Basic Books.

Crawford, K. (2021). *Atlas of AI: Power, Politics and the Planetary Costs of Artificial Intelligence*. New Haven: Yale University Press.

Data Protection Authority (2019). Tillsyn enligt EU:s dataskyddsförordning 2016/679: Ansiktsigenkänning för närvarokontroll av elever. [EU Supervision According to the General Data Protection Regulation 2016/679: Facial Recognition or Attendance control of students]. Datainspektionen.

Deleuze, G. (1995). *Negotiations, 1972-1990.* New York: Columbia University Press.

Emanuel, M. (2009). *Datorn i skolan: Skolöverstyrelsens och andra aktörers insatser, 1970- och 80-tal: Transkript av ett vittnesseminarium vid Tekniska museet i Stockholm den 30 oktober 2008*. [The Computer in the School: The Efforts of the School Board and other Actors, 1970s and 80s: Transcript of a Witness Seminar at the Technical Museum in Stockholm on October 30, 2008]. Stockholm: KTH Royal Institute of Technology.

Foucault, M. (1977). Nietzsche, Genealogy, History. In F. F. Bouchard (Ed.), *Michel Foucault: Language, Counter-Memory, Practice: Selected Essays and Interviews* (pp. 139-164). Oxford: Basil Blackwell.

Foucault, M. (1996). The Discourse on Language. In R. Kearney & M. Rainwater (Eds.), *The Continental Philosophy Reader*. London and New York: Routledge.

Foucault, M. (2007). *Security, Territory, Population: Lectures at the College de France, 1977-1978.* London: Palgrave MacMillan.

Good, K. D. (2021). Multimedia. In G. Balbi, N. Ribeiro, V. Schafer, & C. Schwarzenegger (Eds.), *Digital Roots: Historicizing Media and Communication Concepts of the Digital Age* (pp. 59-75). Berlin: De Gruyter.

Government Office (2017). *Nationell digitaliseringsstrategi för skolväsendet*. [National Strategy for School Digitalization]. Stockholm: Regeringskansliet.

Gregg, M. (2018). *Counterproductive: Time Management in the Knowledge Economy*. Durham, NC: Duke University Press.

Grönlund, Å. (n.d.) Lärarna och robotarna – om lärarprofessionens framtid. [The Teachers and the Robots, about the teaching profession's future]. https://www2.diu.se/framlar/nyheter/lararna-och-robotarna-om-lararprofessionens-framtid/. Accessed 10 September 2022.

Gulson, K., & Witzenberger (2022). Repackaging Authority: Artificial Intelligence, Automated Governance and Education Trade Shows. *Journal of Education Policy, 37*(1), 145-160. https://doi.org/10.1080/02680939.2020.1785552.

Holmgren, O. (1970). Framtidsvision? Datamaskin till eleven vid läsårsstarten med alla kurser inprogrammerade. [Future Vision? Preprogrammed Computer Machines to Students at the School Start]. *Lärartidningen/Svensk skoltidning, 36*.

Hultén, M. (2013). Technology for All: Turning a Keyword into a School Subject in Post-war Sweden. *History of Education, 42*(5), 622-637. https://doi.org/10.1080/0046760X.2013.832410.

Husén, T. (1963). *En skola för 60-talet.* [A School for the 1960s]. Stockholm: Almqvist & Wiksell.

Husén, T. (1968). *Skola för 80-talet: Framtidsperspektiv på utbildningssamhället*. [A School for the 1980s. Future Perspectives on the Education Society]. Stockholm: Almqvist & Wiksell.

Ilshammar, L. (2007). When Computers Became Dangerous: The Swedish Computer Discourse of the 1960s. *Human IT: Journal for Information Technology Studies as a Human Science, 9*(1), 6-37.

Irani, L. (2015). Difference and Dependence Among Digital Workers: The Case of Amazon Mechanical Turk. *South Atlantic Quarterly, 114*(1), 225-234. https://doi.org/10.1215/00382876-2831665.

Kaiserfeld, T. (1996). Computerizing the Swedish Welfare State: The Middle Way of Technological Success and Failure. *Technology and Culture, 37*(2), 249-279. https://doi.org/10.2307/3106816.

KRUT [Critical Education Magazine]. (1985). Tema: IT - hot eller möjlighet? [IT, threat or opportunity?]. *Kritisk Utbildningstidskrift, 2*.

Lundin, P. (2015). Computers and Welfare: The Swedish Debate on the Politics of Computerization in the 1970s and the 1980s. In C. Gram, P. Rasmussen, & S. Østergaard (Eds.), *History of Nordic Computing 4. HiNC 2014. IFIP Advances in Information and Communication Technology, vol 447*. Cham: Springer. https://doi.org/10.1007/978-3-319-17145-6_1.

McCann, E., & Ward, K. (2012). Policy Assemblages, Mobilities, and Mutations: Toward a Multidisciplinary Conversation. *Political Studies Review, 10*(3), 325-332. https://doi.org/10.1111/j.1478-9302.2012.00276.x.

Ministry of Education (2016a). *Likvärdigt, rättssäkert och effektivt – ett nytt nationellt system för kunskapsbedömning*. [Equal, Valid and Effective, a New National Knowledge Assessment System]. SOU 2016a:25. Stockholm: Utbildningsdepartementet.

Ministry of Education. (2016b). *Saknad! Uppmärksamma elevers frånvaro och agera*. [Missing! Pay Attention to Student Absence and Act]. SOU 2016:94. Stockholm: Utbildningsdepartementet.

Ministry of Enterprise and Innovation (2018). *National Approach to Artificial Intelligence.* Stockholm: Government Offices of Sweden.

Morozov, E. (2013). *To Save Everything, Click Here: The Folly of Technological Solutionism*. Public Affairs.

Nissen, J., & Riis, U. (1985). *Datalära på grundskolans högstadium. En ögonblicksbild från tre kommuner och sex skolor vintern 1984/85*. [Computer Education at the Upper Level of Primary School. A Snapshot from Three Municipalities and Six Schools in the Winter of 1984/85]. Stockholm: Liber.

OECD (2021). OECD Digital Education Outlook 2021: Pushing the Frontiers with Artificial Intelligence, Blockchain and Robots. Paris: OECD Publishing. https://doi.org/10.1787/589b283f-en.

Ohlin, T. (1978). Läraren behövs också i framtiden. Datorn torkar inga tårar. [Teachers Will Be Needed in the Future. Computers Do Not Dry Tears]. *Teknik i tiden, 8*, 23-24.

Ohlsson, Ö. (2009). Skolan och IT-tåget. [The School and the IT Train.]. In M. Folke-Fichtelius (Ed.), *Lärande och IT*. (pp. 29–41). Stockholm: Carlsson.

Pasquale, F. (2015). *Black-box Society: The Secret Algorithms that Control Money and Information.* Cambridge, MA: Harvard University Press.

Perrotta, C., Gulson, N., Williamson, B., & Witzenberger, K. (2021). Automation, APIs and the Distributed Labour of Platform Pedagogies in Google Classroom. *Critical Studies in Education 62*(1), 97-113. https://doi.org/10.1080/17508487.2020.1855597.

Pinch, T., & Bijker, W. E. (1987). The Social Construction of Facts and Artifacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other. In W. E. Bijker, T. P. Hughes, & T. J. Pinch (Eds.), *The Social Construction of Technological Systems* (pp. 17-50). Cambridge, MA: The MIT Press.

Prinsloo, P., Slade, S., & Khalil, M. (2022). The answer is (not only) technological: Considering student data privacy in learning analytics. *British Journal of Educational Technology, 53*, 876-893. https://doi.org/10.1111/bjet.13216.

Rahm, L., & Fejes, A. (2017). Popular Education and the Digital Citizen: A Genealogical Analysis. *European Journal for Research on the Education and Learning of Adults, 8*(1), 21-36. https://doi.org/10.3384/rela.2000-7426.rela9113.

Rensfeldt, A. B., Hillman, T., & Selwyn, N. (2018). Teachers Liking Their work? Exploring the Realities of Teacher Facebook Groups. *British Journal of Education Research, 44*(2), 230-250. https://doi.org/10.1002/berj.3325.

Rensfeldt, A. B., & Player-Koro, C. (2020). 'Back to the Future': Socio-Technical Imaginaries in 50 years of School Digitalization Curriculum Reforms. *Seminar.net, 16*(2), 20. https://doi.org/10.7577/seminar.4048.

Riis, U. (1991). *Skolan och datorn: Satsningen Datorn som pedagogiskt hjälpmedel 1988–1991*. [The School and the Computer: The Investment in the Computer as a Pedagogical Aid 1988–1991]. Linköping: Linköpings University.

SALAR, The Swedish Association of Local Authorities and Regions (2018). *Automatsering av arbete. Möjligheter och utmaningar för kommuner, landsting och regioner.* [Automation of Work. Opportunities and Challenges for Municipalities, County Councils and Regions]. Stockholm: Sveriges kommuner och landsting.

SALAR, The Swedish Association of Local Authorities and Regions (2019). *#Skoldigiplan. Nationell handlingsplan för digitalisering av skolväsendet.* [National Action Plan for School Digitalization]. Stockholm: Sveriges kommuner och landsting.

Sandström, U. (2001). *Det föränderliga samhällets skolpolitik: om 1950-talets diskurs kring teknik och skola*. [The Changing Society's School Politics: 1950s' Discourse on Technology and School]. SISTER.

Savage, G. C. (2020). What is Policy Assemblage? *Territory, Politics, Governance, 8*(3), 319-335. https://doi.org/10.1080/21622671.2018.1559760.

Scholtz, T. (2013). *Digital Labor. The Internet as a Playground and Factory.* London and New York: Routledge.

SDS (1957). *Elektronlärare*. [Electronics Teachers]. *Sydsvenska Dagbladet Snällposten.* 21 January 1957.

Selwyn, N. (2019). *Should Robots Replace Teachers?* Cambridge: Polity Press.

Selwyn, N. (2021). The Human Labour of School Data: Exploring the Production of Digital Data in Schools. *Oxford Review of Education, 47*(3), 353–368. https://doi.org/10.1080/03054985.2020.1835628.

Selwyn, N. (2022). Less Work for Teacher? The Ironies of Automated Decision-Making in Schools. In S. Pink, M. Berg, D. Lupton, & M. Ruckenstein (Eds.), *Everyday Automation: Experiencing and Anticipating Emerging Technologies* (pp. 73-86). London and New York: Routledge.

Selwyn, N., Hillman, T., Rensfeldt, A. B., & Perotta, C. (2021). Digital Technologies and the Automation of Education: Key Questions and Concerns. *Postdigital Science and Education*. https://doi.org/10.1007/s42438-021-00263-3.

Söderlind, Å. (2009). *Personlig integritet som informationspolitik: debatt och diskussion i samband med tillkomsten av Datalag (1973:289).* [Private Integrity as Information Politics]. PhD Dissertation. Borås and Gothenburg: University of Borås and University of Gothenburg.

Söderlund, A. (2000). *Det långa mötet: IT och skolan. Om spridning och anammande av IT i den svenska skolan*. [The Long Meeting: IT and School]. Diss. Luleå: Luleå University of Technology.

Swedish Radio. (1958). Skola i omvandling - nioårig skolplikt. [A School in Change, Nine-Year Compulsory Schooling]. https://sverigesradio.se/sida/artikel.aspx?programid=1602&artikel=817716. Accessed 10 September 2022.

Swedish Standards Institute. (2020). *Swedish Standards 12000:2020—Information Management—Interface for Information Exchange between School Administration Processes*. Stockholm: Svenska institutet för standarder.

Taylor, A. (2018). The Automation Charade. Logic Magazine, 1 August. https://logicmag.io/failure/the-automation-charade/. Accessed 10 September 2022.

The IT Commission (1994). Vingar åt människans förmåga; informationsteknologin: betänkande. [Wings for Human Ability: Information Technology: Report]. Informationsteknologikommissionen. Stockholm: Fritze.

The IT Teacher (2021). StudyBee lanserar ny produkt för elevstöd byggd i samarbete med AcadeMedias gymnasieskolor. [StudyBee Launches a New Product for Student Support in Collaboration with Academedia's Upper Secondary Schools]. https://itpedagogen.se/studybee-lanserar-ny-produkt-for-elevstod-byggd-i-samarbete-med-academedias-gymnasieskolor/. Accessed 10 September 2022.

The School World (2021). IT-snurren: Skolor tvingas betala för att ta del av egen data. [IT Issues. Schools Forced to Pay for Access their Own Data]. *Skolvarlden* 18 Januari. https://skolvarlden.se/artiklar/it-snurren-skolor-tvingas-betala-att-ta-del-av-egen-data. Accessed 10 September 2022.

The Swedish Internet Foundation. (2021). *Svenskarna och internet 2021*. [The Swedes and Internet]. Internetstiftelsen. https://svenskarnaochinternet.se/rapporter/svenskarna-och-internet-2021/. Accessed 10 September 2022.

The Teacher Union (2018). *Stör- eller stödfunktion? En rapport om larplattformar*. [Disturbing or Helping? A Report on Learning Platforms]. Stockholm: Lararförbundet. https://www.lararforbundet.se/artikelsidor/stor-eller-stodfunktion-en-rapport-omlarplattformar. Accessed 10 September 2022.

Thorelli, H. (1956). Automationen kan drivas mycket längre. [Pushing Automation Further.] In: Socialdemokratiska partiet & Landsorganisationen (Ed.), *Tekniken och morgondagens samhälle*. [Technology and Tomorrow's society]. Stockholm: Tidens förlag.

UNESCO (1957). International Review of Education on Automation. *International Review of Education, (3)*4.

Watters, A. (2021). *Teaching Machines: The History of Personalized Learning*. Boston, MA: The MIT Press.

Williamson, B., Kalervo, N. G., Perotta, C., & Witzenberger, K. (2022). Amazon and the New Global Connective Architectures of Education Governance. *Harvard Educational Review, 92*(2), 231–256. https://doi.org/10.17763/1943-5045-92.2.231.

Winner, L. (1980). Do Artifacts Have Politics? *Daedalus, 109*(1), 121–136. https://www.jstor.org/stable/20024652.